Effectiveness of Monetary Policy in Controlling Exchange Market Pressures in Pakistan

By

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CERTIFICATE

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DEDICATION

Every challenging task needs self-effort as well as support from those who are very close to us. From the core of my heart, I dedicate my thesis to my sweet and loving wife and my wonderful sons Usman and Sarim for their continued patience and support during my program. A special feeling of gratitude to my loving parents, whose words of encouragement and push for persistence ring in my ears.

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Abstract

This study has two prime objectives. First, to construct an Exchange Market Pressure Index based on, following model dependent approach, Structural Vector Auto Regression Model for the period of January 1991 to April 2019 in the case of Pakistan. Second, to assess monetary policy's effectiveness in controlling foreign exchange pressure markets. To assess the effectiveness of monetary policy in controlling exchange market pressures in Pakistan through SVAR for short run. It is important to mention that the analysis of last three bailout requests to IMF reveals that Pakistan has aggressively used monetary policy to tackle exchange market pressures - 500 basis point increase in policy rate before 2008 program, 100 basis point increase in policy rate before 2013 program and 650 basis points in policy rate so far before the expected program. However, no effort has been made to assess the effectiveness of the policy. This study is pioneer work on assessment of effectiveness of monetary policy to control exchange market pressures in Pakistan. Study found that monetary policy is effective in controlling exchange market pressures in Pakistan for the shorter run, neutral for the longer run and counter-productive for the medium run. The constructed index clearly depicts the level of active management of exchange market pressures by the central bank of Pakistan. Study also reveals that Pakistan has exhausted around USD 112 billion to provide market support in order to keep exchange parity at some prescribed level. However, the policy failed miserably as support of billions of dollars has yielded management of exchange rate by only Rs. 35.92. Another interesting finding of the study is that, had policy makers not attempted to manage exchange rate, the current parity level would have been around Rs. 177.43 per dollar - which is only Rs. 35.92 higher than the prevailing exchange rate of Rs. 141.51 per dollar. Study concluded that central bank's intervention approach failed to control exchange market pressures for Pakistan. Every effort to do so, resulted in exhausting reserves and overshooting of exchange rate. Study also found that to keep exchange parity in check, central bank needs to continuously bridge the supply demand gap of the exchange market. As soon as, central bank decides to refrain from bridging such gap, parity corrects itself through market forces. Study also concluded that, for the longer run, it is a loss-loss situation for the country – as billions of dollars spent only succeeded to manage exchange parity of Rs. 35.92.

Chapter 1: Introduction

Generally, movements in exchange rate are the reflections of comparative economic progress of a country, that is, stability and appreciation in domestic currency reflects better progress as compared to competing countries and vice versa. Furthermore, the stable and gradual movements in exchange rate play an imperative role in realizing the trade potential of the country. While the volatility in exchange parity not only surrounds business cycle with enhanced uncertainties but also slows down the economic growth of the country. Ramey and Ramey (1995) documented a clear and strong association between movements in exchange rate and country's economic progress across cross-country sample. Similarly, Fatas (2000) and Hnatkovska and Loayza (2005) concluded that exchange rate volatility is higher, more pronounced and harmful for developing countries. Therefore, it is safely placed that the exchange parity affects the economic progress and activities for any country. Consequently, the researchers and policy makers need to have a sharp eye on assessment of the development of pressures in exchange markets. In this backdrop, the potential indicators which can depict the exchange market pressures need a special attention from the economic agents.

To avoid potential losses from volatile exchange rate, both fiscal and monetary branches of the policy makers need to devise proactive policies intending to ensure stable exchange rate. Both sides need to create an environment which can ensure stability in foreign exchange market. Treasury side has to ensure that the fiscal policies encourage foreign exchange inflows in the country and discourage outflow. On the other hand, monetary side has to devise policies which can support the initiatives taken by treasury side. Literature suggests that continued fiscal slippages could lead a country to building of exchange market pressures.

Hence this is really important to have a prudent and relevant fiscal policy, which can ensure that unnecessary exchange market pressures are not build. At the same time, wrong and inappropriate use of monetary policy can also complicate the economic scenario and could contribute in building market pressures instead of easing the same.

However, this is not a straightforward task as it requires a complete assessment of exchange market pressures in the economy. It is needless to highlight here that movements in exchange rate alone can depict the exchange market pressures only in the regime of free float exchange rate. However, for regimes with managed float exchange rate country only allow certain portion of exchange market pressures to translate into exchange rate movement while manage the remaining through direct and indirect foreign exchange market interventions. In such cases, trends of exchange rate alone cannot represent the underlying exchange market pressures in that economy. Therefore, the countries need to construct a measure that can potentially account for the managed part[1] of the pressures in addition to exchange rate. This type of measure is known as Exchange Market Pressure Index (EMP) in the literature of international finance.

Girton and Roper (1977), Weymark (1995), Eichengreen *et al.* (1995) and Weymark (1997) explained that EMP is the aggregation of exchange parity movements, changes in country's reserve holdings of foreign currency and movements in interest rate. Exchange rate movements cover the fraction of pressures that was allowed by the central bank to get materialized. While movement in reserve holding of foreign currency and interest rate movements represent the fraction of market pressures managed by the central bank and were

[1] Potential exchange rate change warded off by the central bank through market intervention to keep value of the domestic currency around a certain pre-decided level.

warded off. The entire debate is on "what coefficient we should use for movement in country's reserve holding in foreign currency and interest rate movements".

There are very few countries[2], irrespective of their level of development, which are following the purely flexible exchange rate regime in true spirit. However, keeping currency overvalued for longer periods is more common in the developing countries. The overvaluation is highly unsustainable given the low level of foreign exchange reserves and deep-rooted structural external imbalances associated with the developing countries. Most of these countries keep on doing market interventions with an aim to protect exchange rate until the time they ran out of foreign exchange reserves to play with. In such scenarios, a country has to face overshooting of exchange rate given the low level of reserves, bleak outlook of external account and speculative attacks on exchange market. Ahmed and Donoghue (2010) highlighted that in such a situation, country is not left with requisite buffer to safeguard itself from external shocks like fuel prices shock, global financial crisis, etc. In nutshell, it not only wastes the foreign exchange reserve of the country but also brings excessive volatility in the parity. Such volatility hampers export competitiveness and overall long term terms of trade and puts the country in a position where they require some kind of bailout package to improve its problems surrounding balance of payment position. Boorman *et al.* (2000) highlighted that furthermore to asking for bailout packages, use of tight monetary policy to counter exchange market pressures is another common practice in these instances.

Indeed, Pakistan is no different from other developing countries. It is evident that despite adoption of exchange rate regime revolving around the concept of "market based" in 1982,

[2] According to the IMF's Exchange Rate Arrangements Report, 29 countries in the world are following purely flexible exchange rate regime. List includes Australia, Canada, Chile, Japan, Mexico, Belgium and EMU.

Country has never allowed exchange rate to take its market value. Therefore, it is highlighted that overvaluation of exchange parity has been the norm rather an exception for the country. Consequently, the protection of exchange rate parity has gone so deep in the mindset of policy makers that they injected billions of dollars just to keep exchange rate parity at their *desired* levels. However, every effort to keep the parity at desired level in the medium run has resulted in a situation of "country requiring bailout packages to make balance of payment sustainable". Therefore, Pakistan is an excellent case study to investigate the Exchange Market Pressures.

Tellingly, Pakistan has recently approached International Monetary Fund (IMF) which is country's third time in last one decade. Surprisingly, sequence of economic events in the preceding years of every program remains so similar. Pakistan kept domestic currency artificially overvalued for two to three years, followed by substantial depreciation, drastic decrease in foreign reserves of the country and monetary policy tightening in the year right before knocking on IMF's door. For instance, the year preceding Pakistan's request for an IMF package in 2008, it witnessed depreciation of local currency by 32 percent, 44 percent decline in country's foreign exchange reserves and 500 basis point increase in policy rate. Before 2013 IMF package, country witnessed 15 percent depreciation, 40 percent decline in the reserves and 100 basis point increase in policy rate. Pakistan has approached IMF program recently, and in last one-year country saw 47 percent deprecation, 38 percent decline in reserves and increase of 650 basis points in policy rate.

It is important to mention that there is consensus in the literature on international finance on the subject of monetary policy use to tackle exchange market pressures. Central bank of Pakistan - (SBP) – also intervenes in money market through monetary policy, in addition to

direct sale of foreign exchange in the open market and supporting exchange rate through forward transactions[3], to tackle the exchange market pressures. However, there is lack of conclusive evidences on the impact fullness of monetary policy[4] to achieve its objective of controlling the exchange market pressures. The literature is divided into two major strings. One string of literature[5] concludes that monetary policy is effective in controlling exchange market pressures while the other one highlights ineffectiveness[6]. The ones that conclude ineffectiveness raise some legitimate questions on using monetary policy in the presence of substantial evidence of its no impact on the exchange market pressures. They argue that use of contractionary monetary policy complicates the scenario by adversely affecting fiscal side and the growth trajectory because of high interest rates and increased cost of borrowing for the private sector. With these kinds of serious repercussions of contractionary monetary policy, one has to be very much sure regarding the usefulness of such policy in controlling the exchange market pressures.

Reasonable chunk of literature is available on effectiveness of monetary policy in controlling exchange market pressures in countries with developing status. However, there is barely any research on this topic for the case of Pakistan. Specifically, Khawaja and Din (2007), Khan (2010) and Rao (2013) discuss the issue of construction of the exchange market pressures. However, none of them discussed the effectiveness of use of monetary policy in controlling exchange market pressures for Pakistan. Moreover, construction methodologies of

[3] An agreement between central bank and open market player involving foreign exchange selling and buying on a mutually agreed price and delivery on some future date.

[4] Effectiveness and usefulness of monetary policy means that how much this policy was able to control exchange market pressures. This is a relative term and needs to be read in the contextual framework.

[5] Fiador and Biekpe (2015), Panday (2015) and Tanner (2000)

[6] Kyin, Chin and Habibullah (2013) and Akosah and Dasah (2015)

constructing exchange market pressure index in these studies can be questioned on various grounds. However, we let this discussion for a while.

There is research gap to address the key questions like appropriate method of construction of exchange market pressure index and formation of relevant model for assessing effectiveness of monetary policy. As mentioned earlier that there is hardly any study on effectiveness of monetary policy in controlling exchange market pressure in Pakistan, this study has bridged this gap in the literature. Generally, existing literature has relied on the model proposed by Tanner (2000) without considering that such model is not truly representative for the developing countries. Tanner (2000) estimated a structural vector autoregressive (SVAR) model for exchange market pressure index, domestic credit creation and monetary policy instrument. Critical evaluation of model used by Tanner (2000) reveals that few important variables, especially for developing countries, including but not limited to trade dynamics and government's fiscal behavior are not included in the model. This is evident that Tanner (2000) model suffers from omitted variable bias and results of such model can be misleading. This is the pioneer work regarding documentation of effectiveness of use of monetary policy in controlling exchange market pressures for Pakistan and that too with appropriate model.

As mentioned earlier, other important aspect is the method of construction of EMP. The earlier studies construct EMP through a weak approach[7]. Indeed, a weak approach will always lead to weedy conclusions. If the idea is to evaluate the effect of use of monetary policy in controlling exchange market pressures and the calculated index for such pressures is not representative of actual pressures, then the conclusions from such studies cannot be reliable.

[7]Roper and Turnovsky (1980) and Weymark (1995)indicated that the economy is not static over time. Hence static parameters cannot represent the economy overtime.

More specifically, the existing literature has two fold weaknesses on the construction of exchange market pressure index, which are difficult to ignore.

First, the fact that almost entire existing literature has relied on approaches based on model-independendency for EMP construction. Such exchange market pressure index is static in nature and cannot represent the economy across different structural phases. In literature, there are two main strands on construction of EMP, that is, the model-dependent and the model-independent approach. The former approach was initiated by Girton and Roper (1977) while popularized by Roper and Turnovsky (1980) and Weymark (1995). Approach advocates for using a stochastic macro model for constructing EMP. Protagonists of the second strand campaigns for not using the macro model for exchange market pressure index construction [Eichengreen *et al.* (1995), Kaminsky and Reinhart (1999) and Pontines and Siregar (2007)].

However, model-dependent advocators stance makes more sense as the magnitude of direct and indirect interventions in foreign exchange markets has close association with overall structure of the economy. Impact of intervention can vary with changing structure of the economy. There is barely any Pakistan specific research on the subject, except Khawaja and Din (2007), Khan (2010) and Rao (2013). However, each of them, with an exception to Rao (2013), has utilized model-independent approach to create EMP. Current study has utilized model dependent approaches – an open economy macroeconomic model – to construct exchange market pressure index. This study is the first one of its kind on construction of exchange market pressure index, specifically in the case of Pakistan.

Second, almost all of the studies, except Rao (2013), have utilized the foreign exchange reserve change data to construct exchange market pressure index. However, economic

literature suggests[8] that the true exchange market pressure index should be constructed by using the data on central bank's interventions in the market of foreign exchange. Monetary auhtority's interventions in the foreign exchange market are injection and mop up of foreign currency in ready as well as forward market. However, the governments/authorities generally claim no market intervention to support exchange rate and restrict central banks to provide data on the level of interventions publically. This generates another problem that how to find an appropriate proxy for central bank's direct interventions. Therefore, Khawaja and Din (2007) and Khan (2010) have used *change in country's reserve holding in foreign currency* to proxy monetary authority's direct interventions in foreign exchange markets.

However, existing economic text clearly states that foreign currency reserves dynamics could barely be used as proxy for central bank's interventions, if these are the only contributing factor to reserves' change. With the presence of other contributing factors, using this proxy for central bank's interventions will always offer the deceptive outcomes about the original pressures. Moreover, all these researchers have taken an implicit assumption that the economy works with stable structural relationships[9] and money demand function, which probably is not the case. With instability is such relations – resultant of changing structure of the economy – exchange market pressure indices designed for Pakistan by the existing studies would not be accurate representatives of economy's fundamental pressures.

The current study has addressed these issues in the case of Pakistan. Specifically, study has constructed exchange market pressure index through model dependent approach, using

[8]Girton and Roper (1977), Roper and Turnovsky (1980), Weymark (1995), Eichengreen *et al* (1995), Kaminsky and Reinhart (1999) and Pontines and Siregar (2007)

[9] For example expenditure patterns, saving behaviors and overall attitude of economic agents.

Structural VAR to solve dynamic macro model, and by utilizing the actual interventions data[10]. Study also offers the intervention index that reflects the size of pressures wadded off by Pakistan's central bank from January 1991 to April 2019 on month to month basis. Study has constructed exchange market pressure index for Pakistan which clearly depicts the level of active management of exchange market pressures by the central bank. Study reveals that Pakistan has exhausted around USD 112 billion to provide market support in order to keep exchange parity at some prescribed level. However, the policy failed miserably as support of billions of dollars has yielded management of exchange rate by only Rs. 35.92. Dollars exhausted in failed attempt to manage exchange rate are higher than total external debt of the country. Study also reveals that policy makers have blatantly used borrowed dollars to provide market support.

Another interesting finding of the study is that, had policy makers not attempted to manage exchange rate, the current parity level would have been around Rs. 177.43 per dollar – which is only Rs. 35.92 higher than the prevailing exchange rate of Rs. 141.51 per dollar. Study found that management of exchange market pressures and keeping parity at desired level is so deep in the mindset of the policy makers, that they keep on exhausting foreign exchange reserves in such attempt until the time country ran out of reserves. This is the time, country approach international financial institutions like IMF for a possible bailout package – which generally requires months to assess the request of bailout. To create a buffer for the period of assessment of request at IMF and to improve the negotiation power through improved reserve

[10] Data from January 2004 to June 2012 is taken from State Bank of Pakistan which discontinued the internal sharing of this data in July 2012. Data from July 2012 onwards and prior to January 2004 is calculated by using the definition of intervention. We know that debt servicing, accumulation of new debt, financing of balance of payment deficit and interventions are the causative factors of change in the foreign exchange reserves. Except the market interventions, data on all other indicators is publically available.

level, government starts purchasing foreign exchange from the market. It is the time where, government not only allows exchange markets to make corrections in the parity but also lead to overshooting of parity due to heavy buying by the government.

This study also bridged the gap for Pakistan related literature on assessment of effectiveness of monetary policy in controlling exchange market pressures. Study found that monetary policy remained effective in controlling exchange market pressures for the shorter period. Study also found that for the longer run monetary policy remains neutral while during medium run it is counterproductive. In medium run, instead of controlling exchange market pressures, the use of monetary policy itself contributes in creating such pressures. Study also confirmed that monetary policy itself is a function of exchange market pressures. Study also found that central bank in Pakistan responds to building of exchange market pressures by increasing interest rates.

1.1 Research Question

The current study intends to address three key questions pertaining to the index of exchange market pressures and effectiveness of use of monetary policy to control such pressures in Pakistan. First, study intends to construct technically correct[11] index for exchange market pressures of Pakistan, as this is important for evaluation of rest of the questions in this study. Secondly, economic theory suggests that contractionary monetary policy help policy makers in reducing exchange market pressures. This study will assess whether this theory holds for Pakistan in the sample period. Lastly, literature suggests that countries use contractionary monetary policy to control exchange market pressures. This study will also assess that to what

[11] As compared to previous studies in the context of Pakistan, which used single equation, this study has utilized macro model and also appropriate data for the interventions.

extent the monetary policy is the function of exchange market pressure index. Study also intends to explore whether central bank go for tightening of monetary policy in response to high exchange market pressures in the country.

1.2 Research Objectives

Study has three key objectives:

1. To construct EMP for Pakistan by utilizing actual foreign exchange intervention data, following model-dependent approach, specifically an open economy macro model solution through SVAR model.
2. To evaluate the effectiveness of use of monetary policy in controlling the exchange market pressures in Pakistan through SVAR model.
3. To assess the role of exchange market pressures in the central bank's monetary policy function.

1.3 Significance of the Study

Pakistan started to follow exchange rate regime based on the concept of "managed float" in 1982. However, policy makers put their entire focus on the *"managed"* part of the regime and never allowed the *"float"* part. Country never allowed exchange rate to take its market value and kept on utilizing foreign exchange reserves to keep exchange rate overvalued. However, with struggle of developing countries reference to foreign exchange reserves and structural weaknesses in the external sector this management cannot be done for medium to longer run. Country suffered through macroeconomic instabilities whenever the country attempted the exchange rate management. For example, country lost foreign exchange reserves, have to allow exchange rate to adjust which ended in over shooting and resultantly has to seek bailout

package to avoid balance of payment crisis. Interestingly, country had never been able to form proactive policies mainly because of the absence of any such indicator.

This study has made two significant contributions to literature on international finance which will also be helpful for policy makers. First, the study has constructed exchange market pressure index which can serve as early warning system for the policy makers. Trends of exchange market pressure index can provide useful information to the policy makers and they can come up with proactive policies. Constructed exchange market pressure index will also help in assessing how country has managed the exchange market pressures in the past. Such index is not available for Pakistan right now and the study has bridged this gap.

Secondly, previously there was no literature available on effectiveness of monetary policy in controlling exchange market pressures in Pakistan. This study has bridged this gap and has gauged the effectiveness of monetary policy for exchange market pressures in Pakistan. Study has also evaluated whether exchange market pressures impact the monetary policy decision or not.

Chapter 2: Review of Literature

The economic literature provides a glut of research regarding construction of exchange market pressure index and its utilization. This chapter will give a detail profile of the literature regarding exchange market pressure index and use of the monetary policy for controlling exchange market pressures. Chapter is mainly divided in five major parts. Chapter starts with the theory behind construction of exchange market pressure index. There are two major school of thoughts in this regard, that is, i) an index which is dependent on a macro model and ii) an index which is not dependent on a model but a statistical technique. Second, chapter try to give a brief review of literature which utilizes the different variant of above mentioned two approaches to construct the exchange market pressure index. Third, chapter provides a chronological review of the important studies on construction and use of the exchange market pressure index. Fourth, chapter also provides a snap shot for the review of literature on Pakistan. Fifth, chapter also reviews the existing literature on monetary policy use for controlling exchange pressures in the market.

2.1 Theory

2.1.1 Model Dependent Approaches

Girton and Roper (1977) undertook seminal work on exchange market pressure index. They disagree with the belief that domestic equilibrium for money market could be attained from end to end change in the exchange rate of the currencies and changes in the international reserves. They argue that excessive domestic money demand leads to either appreciation of the exchange parity or increase in the reserves holding in foreign currency or some

combination of both. Similarly, excess supply of domestic money results in slide in exchange parity or loss of foreign exchange holding or some amalgamation of both. They constructed a model to gauge foreign exchange pressures and termed as “Monetary Model for Exchange Market Pressures”. Importantly, this is different from exchange rate’s monetary model.

However, Girton and Roper (1977) utilize the basic framework of exchange rate’s monetary model and balance of payments’ monetary model. Girton and Roper (1977) postulate that the exchange rate’s monetary model can predict or validate the extreme cases of exchange rate regimes, that is, the pure peg or pure flexible. It does not validate the system of exchange rate build on the idea of managed float. It has been settled in the literature of international finance that the exchange rate fully responds and adjusts to the market conditions during the exchange rate regime with the concept of free float. However, on the flip side, the foreign exchange reserves absorb the market pressures and does not allow exchange rate to move under the exchange regime designed with the concept of pure peg. These both are extreme scenarios and extremely difficult to be implemented in real life. Third and more realistic possibility is that both exchange rates and country’s holding of reserves in foreign currency in the intermediate case.

Novelty of Girton-Roper model is that it simultaneously determines the exchange parity and the holding of reserves in foreign currency. More clearly, the endogenous variable in the Girton-Roper (1977) framework is sum of both the variables, that is, the holding of reserves in foreign currency and exchange parity. This model is commonly acknowledged as “monetary model for exchange market pressures”. They formulated their monetary model through the determinants like domestic credit growth, dynamics of money supply in foreign country and domestic and foreign real income differential. They also assumed stable money demand

function, fulfillment of purchasing power parity condition and money market's flow equilibrium. Model clearly states that an increase in the supply of money will lead to the depreciation of local currency and loss of foreign exchange reserves.

Roper and Turnovsky (1980) is one of the key proponents of model based construction of exchange market pressure. They relied on open economy IS-LM framework to build macroeconomic model for construction of exchange market pressure index. Through IS-LM framework they derived the monetary authority's response for exchange rate and interventions to ensure that domestic output remains unaffected by changes in the foreign sector. While model-independent approaches were advocating for assigning equal or variance dependent weights to exchange parity, interest rates differential and the changes of foreign exchange reserve holding, Roper and Turnovsky (1980) estimated the parameters from IS-LM framework to calculate the dynamic weights for variables of interest for exchange market pressure index.

The basic difference between Girton and Roper (1977) and Roper and Turnovsky (1980) is regarding weighting scheme for the exchange parity and holding of reserves in foreign currency. Girton and Roper (1977) give equal weights and Roper and Tunovsky (1980) uses the IS-LM framework for acquiring the weights for the required variables. However, in practice, the central banks also try to mitigate the pressure on foreign exchange market by injecting or mopping up the foreign currency. Therefore, this is very important component in the context of exchange market pressures. However, it is completely neglected by both Girton and Roper (1977) and Roper and Tunovsky (1980).

Considering these issues, Weymark (1995) introduces the importance of central bank intervention through sale and purchase in the discussion of exchange market pressures. More clearly, Weymark (1995) constructed a model for small open economies consisting of demand for money, price dynamics, interest rate parity discussion and central bank's monetary policy response function for the construction of exchange market pressure index. Weymark (1995) also improves on the weaknesses in the work of Roper and Turnovsky (1980) who failed to provide an easily quantifiable measure to gauge the fraction of pressures on exchange parity relieved by the central bank through interventions.

2.1.2 Model Independent Approaches

Eichengreen, *et al.* (1995) is considered a land mark study on exchange market pressure index construction through model-independent approach. The study analyzed data of twenty OECD countries covering sample from 1959 through 1993. Authors argued that macroeconomic variables have weak power for empirical explanations regarding exchange parity. They developed index for exchange market pressures by aggregating changes in exchange parity of the country and differentials of holding of reserves in foreign currency and interest rate between the respective country and two relevant partner countries. They utilized the variance of variables to assign weights while doing aggregation – weight equal to inverse of its variance. They concluded that index constructed through approach proposed by them was successful in capturing exchange market dynamics in OECD countries.

2.2 Empirical Studies on Contraction and Uses of Exchange Market Pressure

A plethora of empirical research is produced relevant to construction of index for exchange market pressures. Almost all of them are a slight variant of above mentioned theoretical models. The major differences lie in the methodology, weights, assumption and coverage of

variables. It is also important to mention that almost all of the studies in this stream of literature start from the construction of index for exchange market pressures and to enlighten its uses. For example, some studies try to highlight the episode of currency crises and some try to investigate that how these indices are being impacted by the macro environment of the economy.

2.2.1 Empirical studies for the construction of Index based on Girton- Roper (1977)

Girton and Roper (1977) use their theoretical framework to empirically construct index for exchange market pressures for Canada for the postwar period. The objective of the construction of the index was to test or show the Canadian central bank's independence and autonomy of its monetary policy formulation. More specifically, they use the domestic credit in exchange pressure model to show the autonomy of the monetary policy. Then Girton and Roper (1977) model was used by Connolly and Da Silveira (1979) to construct the index for exchange market pressures in Brazil for a sample period of 1955-1975 and 1962-1975. It can be said that this was a relatively modified version of Girton and Roper (1977). Connolly and Da Silveira (1979) assumed the presence of parity for purchasing power throughout the analysis. Then Modeste (1981) follows the work of Girton and Roper (1977) in the case of Argentina and concluded results in line with Girton and Roper (1977).

Hodgson and Schneck (1981) constructed and evaluated the stability of index for exchange market pressures for France, Belgium, Germany, Netherlands, Switzerland and Canada by using data on quarterly frequency from 1965 to 1976. Kim (1985) follows the strategy of Connolly and Da Silveira (1979) in the case of Korea and Thornton (1995) in the case of Costa Rica. Taslim (2003) also uses the Girton and Roper's (1977) model to study the

pressure on Australian dollar in post float episode. Similarly, Wohar and Lee (1992) constructed the index following Girton and Roper (1977) for Trinidad, Jamaica, Guyana and Barbados.

2.2.2 Empirical Work based on Weymark Model (1995)

Weymark (1995) innovates, as mentioned earlier, exchange market pressure index by incorporating the sales and purchase of foreign currency data in the model for construction of such index. More specifically, Weymark (1995) uses the simple macro model with rational expectation over the period of 1975 to 1991 for the Canadian economy. Frenkel and Aizenman (1982) also derived an index for foreign exchange market intervention in a binary sense for the exchange parity regimes revolving around flexible and fixed parity concepts. Given the fact that mostly central banks do not release the data of foreign exchange interventions therefore, the respective study modified definitions of central bank's intervention to create the index of exchange market pressures.

For example, Kohlscheen (2000) slightly modified Weymark (1995) by using reserve requirement for gauging the pressure on Chilean peso. Then Apergis and Eleftheriou (2002) utilized Weymark (1995) for Greek economy. Apergis and Eleftheriou (2002) modified the model by assuming absence of parity for interest rate parity in Greek economy. Similarly, Jeisman (2005) utilized the Weymark (1995) work for the Australian economy for assessing the pressure on the exchange market in the post float period. Interestingly, both model dependent and independent approaches are utilized in the study of Jeisman (2005). Leu (2009) replicates the study of Jeisman (2005) for the post float era in the case of Australia and finds the sharp contradictory finding regarding exchange market pressures. The reason may be the

difference of econometric methodology. Jeisman (2005) uses two stage least square methods, while Leu (2009) relies on the Johansen co-integration approach.

2.2.3 Empirical Work based on Eichengreen *et al.* (1995) Methodology

As mentioned earlier Eichengreen, *et al*. (1995) used a different scheme of assigning weight as compare of Girton and Roper (1997), Roper and Tunovsky (1980) and Weymark (1995). More clearly, Eichengreen *et al*. (1995) used the inverse of the variance approach as compared to any model based approach. This scheme of study also becomes popular among the researchers. For example, Bird and Mandilaras (2006) used the index for exchange market pressures which is developed by using the model free approach of Eichengreen *et al.* (1995) to examine the link between exchange market pressure and the fiscal deficit of East Asia and Latin American region.

Mandilaras and Bird (2008) followed the methodology of model independent approach to construct the index and investigated the effect of debt on the index in the case of Latin America during 1970 to 2000. Then Katircioglu and Feridun (2011) also used the Eichengreen *et al.* (1995) methodology in the case of Turkey to evaluate the relationship between the macroeconomic variables and exchange market pressure. Sachs *et al.* (1996) replicated the work of Eichengreen *et al.* (1995) by using the same concept and theoretical framework. However, they calculated the weight for each variable in a different way. They proposed that each variable should be assigned a weight equal to the share of its variance in the total variance of all variables included.

Kaminsky *et al.* (1998) also relied on the concept of Eichengreen *et al.* (1995). However, they calculated the weights in a different way from the work of Eichengreen *et al.* (1995) and

Sachs, *et al.* (1996). They highlighted that instead of exchange parity, holding of reserves in foreign currency is the better benchmark to rely on for calculation of weights.

2.3 Chronology Literature Review of Construction of Exchange Market Pressure

Tori and Tori (2001) is one of the early studies which see beyond the construction of index for exchange market pressures. Their study evaluates impact of such pressure index on export of banking service in the case of United States. The study notes that exchange market pressure has a momentous brunt on the export of banking sector of United States. Other important factors are trade and sovereign rating.

Horen *et al.* (2006) investigates the dynamics of Asian crises in the case of Thailand. Specifically, the study postulates that the contagion effect of Asian crises come through the foreign exchange market pressure or not. If yes, then what were the specific determinants of the contagion of the Asian crises? If we specify the research question of Horen *et al.* (2006) then it comes like evaluating the impact of exchange market pressures of Thailand and the other four countries from Asia i.e. Indonesia, Malaysia, Philippines and Korea. That is, the exchange market pressure index of Thailand has a contagion effect on the other Asian currencies or not. The study used the regression analysis instead of correlation coefficient for the contagion effects. Keeping the nature of analysis in view, the study put some control variables in the regression. The study found that the exchange market pressure of Thailand has a contagion effect on Indonesia and Malaysia. More specifically, Horen *et al.* (2006) notes that there was 13 percent contagion effect from Thailand to Indonesia and 21 percent from Thailand to Malaysia. On the other hand, there is no evidence of contagion in the case of Philippines and Korea.

Pontines and Siregar (2007) highlighted the importance of choice of foreign currency and deviation of inflation from the threshold levels in construction of exchange market pressure index. They highlighted that most of the empirical work done on the concept has been done by taking US dollar as the anchor currency. They also reported that results of exchange market pressure index can be shockingly different with the change of anchor currency. They also mentioned that level of deviation of inflation from the threshold level can bring bias in constructed exchange market pressure index. They analyzed Indonesian, Malaysian and Thai currencies by taking different anchor currencies and considering real exchange rate instead of exchange rate to eliminate inflation led bias and concluded that index for exchange market pressures is highly sensitive to the selection of anchor currency.

Jayaraman and Choong (2008) estimate exchange market pressure for Fiji. The currency of Fiji is pegged with a group of currencies, consisting of its trading partners. Therefore, the currency of Fiji remains under pressure continuously. in this backdrop, Jayaraman and Choong (2008) examines the exchange market pressure by utilizing the annual data of more than 30 years. The study utilized Auto Regressive Distribute Lag Model to assess the presence of longer run association between exchange market pressures and other macro variables like private sector credit, budget deficit and foreign debt. Jayaraman and Choong (2008) confirmed the presence of longer run association between exchange market pressures index and the macro economic indicator of the Fijian economy.

Macedo *et al.* (2009) conducted a study for a different type of sample of the countries. They took five Portuguese Speaking countries as sample to test and evaluate the credibility of the exchange parity regimes of these countries. They took, Guinea Bissau, Cape Verde, Mozambique, Angola and SãoTomé & Príncipe as sample countries. The study gives a high

value to the credibility of the arrangement of the foreign exchange. Specifically, Macedo *et al.* (2009) noted that the credibility should be translated in all three levels of the pressure, low level of pressures in the exchange market, low level of volatility and low level of severity of the crises. They also highlighted that the underlying economic fundamental must be incorporated in the dynamics of exchange market pressures.

The study has few interesting aspects – it investigates about the return-risk relationship. In this regard, it is found that the negative news in the market is more profound for the volatility in the index for exchange market pressures than positive news. Then Macedo *et al.* (2009) ranks the conditional volatility of the selected sample based on econometric findings. They find that Cape Verde and Guinea Bissau have the currency pegs regime of exchange rate and has lesser volatility as compared to managed float exchange rate regimes and therefore enjoy more credibility. Similarly, the episodes of currency crises which are shown by exchange market pressures are much lesser under pegs. As mentioned earlier, the economic fundamental positively account for in the case of pegs and, similarly return-risk relationship is also favorable for the investors in this case. However, there are contrary findings for Mozambique. Country is working under an exchange rate arrangement defined on the concept of managed float parity. The return-risk profile for the investors is same which is being enjoyed under peg. However, Macedo *et al.* (2009) presents an interesting insight that Mozambique is working closely under the IMF framework for managing the exchange parity policy, the monetary policy, limits of foreign assets and domestic assets, therefore, enjoying a good return-risk profile.

Croatian economy is investigated by Tatomir (2009) in the context of exchange market pressures. The study makes the case for investigating the exchange market pressures in

specific context of Asian crises 1997-1998. In this backdrop, Tatomir (2009) noted that the Croatian currency faced a huge pressure during 1999 to 2001. Therefore, Tatomir (2009) postulates that construction and analysis of exchange market pressures is really important. Consequently, the severity of the pressures on the exchange market could be gauged fully. The study of Tatomir (2009) used the intervention data to construct the exchange market pressure index. This study clearly criticized the study of Krznar (2004) in the way of construction of exchange market pressure and its implications. For example, Tatomir (2009) used the data of foreign exchange intervention data to get a clearer picture of the managed portion of the pressure. On the contrary, Krznar (2004) used the change in the holding of reserves in foreign currency. It is obvious that such holdings have other causative factors along with the market intervention by the central banks. Therefore, the change in international reserve is not a god proxy for the development of index for exchange market pressures. Therefore, Tatomir (2009) study is more reliable in the case of Croatian economy.

Feridun (2009) try to link level of foreign exchange reserves, unhealthy banking sector and overvalued exchange parity with the speculative pressure. Feridun (2009) study used the bound test approach for investigating the presence of longer run association between speculative pressure and three mentioned macro variables. Study found the presence of association not only for longer term but also for the shorter periods and therefore, the foreign exchange reserve, health of banking sector and overvalued exchange parity are the contributing factors in the foreign exchange market pressures.

Bertoli *et al.* (2010) praised efforts of Eichengreen *et al.* (1995) for developing index that can show the fraction of management of exchange parity by the central banks. However, at the same time, they noted that the index in highly sensitive to assumptions of aggregations of the

underlined macro variables like exchange parity, holding of reserves in foreign currency and the level of interest rates. Specifically, these assumptions of aggregation become more crucial in the case of emerging economies. Particularly, the study of Bertoli *et al.* (2010) addressed the issue of defining the exchange rate variation and construction of foreign exchange reserves. Bertoli *et al.* (2010) used index for exchange market pressures to identify episodes of exchange crises in binary form.

Aizenman *et al.* (2012) estimate and investigate the exchange market pressures for emerging economies. Aizenman *et al.* (2012) used the international reserve despite a huge criticism. The construction of exchange market index takes the usual route of model independent approach. The study compares the trade and financial factors. Interestingly, the study gave more importance to financial considerations as compared to trade factors. More specifically, the impact of short term debt was more than five time higher in the crises as compared to normal time. Therefore, Aizenman *et al.* (2012) explicitly post that the capital (out) flows were the vital reason to put upward pressure on the index for exchange market pressures during financial crises era.

Heriqbaldi (2012) investigated the dynamic of Indonesian economy in the context of exchange market pressures. Heriqbaldi (2012) put forward an interesting question that whether the index for exchange market pressures is having multiple equilibriums in the case of Indonesian economy or has a linear relationship. To address this question, Heriqbaldi (2012) used the Markov Switching Auto regressive univariate models over the period of 1990 to 2008 by taking the monthly observations. The estimation procedure relied on the usual time series issue like unit root testing and other diagnostic tests. The study found multiple equilibriums for the index of exchange market pressures in the case of Indonesia. Therefore,

Heriqbaldi (2012) sees that the Indonesian economy is a unique in this context and therefore, the exchange rate policies should be implemented very cautiously. Furthermore, the study notes the findings of the other studies cannot be generalized for the Indonesian economy especially in the context of exchange markets.

Hall *et al.* (2013) estimated the foreign exchange market pressures for three different currencies against US dollar. Specifically, they estimated through a quarterly data of Pound sterling, Chinese Yuan and Japanese Yen over the quarterly periods of 2000 to 2009 by utilizing the model based methodology. Hall *et al.* (2013) innovated through a time varying regression for the calculation of conversion factors which were required to estimate the pressures and for the assessment of its deviations from the equilibrium exchange rate. The study noted that Yen remains undervalue during the initial years of the sample while the Yuan remains undervalue over the whole period of the estimation period. Furthermore, the extent of undervaluation of Yuan is 20 percent. However, the study found a low pressure in the case of Pound Sterling. Interestingly, study concluded in line with policies of central banks of the respective countries.

Hegerty (2013) noted that the Principal Components Analysis (PCA) is a better way to give weights for preparing an index which can measure the exchange market pressures. Hegerty (2013) highlighted that the arbitrary way to give weights like variance smoothing could mislead the researchers and the policy makers. Therefore, the preferred strategy should be the PCA. Hegerty (2013) analyzed 21 countries over the period of 2001 to 2012 and noted that the first principal component is never a good approximation; therefore the study relies on the second and the third principal components to produce a correct sign. Hegerty (2013) generates two indices, from the variance smoothening weights and the PCA weights, and then compared

both. The study found that both indices are highly correlated but PCA-based index is relative more smooth. Therefore, Hegerty (2013) documented that the methodology does matter for producing the different policy stance in the context of exchange market pressures.

The study of Heriqbaldi *et al.* (2014) is not directly related to the context of construction of exchange market pressures. They try to investigate that how much the micro and macro fundamentals of Indonesian currency crises can be accounted. To accomplish this task, Heriqbaldi *et al.* (2014) used Markov Switching approach under cross generation crisis models. For this purpose, they need a variable for the speculative attack. Therefore, they use the most widely utilized index, that is, index for exchange market pressures in this regard. Heriqbaldi *et al.* (2014) posts several important conclusions. For example, they noted that index for exchange market pressures is significantly affected by the bank credits, real exchange rates and the liquidity. Furthermore, the behavior of such index is significantly predicted by the first, second and third generation model. Importantly, the regime switching models are found more robust as compared to ordinary dynamic models. This finding implies that the speculative attacks have the nature of multiple equilibriums as compare to unique equilibrium. Additionally, they also found that the tranquil regime is more robust as compare to the volatile one.

Akram and Byrne (2015) contributed in another dimension of the literature by investigating about a link between the market pressures in exchange market and financial liberalization for different countries. Specifically, they took a sample of forty different countries. Their analyses were mainly consisting of two major steps. First, they constructed exchange market pressure index by using the standard statistical methods and second, created a link between pressures in exchange market with the capital controls. Specifically, research is about the

affect of capital controls on the pressures in exchange market. They also take several macroeconomic measures to control the environment in the context of exchange market pressure. Furthermore, Akram and Byrne (2015) used different measures of exchange market pressures to show the robustness. The major finding of the study is that capital controls have a strong association with weak currencies in the case of advance countries.

Patnaik *et al.* (2017) postulated that index for exchange market pressures is primarily used for the purpose of predicting the currency crises. However, these measures give misleading implications in the time of tranquility. Furthermore, the country based indices cannot be used for the cross country analysis. Keeping this backdrop in view, Patnaik *et al.* (2017) proposed a new index which is more useful in the normal times. Importantly, this index is constructed in the panel data setting. Central bank's interventions and exchange rate are the imperative variables used for construction of the index for exchange market pressures. Importantly, both variables have different units in the setting of panel data. Therefore, the focus of Patnaik *et al.* (2017) was to create a conversion factor. The conversion factor is used for the both changes that are the changes which are managed by the central banks and the changes which are translated in the exchange rate depreciation/appreciation. However, these changes cannot be measured, cent per cent, correctly. Importantly, the conversion factor and the estimates are based on the several assumptions. Specifically, Patnaik *et al.* (2017) postulated that foreign exchange interventions have the sizeable, durable and systematic impact on the exchange rates.

Recently, Hossfeld and Pramor (2018) constructed the exchange market pressure index for 32 emerging market countries and attempted to establish an association between pressures in exchange markets and global liquidity. Conceptually the index for exchange market pressures

measures the foreign currency's excess demand and therefore has exchange parity, changes in holding of reserves in foreign currency and the level of interest rates as its key determinants. Hossfeld and Pramor (2018) claims that huge rise in liquidity, shorter term funding and provision of the credit significantly contributed in the appreciation pressure of the currencies of the emerging market economies. Hossfold and Pramor (2018) are also in line with Heriqbaldi *et al.* (2014) in a way that the tranquil time is more important as compared to the volatile one for the working of the transmission mechanism which works under the regular market conditions.

Recently, Hegerty (2018) created the exchange market pressure index for Eastern and Central European countries. Specifically, the analyses are conducted for Romania, Bulgaria, Poland, Hungary, Czech Republic and Ukraine. The study employs monthly data over the period of 1998 to 2017. The specific question of the research was to identify important factors which put the pressure on the foreign exchange markets. For example, they tested the impact of stock prices and commodity prices and try to figure out that which one is more important. Hegerty (2018) takes the depreciation in exchange rate, interest rates differential and change in holding of reserves in foreign currency, for selected countries, to construct the foreign exchange market pressure index. Hegerty (2018) studies the different episodes of the crises and then their causative factor. Then, they used time series models to find Granger causality and impulse response function which further guide us to see the connections between exchange market pressures and the dynamics of macro economy of the selected countries.

The study of Hegerty (2018) is important in a way that there are very few studies on Central and Eastern European region. Hegerty (2018) notes that exchange market pressure increased in 2008 therefore, the degree of interventions of the central banks during this period.

Importantly, Hegerty (2018) posts the key differences among the selected economies. For example, Hegerty (2018) postulates that Czech Republic was protected from the international impact as compared to Hungary. More clearly, Hungary was more vulnerable to international sock and international transmission of the shocks. Poland also gets heats from the other countries. While Ukraine shows the bidirectional causality between stock price indices and exchange market pressure.

Gevorkyan (2018) investigates that how the pressures in exchange markets are sensitive to the commodity market fluctuations. More specifically, the study focuses on the impact of primary commodity exports in the short term. Gevrokyan (2018) focuses on coffee, fuels, cereals and sugar by using the price of crude oil as a bench mark price. The study takes the pre-peak and post-peak prices of the commodities for pegged and floating regimes for exchange parity. From the methodological perspective, study has relied on panel data and panel VAR models. The major finding was that there exists a heterogeneous response from the commodity group. Gevorkyan (2018) also noted that the fluctuation and the volatility occurs thorough various channels in the regime of flexible exchange parity. Particularly, interest rates, foreign exchange markets and credit to private sector are very important in this regard. These factor also fuels in the social cost, especially in the weaker economies, along with the economic cost. The study also documented that the terms of trade deteriorates, in the case of hard peg exchange rate regime, after the post-peak price episode.

2.3.1 Clearing Union and EMP

Stavarek (2010) estimated exchange market pressure index for four European countries including Slovakia, Poland, Hungary and Czech Republic. The exchange market pressure is

estimated against Euro over the period of 1995-2008. Stavarek (2010) clearly mention that the different methodologies of the construction of the index impact the results and hence the two differently constructed indices are not comparable. More clearly, Stavarek (2010) estimated the exchange market pressures with model dependent and independent approaches. Both indices are giving the opposite results. Therefore, they argue that their calculated indices are not comparable with each other, however they find some interesting insights as well. For example, the currencies of Slovakia, Poland, and Czech Republic never faced a pressure for more than one quarter. However, HUF, the Hungarian currency faced a continuous depreciation.

Shekhawat and Kathuria (2018) pointed out another dimension in the context of exchange market pressures. Specifically, they found the affect of international clearing unions on foreign exchange market pressures. Particularly, they took the case of clearing union for Asia in this regard. Specifically, the study takes Iran, Sri Lanka, Pakistan, India, Nepal, Bangladesh and Bhutan for the analysis. The index is constructed over the period from 2006 to 2015 by using the monthly data. The longer and shorter run associations are tested through econometric methods. The study found some shorter run association but could not find the longer run relationship by using co-integration methodologies.

The outcome of the study is that there is no particular impact of Asian clearing union on harmonizing the foreign exchange market pressure in the Asian region. The implication of the study is that the countries which are not the member of any clearing union but they are interested to build a platform like that should study the behavior and the dynamics of their exchange market pressure index before joining such union. Shekhawat and Kathuria (2018)

also noted that the absence of long run relationship implies that being a member of same clearing union does not imply the same exchange rate policies or monetary policies.

2.3.2 Work based on Theory of Extreme Value

Theory of extreme value is also utilized in financial economics and financial econometrics. It is a branch of statistics and econometrics that identifies the probability of the events which are away from the median. That is, the events which are producing the extreme values. In our context, it is very relevant to search the extreme values in a series of index for exchange market pressures to recognize currency crises. Generally, there are two types of estimators are utilized in this regard, that is, parametric and other one is non-parametric. Karimi and Voia (2014) produced one of earliest studies in this regard in context of index for exchange market pressures. However, contributions of Karimi Voia (2014) were purely of statistical nature. More clearly, they suggested that the high frequency data is more appreciated for identifying the currency crises. The study of Karimi and Voia (2014) used Hill estimator for approaching their findings.

Heinz and Rusinova (2015) used the methods of extreme values theory to determine the episode of crises and the contribution in the crisis, that is, the extreme values in series of exchange market pressures. The study focuses on twelve European economies. Heinz and Rusinova (2015) noted that if the definition of extreme value is considered in the case of exchange market pressure then it leads to different set of crises. More particularly, the tails and probabilities of the extreme values for exchange market pressures are affected by the level holding of reserve in foreign currency, exchange parity imbalances, history and severity of the past crises, domestic and external debts, the regional contagion and other global risks.

More recently, there are few studies which used the extreme value theory to predict and relate the exchange market pressures. There are several methods to calculate the extreme values. Particularly, Boer *et al*. (2019) investigated about the exchange market pressure by using two different methodology of extreme value theory and compared the findings of both methods. More specifically, Bore *et al.* (2019) utilized the extreme value theory to analyses the crises and extreme pressures on the currencies of two different African countries – South Africa and Kenya. They used the monthly data series from 1999 to 2017 for three usual components of exchange market pressure index and used two different methodologies – parametric and non-parametric.

2.4 Construction of EMP for Pakistan

Khawaja and Din (2007) did seminal work on Pakistan and constructed exchange market pressure index following the approach proposed by Girton and Roper (1977). In order to proxy the central bank's intervention in the exchange market, study has utilized data on change in holding of reserves in foreign currency. They reported that the level of exchange market pressure index has implications for level of inflation and other macroeconomic variables like debt servicing, fiscal balances and trade dynamics. They argued that this strong association between exchange market pressure index and other macro variables is the core reason for government not letting exchange rate to take its market value.

Khan (2010) constructed exchange market pressure index for Pakistan following Pontines and Siregar (2007) and using data from Jul-1995 to Dec-2008. Similar to Khawaja and Din (2007) this study also utilized data of change holding of reserves in foreign currency to proxy the central bank's interventions in exchange market Study also used the constructed exchange

market pressure index to identify signals of exchange pressures for the sample – to judge capacity to use this indicator as early warning system. Study identified 24 signals of exchange market pressure during the sample period, from which 10 were observed in the period of three years (FY96 to FY98). Study also highlighted that Pakistan approached six times to IMF for bailout package due to exchange market pressures. Study also reveals that in the case of Pakistan, private sector credit, current account dynamics and inflation have strong influence on exchange market pressure index.

Gilal (2011) constructed exchange market pressure index for Pakistan following Eichengreen *et al.* (1995) approach and utilizing change in holding of reserves in foreign currency data in order to proxy the central bank's intervention. Study reveals that the constructed exchange market pressure index confirms active central bank intervention. Study also revealed that the central bank remained thriving in bringing down the exchange parity volatility. Ahmed (2013) concluded contradictory results to Gilal (2011) and highlighted that central bank of Pakistan has a limited control on the foreign exchange market and any intervention aimed at protecting exchange rate remained unsuccessful.

Rao (2013) constructed exchange market pressure index for Pakistan by utilizing actual intervention data as compared to all other studies using change in foreign exchange reserves to proxy interventions. Rao (2013) made threefold contribution in the literature on Pakistan. Firstly, study identified weaknesses in exchange market pressure indices constructed by utilizing change in foreign exchange reserve data. Second contribution of the study is to settle the debate of stability of economic relations. Study highlighted that the existing research for Pakistan was taking an assumption of stability in economic relationships, which is bit unrealistic assumption to be taken for Pakistan. Last but not the least contribution is the

quantification of central bank's interventions through construction of intervention index. Study also utilized the constructed intervention index to evaluate the policies of the central bank.

2.5 Monetary Policy and Exchange Market Pressure Index

Tanner (2000) did the seminal work on effectiveness of monetary policy in controlling exchange market pressures in Mexico, Brazil, Indonesia, Korea, Chile and Thailand. Study utilized variables of domestic money creation, exchange market pressure index and interest rate differential with partner countries to estimate a SVAR model. Study concluded in favor of effectiveness of monetary policy and highlighted that tight monetary policy helped to trim down exchange market pressure index in the subject countries. Study also revealed that response of exchange market pressure index to the monetary policy is more pronounced if domestic credit growth dominates the monetary policy stance, the same is weaker if monetary policy is represented by interest rate differentials. This finding remained consistent for individual country as well as pooled estimates.

Bautista and Bautista (2005) replicated the work done by Tanner (2000) for Philippine. Study examined how monetary authority of Philippine responds to exchange market pressures and whether tight monetary policy has any impact on level of these pressures. Results of the study remained aligned with the findings of Tanner (2000) and concluded that tight monetary policy remained effective in controlling exchange market pressure index in Philippine. Unlike Tanner (2000), Bautista and Bautista (2005) found monetary policy effective irrespective of its definition. Results are consistent for domestic money creation as well as interest rate.

Fiador and Biekpe (2015) tested significance of the monetary policy in controlling exchange market pressures for sub-Saharan countries. Using model with a dynamic panel, study tested the proposition of strong, significant and negative consequence of the monetary policy on exchange market pressures in these countries. Study found substantial evidence in favor of the proposition of significant consequence of monetary policy on exchange market pressure index and concluded that contractionary monetary policy is helpful in reducing exchange market pressures for these countries. Study also found significant relationship between public debt, terms of trade, current account balance and exchange market pressure index.

Panday (2015) tested the significance of monetary policy in controlling EMP for Nepal by using impulse indicator saturation technique along with general to specific modeling approach. Study concluded that contractionary monetary policy remained helpful in controlling EMP for Nepal.

Kyin, Chin and Habibullah (2013) conducted a study to test effectiveness of monetary policy in controlling EMP for Malaysia. Study utilized monthly data from 1990 to 2008 and applied VAR approach on the same lines as done by Tanner (2000) – the only difference was Tanner used Structural while this study estimated unrestricted VAR. Study concluded that conventional monetary policy remained unsuccessful in controlling EMP in Malaysia and monetary authority needs to come up with different monetary policy tools to make it more effective.

Akosah and Dasah (2015) conducted study on effectiveness of monetary policy in controlling fiscally induced EMP in Ghana. They analyzed how fiscal balances are related to EMP and how consistent fiscal slippages restrict the effectiveness of monetary policy in controlling

EMP. They found monetary policy ineffective in controlling EMP mainly because of continuation of bad fiscal policies. They suggested having a strong fiscal and monetary coordination to ensure that monetary policy has any impact on EMP.

Ahmed (2013) follows the monetary model of Griton of Roper (1977) for the construction of the index of exchange market pressure. Ahmed (2013) noted that the exchange market dynamics could be elaborated through the dynamics of money market in case of Pakistan. More clearly, Ahmed (2013) talked in the context of exchange and money markets' disequilibrium. Therefore, Ahmed (2013) observes, if the monetary authority is able to handle money market disequilibrium then exchange market is handled automatically as it corrects itself. The other important observation of the study is that the central bank will lose the control on domestic supply of money as it seeks a departure from flexible exchange to hard peg.

2.6 Gaps Identified from Literature

Extensive review of literature has identified three key gaps in the existing literature with specific reference to Pakistan:

1. Existing studies, with exception of Rao (2013), have constructed exchange marker pressure index for Pakistan by utilizing change in holding of reserves in foreign currency data to proxy the central bank's intervention in the exchange markets. However, literature clearly indicates that such data could only be utilized as proxy to intervention if that is the only causative factor for change in the reserves. Exchange marker pressure index constructed through wrong proxies will lead to misleading conclusions. Rao (2013) mentioned that exchange marker pressure index constructed

from actual intervention data was significantly different from the one constructed by using change in foreign exchange reserves data. Rao (2013) study only covered period from 2004 to 2012, which is quite short to make any judgment. Current study will construct exchange marker pressure index by using actual intervention data and covering period from 1991 to 2019 and hence will bridge the gap in the literature for Pakistan.

2. All the existing literature on Pakistan in specific and most of the global literature in general has relied on model-independent approaches for construction of exchange marker pressure index. Even the ones relied upon model-dependent approaches have not covered the entire macro economy. Current study will construct exchange marker pressure index through an open economy macro model and hence will bridge the gap in the existing literature.

3. Review of literature reported in this study confirms the absence of consensus on the efficacy of the monetary policy for controlling exchange marker pressure index. Different studies confirm that such effectiveness is variant across countries. Hence, country specific research is essential. However, there is no study addressing this issue for Pakistan. Current study will be the seminal work on this topic for Pakistan.

Chapter 3: Econometric Model and Specification

The prime objective of the present chapter is threefold. The study is intending to construct index for exchange market pressures and then evaluate the effectiveness of monetary policy to control pressures in the exchange market by using the Structural VAR methodology. Therefore, this will be explained in three main sections. First, it will give a bit detail of SVAR model and then the Impulse Response function. Second, study will present theoretical model, solution through SVAR, for the construction of index capturing pressures in the exchange market. Third, the SVAR setup will be settled for assessment of usefulness of the monetary policy.

3.1 Structure Vector Auto Regressive Model and Impulse Response Functions

Structural Vector Autoregressive (SVAR) will be utilized to solve the model for construction of exchange market pressure index and assessment of effectiveness of monetary policy in controlling such pressures. Vector Autoregressive (VAR) analysis is one of the popular time series techniques given its ability to tackle multiple endogenous variables and also uncover the anticipated as well as unanticipated relations. However, method faced serious criticism as it was unable to explain key economic structures existing between variables of interest. To overcome this issue, SVAR approach was introduced which has the capacity to incorporate the economic structure in powerful VAR model.

SVAR has been extensively used in current literature for monetary policy analysis and fluctuations in growth cycles. Identification is always a key concern in the estimation of structural models. To some extent SVAR also suffers from same issue; however, these models

focus on role of shocks in the dynamic structures to make the right identification. It potentially avoids few inherent difficulties which traditional approaches generally face in identification, but use of SVAR model do have some opportunity cost. It cannot be used for policy simulations which is very basic output from other dynamic simultaneous equation models. Still SVAR is really useful to uncover anticipated as well as unanticipated relations between the variables of interest.

As mentioned earlier, we are using SVAR methodology for technically correct construction of index for exchange market pressures in Pakistan and also to assess the monetary policy usefulness in controlling such pressures in Pakistan. Predominantly, VAR discusses the issue that how does a particular shock effect the economy. However the identification issue can give the unreliable findings. The econometricians put some extra restriction to identify the VAR models. Therefore, VAR model will serve as a base for the derivation of Blanchard-Quah SVAR model which is proposed and popularize by Blanchard and Quah (1989). The Vector Autoregressive model is:

$$Z_t = B_1 Z_{t-1} + ... + B_p Z_{t-p} + u_t \qquad \textbf{(1)}$$

Equations one to three represents vector auto regression for all observed variables and unobserved, that is "*u"*, white noise. The white noise process advocates for a positive covariance matrix, that is, $E(u_t, u_t^{'}) = V$. ***p*** is the lag length of the endogenous variables of the VAR system. The *B*'s , *u*'s and *V* can easily be calculated through OLS. The issue is that the *u*'s are the statistical innovations in the above setting and we want the impulse response functions to the specific fundamental economic shock on an open economy.

More clearly, the impulse Response Functions (IRFs) shows the response, to an impulse or innovation to concerned variables, of the variables being explained in the setting of VAR model for the following time periods. Even the critics of VAR analysis recognize that IRFs are the important outcomes of VAR analysis to study the transmission mechanism of the shock. Keeping the importance in view, we specify the IRFs in which the stationary process is employed

$$Z_t = \lambda_0 u_t + \lambda_1 u_{t-1} + \lambda_2 u_{t-2} + ... \qquad \textbf{(2)}$$

It is obvious that it is a moving average data generating process. In this process, (kxk) identity matix ($I_k = \lambda_o$) and the matrix λ_s are the coefficients of impulse reference functions. These coefficients can be calculated as:

$$\lambda_s = \sum_{j=1}^{s} \lambda_{s-j} B_j \qquad \textbf{(3)}$$

More clearly, the all (i, j) the lemmda coefficient are the expected reaction of future value of the endogenous variable of one unit change in the *yjt* keeping all past value of *yt* constant. The innovation *ut* will be computed with *yjt*. Breitung *et al.* (2004) noted that the innovations, that is *ut*, are the impulse response forecast errors.

Let's assume that the components of *ut* are correlated (instantaneously) then the well-known Cholesky decomposition will be employed to the innovations of VAR for the orthogonalization purpose. If we denote the lower triangular matrix by C then the covariance matrix of *u* is $\sum u = CC'$, and $\varepsilon_t = C^{-1} u_t$ will represent, on the basis of innovation equal to a standard deviation, the orthogolize shock. Resultantly the equation 3 will be

$$Z_t = \theta_0 \varepsilon_t + \theta_1 \varepsilon_{t-1} \ldots\ldots \quad \textbf{(4)}$$

Where $\theta_i = B\lambda_i$ and, specifically θ_0 is lower triangle.

However, it is important to note that, the innovation in first variable may transmit instantaneously to all variables of the VAR model but a shock in the second variables will not transmit in instantaneous way on the all other variables.

It is important to mention here that A and B matrices cannot be separately estimated or observed. Therefore, we have to impose some restriction to identify under consideration VAR to recover the equation no 1 and 2. These restrictions could be enforced on the basis of longer run behavior of the economy and shorter run behavior of the economy.

3.2 Theoretical Model for Construction of Exchange Market Pressure Index

As mentioned earlier, all the existing literature on Pakistan in specific and most of the global literature in general has relied on model-independent approaches for construction of EMP. Even the ones relied upon model-dependent approaches have not covered the entire macro economy. Therefore, the current study has utilized macro framework of an economy to construct EMP through an open economy macro model. Specifically, we have followed the structural VAR approach. One of the novelties of the study is that it uses the SVAR model to calculate the weights for generating the EMP index. Therefore, we shall set up for an open economy. In this regard, six different equations are constructed. These are dynamic IS equation, dynamic Philips curve, equation for the private sector credit, interest rate equation, equation of central bank's interventions in the exchange market and equation of exchange

parity. The SVAR is formulated in the context of Pakistan and therefore tried out to follow the literature on Pakistan in this regard.

Study starts with the dynamic IS equation (equation 5) by following Cheema and Atta (2014) for specifying the equation. The equation postulates that the output growth is dependent on interest rate. Then we augment it with exchange rate to make it a case of open economy. Therefore, we specify:

$$y_t = \beta_{10} + \beta_{14} i_t + \beta_{16} e_t + \varepsilon_t^y \qquad \textbf{(5)}$$

The equation 5 shows the typical condition of the equilibrium of goods market in an open market. The coefficient $\boldsymbol{\beta_{14}}$ is expected a negative sign and work through the investment channel. More clearly, an interest rate increase will slow down the investment activities [through low disbursement of private sector credit] and the lower output. Similarly, for $\boldsymbol{\beta_{16}}$ a positive sign is expected. That is depreciation/devaluation will make the exports cheaper and, naturally, a rise in export. This will transmit, ultimately, in higher output of the country.

The next equation (equation 6) will be the dynamic Philips Curve. Study has specified that inflation as function of output growth, domestic interest rates, exchange parity, and inflation expectations.

$$\pi_t = \beta_{20} + \beta_{21} y_t + \beta_{24} i_t + \beta_{26} e_t + \beta_{27} E_t[\pi_{t+1}] + \varepsilon_t^{\pi} \qquad \textbf{(6)}$$

The coefficient $\boldsymbol{\beta_{21}}$ is showing output growth's impact on the inflation. The literature finds a mixed affect of output growth on inflation. Malik and Khawaja (2006) and Malik and Ahmed (2010) found positive significant impact of output growth on inflation of Pakistan. While

Khalid *et al.* (2007) found negative effect of output growth on inflation. The coefficient $\boldsymbol{\beta_{24}}$ is the relationship between rate of interest and inflation. Technically, higher rate of interest should control the inflation. Therefore, $\boldsymbol{\beta_{24}}$ should carry a negative sign. Khan and Gill (2010) findings are in line with theory in the case of Pakistan. However, Tahir *et al.* (2015) contradict with the finding and reported positive effect of rate on interest on inflation and explain the cost increasing channel. The coefficient $\boldsymbol{\beta_{24}}$ elaborates the effect of exchange parity on inflation. Ideally, coefficient should have a positive sign. Higher exchange rate will add in the inflation of the country. Khan and Gill (2010), Khan *et al.* (2007), Ahmad and Ali (1999) and Ali *et al.* (2015) provide the empirical evidence and concluded positive association between inflation and exchange parity.

Next equation (equation 7) in the model shows dynamics of private sector led domestic creation of money. This is one of equations of Roper and Turnvskoy (1980) IS-LM model for exchange market pressures. The equation shows measure of private sector credit will depend on domestic output and interest rate.

$$psc_t = \beta_{30} + \beta_{31} y_t + \beta_{34} i_t + \varepsilon_t^{psc} \qquad \textbf{(7)}$$

The coefficient $\boldsymbol{\beta_{31}}$ explains the impact of output growth on private sector credit; ideally the coefficient should have positive sign. As economy on high growth trajectory provides more opportunities of expansion to the private sector and hence creates more private sector credit demand. The coefficient $\boldsymbol{\beta_{34}}$ explains the impact of rate of interest on credit to private sector; ideally the coefficient should have negative sign. As high rate of interest increases cost of borrowing for the private sector and hence bring private sector credit demand down. These are consistent with Tahir *et al.* (2015).

Next equation (equation 8) is central bank's monetary policy function for Pakistan. Equation explains how central bank's interest rate decision is influenced by output gap, level of inflation and dynamics of exchange rate

$$i_t = \beta_{40} + \beta_{41} y_t + \beta_{42} \pi_t + \beta_{46} e_t + \varepsilon_t^i \quad \textbf{(8)}$$

The coefficient $\boldsymbol{\beta_{41}}$ explains the impact of output growth on monetary policy decision of the central bank. There is ambiguity regarding the sign of this relationship in the case of Pakistan. Mushtaq and Siddiqui (2016) advocates for a positive relation, while Malik and Ahmed (2010) argues for a negative relation. The coefficient $\boldsymbol{\beta_{42}}$ explains relation between inflation and policy instrument of interest rate. Malik and Ahmed (2010) and Mushtaq and Siddiqui (2016) found positive association between inflation and policy instrument of interest rate. Coefficient $\boldsymbol{\beta_{46}}$ explains association between exchange parity and policy instrument of interest rate. Malik and Ahmed (2010) and Mushtaq and Siddiqui (2016) also found a positive association between exchange parity and interest rates.

Next equation (equation 9) in the system represents central bank's market intervention behavior. It explains that intervention depends on interest rates and exchange rate.

$$INT_t = \beta_{50} + \beta_{54} i_t + \beta_{56} e_t + \varepsilon_t^{INT} \quad \textbf{(9)}$$

Coefficient $\boldsymbol{\beta_{54}}$ explains impact of interest rate on central bank's direct interventions level. High interest rates provide more returns on domestic currency denominated investments and hence reduce pressure from the exchange rate. On the flip side lower interest rate, incentivize dollar denominated investments and also provide opportunity to make profits through currency arbitrage. In this backdrop, there should be a negative sign for this coefficient.

Coefficient $\boldsymbol{\beta_{56}}$ explains the impact of exchange parity on central bank's direct interventions. High exchange parity, deprecation of local currency, leads to higher volume of central bank's foreign exchange market interventions and hence a positive sign is expected for this coefficient.

Last equation (equation 10) is for exchange rate which elaborates association of exchange parity, inflation, interest rate and central bank's interventions in exchange market.

$$e_t = \beta_{60} + \beta_{62}\pi_t + \beta_{64}i_t + \beta_{65}IN_t + \varepsilon_t^e \qquad \textbf{(10)}$$

Coefficient $\boldsymbol{\beta_{62}}$ explains the association of inflation and level of exchange parity. During high inflation periods, country with high imported content in basket of goods tends to restrict local currency depreciations to improve inflationary trends. It is expected to have a positive sign for this coefficient. Coefficient $\boldsymbol{\beta_{64}}$ elaborates association of rate of interest and exchange parity. Generally, high interest rate periods witness fewer opportunities for speculative attacks and provide lucrative returns on domestic currency denominated investments. These collectively reduce pressure from exchange rate and improve exchange parity. It is anticipated to have negative association between these variables. Coefficient $\boldsymbol{\beta_{65}}$ is the most important coefficient for this study. It explains the effect of central bank's interventions on the level of exchange rate. A negative sign for this coefficient is expected.

3.3 Theoretical Model for Effectiveness of Monetary Policy in Controlling Pressures

A prime contribution of the study is that it evaluates the effectiveness of the monetary policy on the pressures in exchange market of Pakistan. We can safely claim, as mentioned earlier, that the present study is a pioneer in this regard. In general, Tanner (2000) starts the

discussion on monetary policy effectiveness in controlling exchange market pressures. We argue that the Tanner (2000)'s model cannot be generalized for all the economies. Because, it overlooks some important variable which may severely affect the economy like Pakistan. For example, fiscal dynamics and trade dynamics are totally neglected by Tanner (2000). It is very obvious, keeping the present scenarios of the Pakistani economy, the fiscal dynamics and the trade dynamics cannot be neglected. It is argued that the major pressures are piling up from fiscal and the external side. Therefore, the structure of the SVAR will rely on seven different variables. That is, fiscal discipline of the government, output growth, inflation, dynamics of private sector credit, interest rates, trade dynamics and exchange market pressures. Study has customized the model of Tanner (2000) with seven different equations to show the assumed structure of the economy. So, this portion of the study will rely on SVAR approach for assessing effectiveness of monetary policy in controlling exchange market pressures in Pakistan. The following structural model will be used.

$$FD_t = \alpha_{10} + \alpha_{12} y_t + \alpha_{15} i_t + \alpha_{16} TD_t + \varepsilon_t^{FD} \qquad \textbf{(11)}$$

Firs equation in the system (equation 11) explains the dynamics of fiscal discipline. Due to data availability issues, fiscal discipline is proxied by government's borrowing raised through the banking system. Coefficient $\boldsymbol{\alpha_{12}}$ explains the relationship between output growth and government's borrowing from the banking system. Pakistan lacks an efficient and good tax collection system and hence growth periods require government to borrow more from the banking system. It is expected to have a positive sign for this coefficient. Coefficient $\boldsymbol{\alpha_{15}}$ explains the impact of interest rate on fiscal discipline of the government. High interest rates make domestic debt and its servicing costly and more financial resources are needed to meet

the obligated debt servicing. This leads to more borrowing by the government from the banking system to meet its debt servicing obligations. It is anticipated to have a positive association between these variables. Coefficient $\boldsymbol{\alpha_{16}}$ explains the impact of trade dynamics on fiscal discipline of the government. Pakistan is a country with trade deficit and famous for its subsidy packages to boost exports, which requires more borrowing. Hence a positive sign is expected for this coefficient.

$$y_t = \alpha_{20} + \alpha_{21} FD_t + \alpha_{24} PSC_t + \alpha_{25} i_t + \varepsilon_t^y \qquad \textbf{(12)}$$

The second equation in the system (equation 12) shows that the output is determined by the three major factors, fiscal deficit, credit to private sector and discount rate. High borrowings by the government using the banking system mean in future country has to allocate further for debt servicing. This means that government is left with low financial leverage for its developmental plans – only few schemes could be financed as major chunk is taken by debt servicing. Hence, a negative association is expected through coefficient $\boldsymbol{\alpha_{21}}$. High demand of private sector for the credit generally reflects high business confidence and leads to high output growth. A positive sign is expected for the coefficient $\boldsymbol{\alpha_{24}}$. Coefficient $\boldsymbol{\alpha_{25}}$explains the association between rate of interest and output growth. High rate of interest discourage investment and slow down the economic activity and hence a negative sign is expected for this coefficient.

$$\pi_t = \alpha_{30} + \alpha_{32} y_t + \alpha_{35} i_t + \alpha_{37} EMP_t + \varepsilon_t^{\pi} \qquad \textbf{(13)}$$

Third equation in the system (equation 13) models the dynamics of inflation through the determinants of output growth, interest rate and index for exchange market pressures. Sign for

relation between output growth and inflation is ambiguous – as it depends whether inflation is demand driven or from supply side. Interest rate is used to manage demand pressures and reduce inflation in the economy and hence negative sign is expected for coefficient explaining relationship between interest rate and inflation. Over 50 percent of basket of goods for consumer price index in Pakistan is composed of imported goods and hence exchange market pressures have a positive relation with the inflation in Pakistan.

$$PSC_t = \alpha_{40} + \alpha_{41} FD_t + \alpha_{42} y_t + \alpha_{45} i_t + \varepsilon_t^{PSC} \quad \textbf{(14)}$$

Fourth equation in the system (equation 14) models the dynamics of private sector credit through the determinants of fiscal discipline, output growth and interest rate. Higher volume of borrowing by the government through banking system crowds out the private credit demand and hence a negative sign is expected for this relationship. Output growth provides private sector a confidence to undertake expansions and hence a positive sign for the coefficient explaining association between output growth and credit demand by private sector is expected. Interest rate makes credit for the private sector costly and hence a negative sign is expected for this relation.

$$i_t = \alpha_{50} + \alpha_{52} y_t + \alpha_{53} \pi_t + \alpha_{57} EMP_t + \varepsilon_t^i \quad \textbf{(15)}$$

Fifth equation in the system (equation 15) is the modified form of Taylor rule of monetary policy. It explains that in Pakistan monetary policy is formed while keeping in view the developments in output growth, inflation and exchange market pressures. Expected sign for the relation between output growth and interest rate is ambiguous for Pakistan. Mushtaq and Siddiqui (2016) found a positive while Malik and Ahmed (2010) found negative relation

between output gap and interest rate for Pakistan. Central bank is meant for safeguarding purchasing power parity of the general public and hence any increase in inflation from the explicit or implicit comfort zone escorts to interest rate hike and hence a positive sign is expected for this relation. Central bank in Pakistan use monetary policy attempting to control exchange market pressures and hence a direct and positive relation is expected between these variables.

$$TD_t = \alpha_{60} + \alpha_{62} y_t + \alpha_{63} \pi_{tt} + \varepsilon_t^{TD} \quad \textbf{(16)}$$

Sixth equation is the system (equation 16) explains the dynamics of trade through the determinants of output gap and inflation.

$$EMP_t = \alpha_{70} + \alpha_{71} FD_t + \alpha_{74} PSC_t + \alpha_{75} i_t + \alpha_{76} TD_t + \varepsilon_t^{EMP} \quad \textbf{(17)}$$

Last equation in the system (equation 17) explains the dynamics of exchange market pressure index through the determinants of fiscal discipline, private sector credit, interest rate and trade dynamics. Weak fiscal position of the government impacts the efficient use of financial resources and hence contributes in building the additional exchange market pressures in the economy. It is expected to have a positive coefficient for this relation. Generally higher private sector credit enable high growth, improve demand and supply forces of foreign exchange markets and hence help in reducing exchange market pressures in the economy. Hence a negative coefficient is expected for this relation.

Impact of rate of interest on the exchange market pressures in the economy is the most important coefficient for this study. Generally high interest rates help in easing out exchange market pressures and hence a negative coefficient is expected. Trade dynamics in this study

are defined as import minus export and hence a positive coefficient is expected – as increase in gap of import and export puts further pressures in the exchange market.

Chapter 4: Variable Construction and Data

This study has twofold objectives, initially it is intended to construct technically correct index for Exchange Market Pressures for Pakistan and secondly to assess the effectiveness of monetary policy in controlling EMP in Pakistan. Study has utilized data from January 1991 to April 2019 on monthly frequency; sample has been selected after evaluating different exchange rate regimes of Pakistan. Weymark (1995) proposed macro model to yield EMP, the same has been modified and improved in this study by including the dynamic component to the macro model for construction of EMP for Pakistan. For assessing the effectiveness of the monetary policy for controlling EMP, this study has improved the model proposed by Tanner (2000). Major data sources for this study include State Bank of Pakistan, Pakistan Bureau of Statistics, Ministry of Finance and Debt Coordination Office of the Ministry.

Large Scale Manufacturing Index

Size of economy plays an important role in overall exchange market pressures for a country. Mishra and Sharma (2011) highlighted that the size of economy has a strong influence on the level of reserves and country's intervention capacity in the exchange market. Size and trajectory of economy not only plays an important role in determining level of reserves and country's intervention capacity in the exchange market, but it also influence the fiscal position of the government, inflationary trends, demand for private sector credit, monetary policy reaction and overall trade dynamics of the country. Upward trajectory of the economy, if based on improvement in fundamental, leads to better revenue streams for the government and hence improves its fiscal position. Similarly growing economy can provide more exportable items and can hence improve the country's trade pattern.

Mishra and Sharma (2011) rely on Gross Domestic Product (GDP) data to model size of the economy. However, GDP data in Pakistan is only available at annual frequency, while construction of EMP and testing efficacy of monetary policy in controlling EMP requires data analysis at higher frequency – at minimum monthly level. Given the constraint of availability of GDP data at higher frequency, this study rely on Index of Large Scale Manufacturing data to proxy GDP and model the size of the economy. Selection of this proxy for GDP is in line with the literature available on the subject. Data for January 1991 to April 2019 on monthly frequency is taken from Pakistan Bureau of Statistics.

Interest Rate

Interest rate is an important variable for the macro model intending to construct index for exchange market pressures in Pakistan. This is an important link in the open economy IS curve, it effects size of economy and its growth trajectory. High interest rates normally cause a fall in size of economy and its future trajectory. In addition to its important role in the open economy IS curve, interest rate is also an important factor for the dynamic Philips curve equation. It has the potential to effect long term trend of inflation in the economy through demand management – generally high interest rate helps in curbing inflation. Moreover, rate of interest also play important role in determination of private sector credit demand and hence growth in broad money.

Generally high interest rates reduce private sector credit and hence constraints domestic source led growth in broad money. Level of interest rates also plays important role in determining central bank's direct interventions in the exchange market and level of exchange parity in the country. Moreover, rate of interest also plays vital role in government overall

fiscal behavior – especially for debt burdened countries like Pakistan. Any upward movement in interest rate could add into the weak fiscal position through increased debt servicing burden for internal debt.

There are several different indicators available for interest rate, which have been interchangeably used by the researchers. The key indicators include discount rate (also known as policy rate), T-bill rates of different maturity (rate at which government issues its paper), KIBOR (interbank rate), lending rate (rate at which retail lending happens) and OMO rate (rate at which central bank do the liquidity management). As this study is an effort to model monetary policy angel through incorporation of interest rate, T-bill rate for 3 month maturity has been chosen mainly for two reasons; first before 2007-08 it was T-bill which was primarily the policy rate for the markets (as discount rate has a serious disconnect from the market) and secondly because all the other rates follow the changes in T-bill rates with maturity of three months.

Monthly data for January 1991 to April 2019 is acquired from State Bank of Pakistan. Descriptive analysis also reveals that T-bill rate is a better choice as compared to discount rate where sample includes time beyond 2007-08. Descriptive statistics also reveals that T-bill rate is more real data as compared to stepwise behavior of discount rate.

Exchange Rate

Exchange rate is one of the most noteworthy variables for this study as the entire work revolves around the dynamics of exchange rate and the amount of pressures managed by the government and not allowed to translate into changes in exchange rate. Exchange rate plays in important role in defining the open economy goods market equilibrium. Pakistan has almost

50 percent imported content in the basket of goods for its official Consumer Price Index (CPI). Official inflation in Pakistan is calculated from CPI and hence exchange parity plays an imperative role in defining the level and trajectory of inflation.

In Pakistan, exchange parity is also an important contributor in monetary policy reaction function. Analysis of monetary policy statements since January 2018 and from the periods 2009 and 2013, reveals that movement in exchange parity is an imperative indicator for policy makers while deciding on the monetary policy decisions. Exchange parity also plays vital role in determining the central bank's interventions in exchange market. Generally, movements of exchange rate parity within the presumed tolerance level see lesser interventions by the central bank while heavy interventions when such movement of parity breaches the comfort zone of the policy makers [Hussain and Jalil (2006), Jalil and Feridun (2011) and Aizenman and Marion (2003)].

Different variants available for exchange rate in Pakistan are weighted average exchange rate, open market exchange rate, real and nominal effective exchange rates and mark to market exchange rate. As the core aim of this study is to construct index for exchange market pressures, hence the most relevant definition of exchange rate for the study is weighted average exchange rate – as this is the one which directly affect inflation rate, controlled by the central bank and gives signal about parity. Monthly data for January 1991 to April 2019 is acquired from State Bank of Pakistan.

Inflation

Inflation is another important variable for the macro model intending to construct index for exchange market pressures. For countries like Pakistan, with high ratio of imported content in

basket of goods for consumer price index, inflation is imperative factor for the decision about the level of exchange rate. Inflation is generally the key motive behind managing exchange market pressures in such countries, as the policy makers fear that allowing market based exchange rate could fuel inflationary pressures. Moreover, inflation is also a key factor for the central bank's reaction function for monetary policy. Central bank's decision about monetary policy largely revolves around the level and trajectory of inflation. Furthermore, inflation also plays vital role in determining country's trade dynamics.

There are different variants of price indices and resultant inflation numbers are available in Pakistan, like consumer, sensitive and wholesale price index. Each of these indicators have different basket of goods, market representations and calculation methodologies. Pakistan use consumer price index to calculate official numbers of inflation for the country. In this backdrop, this study has utilized consumer price index to model inflation. Monthly data from January 1991 to April 2019 is taken from Pakistan Bureau of Statistics.

Inflation Expectations

Inflation expectations play an important role in modeling dynamic Philips curve equation. Generally there are two forms of inflation expectations i.e. rational expectation and adaptive expectation. State Bank of Pakistan do conduct survey for consumer confidence and inflation expectations, however, this exercise is started quite recently and historical data on rational expectations is not available. Given the constraint on rational expectation, this study has relied on adaptive expectation to model the expectation component for the dynamic Philips curve. Lagged value of consumer price index based inflation is used as adaptive expectation.

Private Sector Credit

Dynamics of private sector credit are important in constructing exchange market pressures index. It explains the dynamics of growth in domestic credit and resultant monetary base from the domestic sources. Size of economy along with its trajectory and prevailing rates of interest are the key determinants for domestic credit demand. Economy on high trajectory and low rates are generally associated with high demand for domestic credit as most of the businesses initiate horizontal or vertical expansion. There are several indicators available to model the private sector credit dynamics like private sector credit disbursement data by the banking system, capital generated by listed companies through stock markets and private businesses appetite for loan from banking and non-banking sectors. However, the standard indicator used in previous researches is private sector credit disbursement. In line with the previous practice, this study has used credit disbursement to model credit dynamics for the private sector.

Government's fiscal behavior has a strong influence on dynamics of credit to the private sector. High appetite of borrowing from the government generally leaves banks unwilling to make lending to the private sector. Lending to public sector has zero risk and in bad economic times offers reasonable rate of return, generally banks in Pakistan have preferred to earn easy risk free money through lending to the government. Monthly data for January 1991 to April 2019 is acquired from State Bank of Pakistan.

Central Bank's Interventions in Exchange Market

Central Bank's intervention in exchange market is the most important variable in the construction of index for exchange market pressures. While exchange rate led change in monetary policy reflects the indirect intervention, data on central bank's sale and purchase in

exchange market explains direct interventions. In an effort to manage exchange market pressures, central bank supply foreign exchange in the market to viaduct the cracks between demand and supply with an objective to keep exchange parity at a presumed level. Generally, data on direct intervention is not publicly available – especially in developing countries. That was the reason that most of the previous studies for Pakistan have relied on use of change in reserves data to proxy central bank's intervention. Rao (2013) was the first one to use actual intervention data and concluded that exchange market pressures index generated by using actual intervention data is more accurate and depicting actual happenings as compared to the one generated from use of reserves data.

Building on the work of Rao (2013), this study has also utilized central bank's actual interventions data. Data for January 2004 to June 2012 acquired from State Bank of Pakistan which discontinued the internal sharing of this data in July 2012. Data from July 2012 onwards and for the period January 1991 to December 2003 is constructed by using the definition of intervention. We know that debt servicing, accumulation of new debt, financing of balance of payment deficit and interventions in the exchange market are the causative factors of change in country's reserves. Except market interventions, data on all other indicators is publically available. Key sources for this data and its causative factors are State Bank of Pakistan, Debt Coordination Office of Ministry of Finance and Economic Advisors' wing of the Ministry.

Fiscal Behavior of Government

Monetary and fiscal policies work in tandem and it is impossible to gauge effectiveness of any of them in isolation. The major mistake Tanner (2000) committed was to ignore the fiscal

behavior while assessing the effectiveness of the monetary policy. Literature recommends that fiscal behavior of the government plays an imperative role for the usefulness of monetary policy. This study has improved the model used by Tanner (2000) by incorporating fiscal behavior.

Generally, fiscal behavior is constructed from the gap between government's revenue and expenditure. However, for Pakistan revenue and expenditure numbers are not available on monthly frequency. With this constraint, this study has utilized monthly borrowing numbers of the government to proxy fiscal behavior of the government. Intuitively, governments rely on the banking system to finance its day to day fiscal deficit. Data from January 1991 to April 2019 is acquired from State Bank of Pakistan.

Trade Dynamics

Level of exchange market pressures is primarily an outcome of demand and supply sources of foreign exchange. Positive gap between demand and supply of foreign exchange, market pressures mount and ease when such gap is negative. Key sources of demand and supply are exports and imports and investment climate of the country. Countries with negative trade balance and less attractive investment climate always struggle to maintain exchange parity. While countries with negative trade balance but with attractive investment climate do fine with the exchange parity.

For country like Pakistan, which is quite low on ease of doing business and hence not a first choice for international investors, gap of export and import plays an imperative role in determination of exchange market pressures and assessment of efficacy of monetary policy.

Variable of trade dynamics has been constructed by utilizing monthly information on export and import – which has primarily been sourced from Pakistan Bureau of Statistics.

Exchange Market Pressures

Exchange market pressure is the aggregation of pressures allowed to get materialized through change in exchange parity and the pressures warded off by the central bank through direct interventions. Exchange market pressure data is constructed through the first objective of this study and has been utilized to assess the efficacy of monetary policy in controlling such pressures. Generally, exchange market pressures are influenced by the fiscal behavior of the government, domestic credit creation, level of interest rates and trade dynamics. Use of monetary policy is quite common for Pakistan – as depicted by the analysis of monetary policy decisions for last one year as well as for the period around 2013 and 2008.

Chapter 5: Results and Discussion

5.1 Unit Root and Stationarity

Condition of Stationarity is an important aspect for time series modeling. Majority of time series models, except few, require data to meet this condition. Time series models estimate "on average" relationship between the variables of interest – same is the case with Structural Vector Autoregressive (VAR) Models. This "on average" term requires that data should revert back to its mean value – also known as Stationarity condition. Otherwise, the estimated "on average" relationship will be misleading as the results rely on relationship between average paths of the variables of concern whereas data never revert back to its mean. This is the very reason, that data's reversion to its mean value is utmost important to find out a plausible and meaningful results from a structural VAR model.

For construction of exchange market pressure index, this study has solved six variable Structural VAR model. Variables included index of large scale manufacturing (IPLSM) to model the size and trajectory of the economy, consumer price index (CPI) to model inflation dynamics, private sector credit (PSC) to model domestic money creation dynamics, T-bill rate to model monetary policy response, central bank direct intervention and nominal USD-PKR parity.

In the second part of this study, for testing effectiveness of monetary policy in controlling exchange market pressures, this study has solved seven variable Structural VAR model. Variables included pattern of government borrowing from the banking system (FD) to model the fiscal discipline of the government, index of large scale manufacturing (IPLSM) to model the size and trajectory of the economy, consumer price index (CPI) to model inflation

dynamics, private sector credit (PSC) to model domestic money creation dynamics, T-bill rate to model monetary policy response, dynamics of trade account (TD) and nominal USD-PKR parity.

Augmented Dickey Fuller (ADF) and Phillips–Perron (PP) tests are used at levels and first differences for each series. ADF test scrutinizes null hypothesis of having data series integrated of order one against the alternate of integration of order zero. ADF also assumes that the series follows ARMA structure – which makes selection of lag length an important decision. However, this turn out to be a major practical issue in using ADF test. If selected lag length is too small, results of the test will be biased as the remaining serial correlation could potentially make the errors biased. If selected lag length is oversized then it affects test power. PP test differ from ADF mainly on the parameters explaining how to deal heteroskedasticity and serial correlation in the residuals. While ADF relies on parametric approach to ballpark the structure of ARMA, the PP test take no notice of serial correlation. Advantage of PP test as compared to ADF is that it is more robust and does not involve any specific lag length. However, if the conclusions of ADF and PP test are similar then both tests enjoy similar power and theoretical acceptance.

For the variables under consideration for construction of index for exchange market pressures and effectiveness of the monetary policy in controlling exchange market pressures for Pakistan, both tests reported similar results on the level of Stationarity – hence results from ADF taking into consideration intercept, intercept and trend and without intercept and trend are reported in the below table. P-values from ADF test are reported to testify the null hypothesis of data being integrated of order one. At the levels, all the p-values turn out to be greater than 0.05 which explains that test fails to reject null hypothesis and concludes that

tested variables at levels are non stationary. While the P-values at first difference turns out to be less than 0.05, which supports to reject null hypothesis that data is integrated of order one. Rejection of null hypothesis concludes that at first difference data is stationary – which perfectly suits estimation of Structural VAR.

Table 1: Results of Unit Root Test

	Level			**First Difference**		
	Intercept	**Trend and Intercept**	**None**	**Intercept**	**Trend and Intercept**	**None**
Log (IPLSM)	0.9232	0.9069	0.9999	0.0000	0.0000	0.0000
Log (CPI)	0.4078	0.8586	1.0000	0.0000	0.0000	0.0000
Log (PSC)	0.6526	0.1995	0.9993	0.0073	0.0226	0.0310
T-Bill Rate	0.5098	0.6486	0.4951	0.0000	0.0000	0.0000
Log (Intervention)	0.3804	0.7572	0.9127	0.0000	0.0000	0.0000
Log (ER)	0.4445	0.4480	1.0000	0.0000	0.0000	0.0000
Log(PSB)	0.9916	0.9407	0.9999	0.0000	0.0000	0.0000
Log (TD)	0.3408	0.3463	0.8679	0.0000	0.0000	0.0000
EMP Index	0.9925	0.7929	1.0000	0.0000	0.0000	0.0000

5.2 Identification of Structural VAR

Traditional approach to appropriate identification of the model capturing the behavior of economic variables is to include more exogenous variables and past observations of endogenous variables. Such way of identification is generally acknowledged as the practice of "Cowles Commission". The practice was criticized in the 1970s and was eventually abandoned. Two major criticisms on such practice came from Lucas and Sims. Lucas mentioned that identification through the practice of Cowles Commission does not take into account the expectations component explicitly, which is not stable across different policy regimes. Resultantly, parameters identified through Cowles Commission practice are an amalgamation of structural parameter and parameters of expectation and hence does not represent the actual relationship.

Sims pointed out several weaknesses in the process of Cowles Commission like lack of economic and econometric arguments for the identification, categorizing variables as exogenous (which is difficult in rational forward looking agents) and the process to impose exclusion restrictions. He highlighted that variables should be declared exogenous by following some proper system instead of doing it arbitrarily. Sims introduced VAR methods to overcome the weaknesses of Cowles Commission process. Sims initially proposed idea to assume contemporaneous relationships between variables through introduction of a specified structural ordering of the variables. Initially such ordering was leading the way for the identification. Later on, variety of forms for identification of restrictions unearthed.

Identification of VAR system is important and has three possible outcomes i.e. system is over identified, under identified and exactly identified. A model is categorized as over identified, if

the solution has more reduced form coefficients against lesser number of structural parameters. In such case, unique results are hard to be obtained. Under identified models are the ones where structural form is not uniquely determined. Exactly identified models provide unique mapping between the reduced form and structural form and provides unique solutions. To have robust and meaningful results, study has relied on exactly identified Structural VAR for both construction of exchange market pressure part of the study and also for part of assessment of effectiveness of monetary policy in controlling exchange market pressures.

5.3 Construction of Exchange Market Pressure Index

The aim of the study is to construct a technically correct and robust index for Exchange Market Pressures (EMP) for Pakistan. Country follows exchange rate regime based on the concept of managed float – where certain portion of exchange market pressure is managed through interventions by the central bank. With countries following such exchange rate regime, technically correct information on managed part of exchange market pressure is essential. Analysis of existing literature on EMP construction for Pakistan reveals that all of those studies are technically weak. EMP constructed through a technically weak process could lead to wrong conclusions about the details of managed and allowed portions of exchange market pressures in the country. This study has constructed EMP through a well-defined dynamic macro-economic model, which has been solved through exactly identified Structural VAR. The study has contributed in Pakistan specific literature on construction EMP – as the study is first one utilizing proper macro-economic model.

5.3.1 Estimated Results

First equation in model explains association between output, rate of interest rate and exchange parity. Estimated result $\boldsymbol{\beta_{14}}$ indicates that rate of interest and output has statistically significant negative relationship. Increase in rate of interest effects the investment level in the country and hence the output growth. High interest rates make credit expensive and bring down the profit model for the projects involving borrowed money. These channels results in a negative association between rate of interest and output. Estimated association is quite similar to the findings of Bokil and Schimmelpfennig (2005) for Pakistan and Smets (1998) for United States of America.

Second component of IS equation is the effect of exchange parity on the output. Estimated result $\boldsymbol{\beta_{16}}$ indicates that exchange parity has a statistically significant and positive effect on output. Results highlight that depreciation of local currency is largely beneficial for output. Depreciation of local currency promotes country's export potential while at the same time makes imported goods costly and hence provide incentive to the domestic manufacturer to manufacture extra to accommodate for the demand shifted from imported goods. All these channels, collectively, results in a positive association between exchange parity and output. Estimated relationship is in line with the findings of Farooq (2009) for Pakistan.

Second equation in the model represents dynamic Phillips curve that explains association between inflation, output, rate of interest, exchange rate and inflation expectation. Inflation expectation is modeled through following the adaptive expectation model – by introducing lagged value of inflation. Estimated result $\boldsymbol{\beta_{21}}$ indicates that output and inflation has a statistically significant positive relationship. High output growth results in higher incomes and

more demand for goods and services. Such high demand leads to inflation. Estimated results are consistent regarding the direction with conclusions of Malik and Khawaja (2006), Malik and Ahmed (2010) and Khalid *et al.* (2007). However, magnitude of coefficient estimated in this study is significantly lower than the magnitude reported by above-mentioned studies. The reason for difference in magnitude is mainly because; the referred studies examined this relationship in isolation while the current study did the same through a complete macro-economic model. Analyzing relationships in isolation suffers from the omitted variable bias and could be over stated.

Philips curve equation also models association between rate of interest and inflation. Estimated result $\boldsymbol{\beta_{24}}$ indicates a statistically noteworthy negative association between interest rate and inflation. Economic theory suggests that lower interest rates enable people to borrow more money – as the cost of doing so is less. Resultantly people have more money to spend which results in increased goods' demand in domestic market and leads to high inflation. On the flip side, higher interest rates discourage people to generate demand through borrowed money and hence reduce inflation. Findings are quite consistent with the conclusions of Khan and Gill (2010) and Bokil and Schimmelpfennig (2005). Effect of exchange parity on inflation is another component of Philips curve equation.

Estimated result $\boldsymbol{\beta_{26}}$ indicates a statistically significant positive effect of exchange parity on inflation. Country's basket of goods for consumer price index has almost 50 percent imported content. Any increase in exchange rate – deprecation of local rupee –translates into increase in prices of imported item and hence the inflation. Estimated result is exactly similar to the findings of Khan *et al.* (2007) and Ahmed and Ali (1999). Coefficient estimated during the study is almost half to the one estimated by Khan and Gill (2010). Prime reason for this

significant difference between this study and Khan and Gill (2010) is the model used. Khan and Gill (2010) have utilized small model and potentially suffers from omitted variable bias. Estimated result $\boldsymbol{\beta_{27}}$ indicates a statistically significant positive impact of inflation expectations – measured through adaptive expectation.

Third equation in the model represents determinants of private sector credit, which led to domestic creation of money. Estimated result $\boldsymbol{\beta_{31}}$indicates a statistically significant positive impact of output on demand for private sector credit. Literature suggests that economy at high growth trajectory offers more business opportunities to the private sector. During such trajectory, private sector undertakes vertical and horizontal expansions and hence demand for private sector credit goes up. Estimated result $\boldsymbol{\beta_{34}}$ indicates a statistically significant and negative effect of interest rate on the private sector credit. Increase in interest rate makes cost of private sector borrowing high and resultantly affects project feasibilities negatively. With high interest rate, only few projects offer economic and financial rationale to the private sector and hence lower the demand for private sector credit. Results of third equation are consistent with the findings of Tahir *et al.* (2015).

Fourth equation in the model represents central bank's reaction function for monetary policy decisions in Pakistan. Taylor (1993) in the seminal work described that the monetary authority adjusts its instrument of interest rate in response to the divergences in inflation from the inflation target either it be an explicit or implicit target and to the movements in the output growth. However, for smaller open economies, the exchange parity is an important element for the decision on the instrument of interest rate. In such countries, central banks prefer to manage the exchange parity at some presumed level and incorporates exchange rate element into the Taylor rule, like De Paoli (2009). Estimated result $\boldsymbol{\beta_{41}}$indicates that whenever the

output gap is positive, central bank responds that by reducing interest rates. This relationship is not clear in case of Pakistan. Mushtaq and Siddiqui (2016) found a positive relation between output growth and level of interest rates, while Malik and Ahmed (2010) found a negative relation. Findings of the current study are aligned with the findings of Malik and Ahmed (2010).

Estimated result $\boldsymbol{\beta_{42}}$ indicates a statistically significant positive relation between inflation and policy instrument of interest rate. Results indicate that whenever inflation is on rise, central bank responds by increasing interest rate. Results are consistent with findings of Malik and Ahmed (2010) and Mushtaq and Siddiqui (2016). Estimated result $\boldsymbol{\beta_{46}}$ indicates a statistically significant positive relation between exchange parity and the policy instrument of interest rates. Results validate the hypothesis that central bank use monetary policy to protect the exchange rate. Similar to the results of inflation and interest rates, these results are also consistent with findings of Malik and Ahmed (2010) and Mushtaq and Siddiqui (2016).

Second last equation intends to model interventions of the central bank in the exchange market. It explains that the altitude of central bank's direct interventions is determined by the level of prevailing interest rate in the economy – primarily through the channel of arbitrage opportunity between currencies – and the exchange parity. It is evident in Pakistan that protection of exchange rate at some overvalued level has gone so deep in the mindset of the policy makers that whenever there are instances of depreciation, central bank tend to intervene more in the exchange market. Estimated result $\boldsymbol{\beta_{54}}$ indicates a statistically significant and negative effect of rate of interest on the level of central bank's direct interventions. High interest rates provide more returns on domestic currency denominated investments and hence reduce pressure from the exchange rate. On the flip side lower rates of

interest, incentivize foreign currency denominated investments and provide opportunities to make profits through currency arbitrage. Estimated result $\boldsymbol{\beta_{56}}$ indicates a statistically significant and positive consequence of level of exchange parity on the level of interventions in the exchange market by the central bank. High exchange parity, deprecation of local currency, leads to higher volume of central bank's direct interventions.

Last equation in the structure intends to model domestic determinants of exchange rate parity. It identifies level of inflation rate, interest rate and central bank's direct interventions as the key determinants of level of exchange rate. Estimated result $\boldsymbol{\beta_{62}}$ indicates a positive impact of inflation on the level of exchange parity. Result is statistically insignificant and is not consistent with economic intuition, which advocates for a negative relation. During high inflation periods, country with high imported content in basket of goods tends to restrict local currency depreciations to improve inflationary trends. Estimated result $\boldsymbol{\beta_{64}}$ indicates a statistically significant and negative effect of interest rate on exchange parity. Generally, high interest rate periods witness fewer opportunities for speculative attacks and provide lucrative returns on domestic currency denominated investments. These collectively reduce pressure from exchange rate and improve exchange parity.

Estimated result $\boldsymbol{\beta_{65}}$ is the most important coefficient for this study. Girton and Roper (1977), Roper and Turnovsky (1980) and Weymark (1995) explained that exchange market pressures is the aggregation exchange rate movements and the pressure not allowed to materialize. Portion not allowed to materialize need a weight so that aggregation with the exchange parity change is possible, to arrive at overall exchange market pressures. The estimated coefficient provides that weight and enables aggregation of allowed and managed part of exchange market pressures. Estimated coefficient indicates a negative and statistically significant

association between the central bank's direct intervention and exchange rate movements. It reveals that higher magnitude of central bank's direct interventions helps in keeping domestic currency at an appreciated level.

However, the sustainability of such ability still needs further clarification. Coefficient itself does not answer the question of sustainability of such ability. The answer to this lies in the lag length structure of the model. Model estimated in this study has found two lags as optimal lag length. Hence, it can be concluded that impact of central bank's intervention is transitory. This conclusion is quite consistent with economic intuition. Theoretically, exchange rate is the reflection of mismatch between supply and demand of exchange rate. Central bank intervention can only bridge the gap between supply and demand for that specific period. If country decide to keep its local currency overvalued, its central bank has to keep doing market interventions on regular basis. Otherwise, as soon as that gap is not bridged the parity will change.

Table 2: Results of Structural VAR for Construction of Exchange Market Pressure Index			
Coefficient	**Value**	**t-test**	**P-value**
β_{14}	-0.0296	-3.3314	0.0008
β_{16}	0.0149	2.8277	0.0011
β_{21}	0.1144	3.1261	0.0019
β_{24}	-0.1258	-2.2374	0.0259
β_{26}	0.1479	2.3310	0.0204
β_{27}	0.0317	2.8761	0.0007
β_{31}	0.8573	4.0445	0.0000
β_{34}	-0.0553	-4.6771	0.0000
β_{41}	-0.0139	-1.1703	0.2596
β_{42}	0.0874	7.2429	0.0000
β_{46}	0.2147	3.2950	0.0019
β_{54}	-0.0225	2.2142	0.0227
β_{56}	1.8986	4.1424	0.0000
β_{62}	0.0981	1.1163	0.2652
β_{64}	-0.0028	-2.3793	0.0179
$\boldsymbol{\beta_{65}}$	**-0.6244**	**-4.6297**	**0.0000**

5.3.2 Exchange Market Pressures (EMP)

Countries generally respond to global shocks in four potential ways: allow movements in exchange parity to make adjustments, control exchange parity by making intervention through central bank, altering rate of interest to influence the exchange parity and introducing changes in capital controls. During last four decades, thought makers in the field of economics have struggled to aggregate these four into a single indicator to assess the market pressures. Entire

idea of index for exchange market pressures rotates aggregation of movements in exchange parity and the movements not allowed by the central bank by making interventions.

Initially, Weymark (1995) defined the EMP as$\boldsymbol{EMP_t = \Delta s_t + \eta \Delta res_t}$.Most of the empirical work in late 1990s and early 2000sfollowed the idea of Weymark and used change in reserves as proxy for the central bank's direct intervention data. However, Patnaik and Shah (2011) found that change in reserves is not an appropriate proxy for the reserves used to manage exchange parity. Rao (2013) extended the work of Patnaik and Shah (2011) for Pakistan and concluded that exchange market pressure calculated by using actual intervention data is less volatile and explains more real time developments of the foreign exchange market. Rao (2013) also explained that Weymark (1995) used change in reserves to overall reserves ratio for the aggregation of controlled and allowed exchange market pressures. Rao (2013) relied on actual intervention data to the foreign exchange inflows ration to quantify the impact of central bank intervention to the external account. Rao (2013) argued that level of intervention itself does not provide the actual information, as an intervention of $500 million could altogether be different for a country with $5 billion as monthly inflow to a country with $50 billion as monthly inflow.

Rao (2013) defined the EMP as: $\boldsymbol{EMP_t = \Delta ER_t + \eta[INT_t / FX\ INF_t]}$**.** Following the work done by Rao (2013), this study has utilized the actual intervention data for the construction of exchange market pressures. Below figure explains how policy makers have allowed and warded off the exchange market pressures. Blue line represents the pressures warded off and reveals that Pakistan has a strong history for controlling exchange market pressures through direct intervention. Positive blue line explains that largely central bank's intervention remained positive – mean it was injecting foreign exchange liquidity in the market through

selling foreign exchange. Negative blue line represents those periods, where central bank opted to build reserves through buying or mopping up the foreign currency from the exchange market. This is also known as central bank leaning with the wind policy. Below figure also explains a sort of homogenous approach by the central bank across time history.

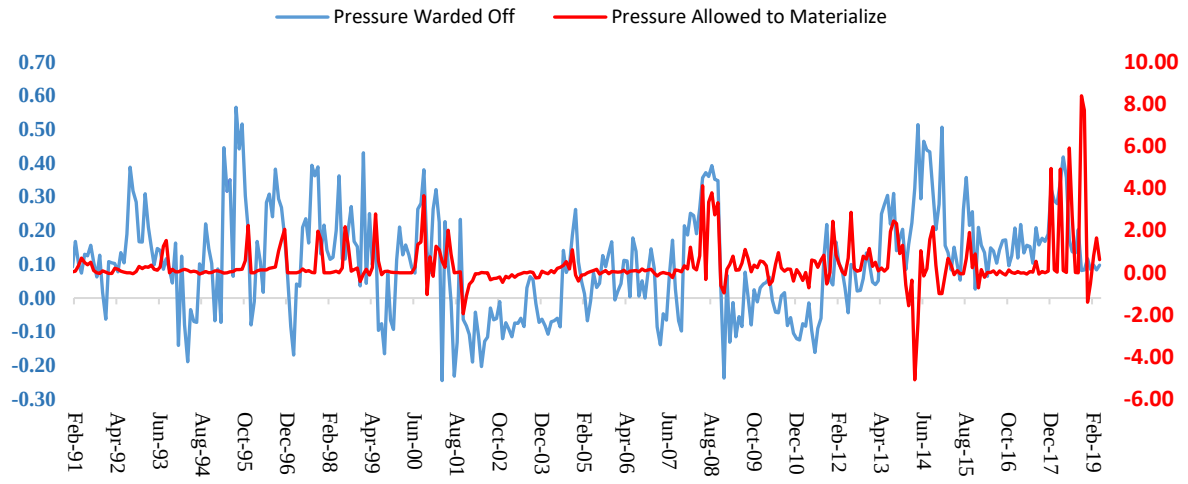
Central bank in Pakistan generally exhausts foreign exchange reserves to protect exchange parity, till the time it came out of reserves. And generally this is the point where, if central bank is negotiating any bailout package or financial assistance, it starts building reserves through purchases from the market to improve its negotiating power. This is the time when exchange rate is already on the slide in the market because of absence of active central bank support, and central bank's purchasing mode further exaggerates foreign currency demand in the exchange market and hence generally results in overshooting of exchange rate. Below figure provides strong evidence for the scenario explained above. Blue line depicts that every active continuous market intervention has a stable exchange rate, followed policy of leaning with the wind by central bank to build some holding of reserves and resultant overshooting of exchange rate (spikes in red line).

Red line in the figure represents exchange market pressures allowed to materialize by the policy makers. The plotted red line supports the hypothesis that exchange market pressures in Pakistan are generally not allowed to get materialized – red line is general is at zero. Line also supports the presence of periods where exchange market pressures were literally not allowed to materialize. Line also depicts that such periods have corresponding active central bank direct interventions and also reveals that such periods are followed by overshooting of exchange rate. These findings support the proposition that protection of exchange parity is so

deep in the mindset of policy makers that they try to use every dollar from the reserves to protect the parity at some perceived level.

Pakistan is a balance of payment deficit country and also has to use foreign exchange reserves to finance such deficit. When majority of dollars are exhausted in this exercise and balance of payment crisis start looming, policy makers start to build reserves to hedge for short run and to improve country's negotiating power for any possible bailout package. This is the time, when not only exchange parity is allowed to make corrections but also generate some speculations in the market and hence results in overshooting of exchange rate. Spikes in red line are the evidence for such overshooting. Line also supports the aforementioned scenario, as there are longer periods of almost zero level for exchange market pressures allowed to materialize coupled with active exchange market interventions. Consistent episodes of active market interventions are followed by spikes in the red line – these spikes represent those periods where country ran out of reserves and allowed market to dictate the parity decision. Such spikes are followed by central bank's policy of leaning with wind, negative interventions in the market, and resultant further spikes – which explains the overshooting. As soon as country has some bailout package and reserves attain a reasonable level, policy makers switch back to their policy of not allowing market pressures to materialize.

Figure 1: Controlled vs Allowed Market Pressure



Source: Author's calculations

5.3.3 Exchange Market Pressure Index

Downside of using absolute data of managed part of exchange market pressures is that it is difficult to elaborate and hard to digest for a common person. This toughness in understanding limits its usage for the policy makers as there are possibilities that policy makers can start using their discretion for the interpretation of such data. As mentioned in the introductory part of this study, that one purpose to construct data on exchange market pressures is to present methodological details to the policy makers and stakeholders. In this backdrop, it is always preferred to use an intervention index instead of absolute data for managed part. Intervention index calculates the portion of currency pressures relieved by the central bank. Hence, it is the proportion of managed exchange market pressures to the total exchange market pressures. Intervention index is calculated as:

$$II_t = \frac{\eta[INT_t/FX\ INF_t]}{\Delta ER_t + \eta[INT_t/FX\ INF_t]}$$

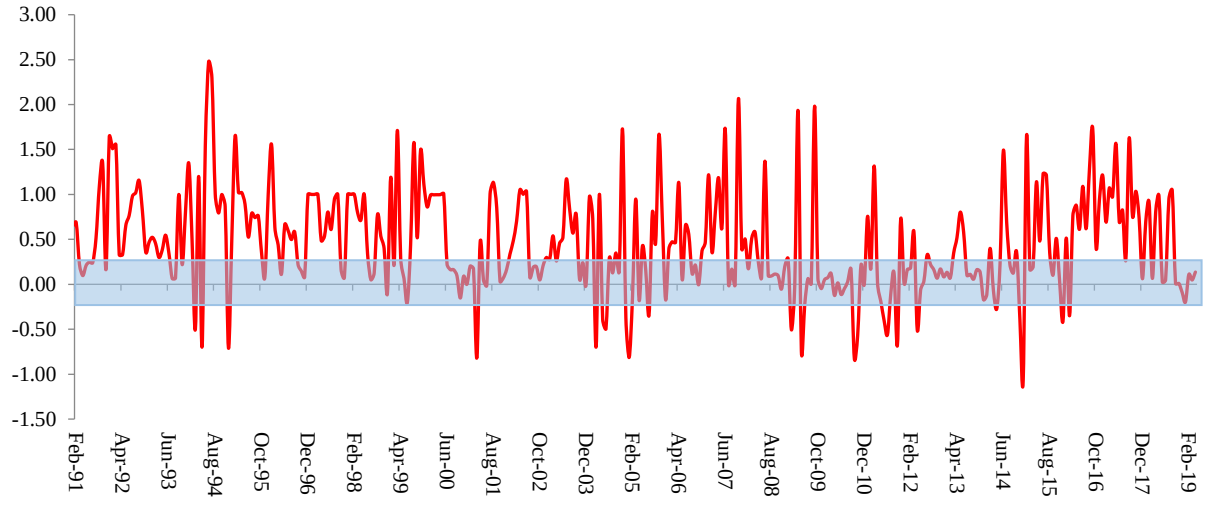
Generally intervention index should be between$-\infty < II < \infty$. Value of the index equal to zero is a reflection that central bank refrained from the interventions. Value of the index approaching one is a reflection that country is under fixed parity regime. Value of the index between zero and one is a reflection that the country is following regime based on the idea of managed float. Index acquiring value less than zero indicates central bank's leaning with the wind policy. It can be construed that the central bank bought foreign currency from the market, in the presence of descending pressures on local currency. Value of index exceeding one is an indication that the central bank overdid the management of pressures. It results in movement of exchange parity to in the totally opposite direction to the one warranted by market forces.

Figure 2 discloses that since January 1991 Pakistan's central bank kept on overdoing the interventions. However, results also found few instances where central bank adopted the policy of leaning with the wind. Generally there is provision of central bank intervention under the exchange rate regime based on the concept of managed float – under which Pakistan remained for the sample period. However, this provision is provided to keep a check on excess volatility and ideally this management part should not be more than one-fifth of total pressures. If a central bank is managing up to 20 percent of total market pressures, case could be made that central bank did so to avoid excess volatility in the market and to keep exchange rate movements stable. However, if such management part is beyond 20 percent of total market pressure, then intervention are not curb excess volatility but to keep parity at some decided level.

In figure 2, shaded blue area explains the tolerance band of 20 percent. It is evident from the figure that Pakistan has traditionally made market interventions beyond this tolerance band

and hence falls into the category where interventions are made to keep parity at some decided level and not to curb excess volatility. Figure also reveals that there are frequent instances where central bank was involved in overdoing for the management – managed more than 100 percent of market pressures. Sample period has substantial instances where the central bank remained successful in changing the direction of exchange rate movement – when market was advocating for depreciation of local currency, interventions by the central bank not only kept the depreciation in check but also led to appreciation of local currency. Interestingly, every attempt to overdo management is followed by instances of the central bank following policy of leaning with the wind. As explained in the previous section, the central bank exhausted huge amount of reserves to keep a check on exchange rate movements and when reserves came to lower bounds central banks have to not only allow depreciations but also have to contribute in that – as purchase o foreign exchange from the market is essential to build reserves.

Figure 2: Intervention Index (Fraction of Total Market Pressures)



Source: Author's calculations

5.3.4 Impact of Central Bank Intervention on Exchange Rate

Movements in exchange parity are reflections of supply and demand gaps in the exchange market. With demand outpacing supply of foreign exchange, markets generally depreciate the local currency while the opposite scenario leads to appreciation. Countries intending to keep exchange rate at some predetermined level use their central bank to bridge the demand supply gaps to attain the objective. Markets where demand is outpacing supply, central bank supply foreign exchange in the market to bridge the gap and keep parity at desired level. However, it is essential to understand that as soon as central bank discontinues its market support, the parity will fall to the level determined by the market. Effect of the interventions by the central bank is, therefore, transitory in nature. Intervention can only influence the parity level for that specific period. Central banks intending to keep parity at predetermined level for longer term needs to continuously make interventions in the market.

Exchange market pressure index for Pakistan – explained in the previous section – reveals that central bank of Pakistan remained engaged in market interventions on continuous basis. Central bank keeps bridging the gap between demand and supply for longer period. As soon as central bank was left with low level of reserves and was not able to support the market through direct foreign exchange market intervention, exchange rate parity moved along the market forces.

Figure 3 is impulse responses of exchange rate to structural one standard deviation shock in central bank's intervention. Figure explains that the response of exchange parity to the interventions made by the central bank only lasts for a shorter period of time and tappers off immediately. This result is consistent with economic intuition, as central bank's intervention

can only bridge the gap between demand and supply for a very short period and as soon as the gap remerges the impact of intervention tappers off. Impulse response provides the dynamics of unanticipated response between variables. Economic theory suggests that with increased information available to the stakeholders, anticipated responses are hard to segregate between different interventions. As with the access to information, stakeholders can incorporate the potential policy changes in their behavior and hence leads to kind of no response to different policy interventions. In such circumstances, unanticipated policy shocks are helpful as market cannot predict and early incorporate the policy changes.

Figure 3: Response of Exchange Rate to Structural one SD shock in Intervention

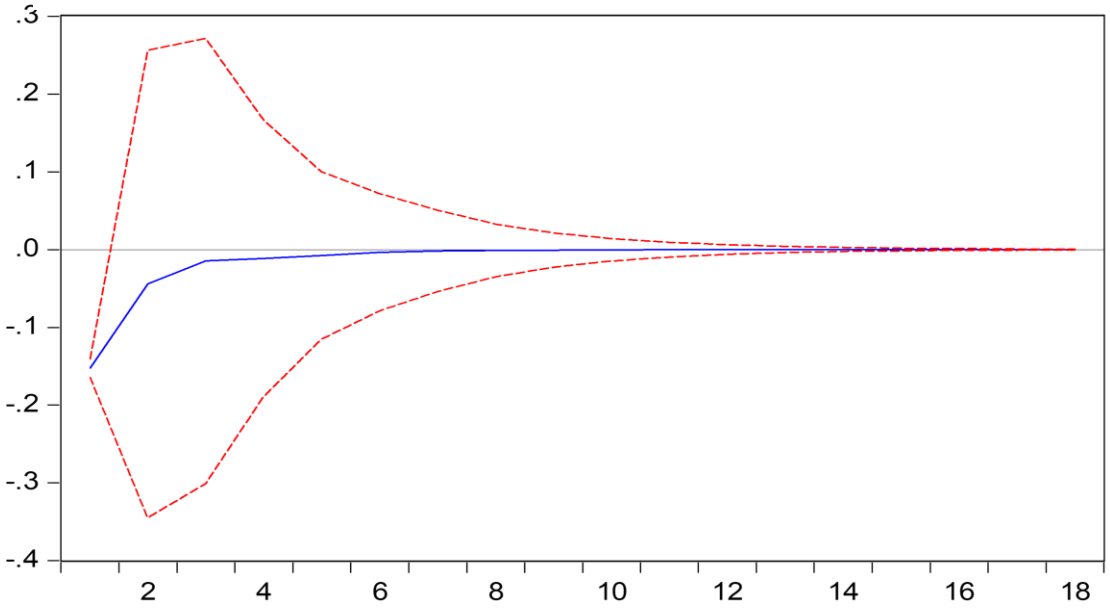


Figure 4 provides historical evaluation of Pakistan's central bank's intervention pattern and its effectiveness in controlling exchange rate. Similar to the findings through impulse response function, figure 4 depicts largely a failure on part of central bank in managing parity during the sample period. Data on central bank direct intervention indicates that central bank has provided a cumulative direct market support of USD 112 billion since January 1991. However, support of this USD 112 billion has yielded a management of exchange rate by only

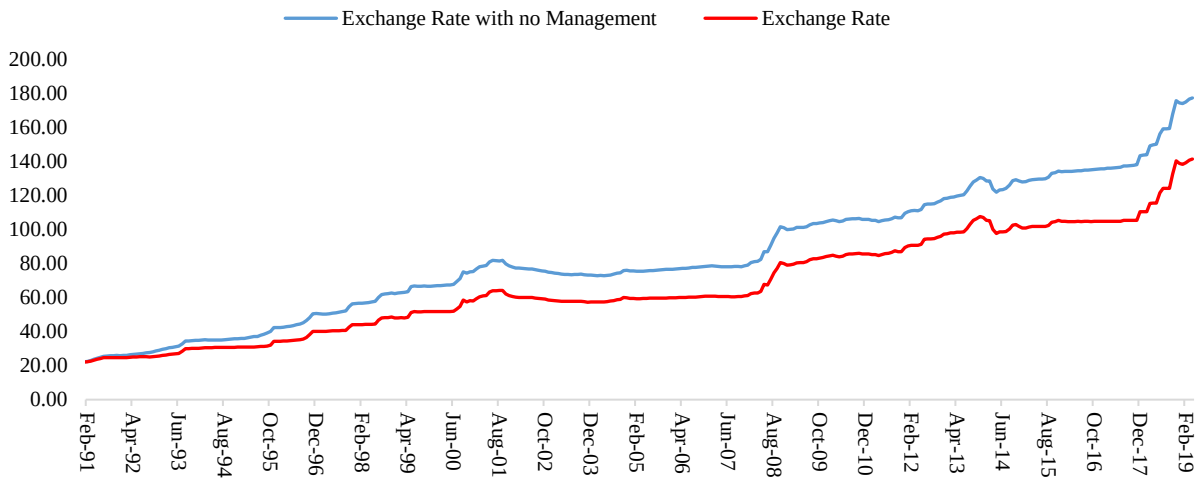
Rs. 35.92. Red line in the graph represents the prevailing exchange rate which incorporates the impact of management. While the blue line represents the exchange rate calculated by assuming that no management done by the central bank. Without making these continuous interventions, model suggests the exchange parity for April 2019 would have been Rs. 177.43 per dollar as compared to the prevailing exchange rate of Rs. 141.51 per dollar. These numbers largely suggest a complete failure of managed exchange rate regime followed by the policy makers since early 90s.

Finding is quite consistent with the hypothesis that intervention can only safeguard exchange rate against the pressures for that specific period. But as soon as the country becomes reserve deficient, market makes all the necessary corrections which were previously managed through exhausting reserves. Findings also suggest that reliance on market based exchange rate would have been a better approach, in that way precious dollar reserves could have been saved. Interestingly, Pakistan spent almost USD 112 billion just to protect exchange rate – in which they miserably failed. Pakistan's external debt and liabilities have a similar number – in fact couple of billion dollars less than the dollars exhausted for failed attempt of exchange rate management. Figure 4 clearly demonstrates that Pakistan would have been better off, if the country had opted for market based exchange rate.

Findings also indicate that with less protective exchange rate regime, country could have avoided the frequent balance of payment crisis in last three decades. Policy to keep exchange rate at an overvalued level, largely subsidized the imported consumption and distorted competitiveness of exportable items. Both these translated into higher trade deficits, led to balance of payment crisis and resulted in country needing bailout packages. With market

based exchange rate regime, such scenarios could have easily been avoided. Largely, spending USD 112 billion to protect exchange rate for only Rs. 35.92 is a failure of policy.

Figure 4: Exchange Rate with Management vs No Management



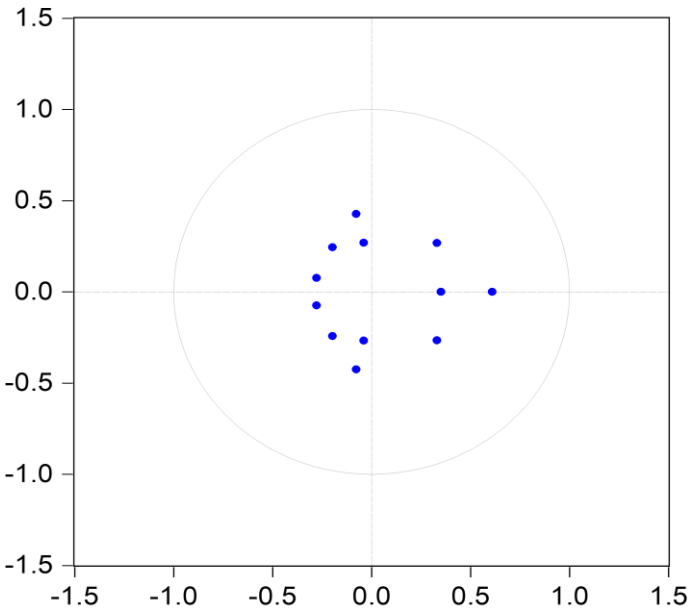
Source: Author's calculations

5.3.5 Stability Diagnostics for Structural VAR

Stability of Structural VAR model is a pre-requisite to have robust, correct and plausible information from the estimated model. AR characteristic polynomial' Inverse Roots are used to conduct the stability diagnostics for Structural VAR. Estimated Structural VAR is treated as a stable or stationary, if modules of all the roots is less than one and are placed within the circle unit. If one or more roots like outside the unit circle, Structural VAR is treated as unstable. If the Structural VAR is unstable, results like impulse responses become invalid. As mentioned earlier that impulse response is an added advantage of such models and unearths useful information, hence invalidity of such puts serious question marks on use of Structural VAR model. Structural VAR model used for construction of exchange market pressure index was tested for stability and inverse roots of AR characteristic polynomial found all roots lying

in circle unit. Hence, it can be concluded that Structural VAR used for index construction for exchange market pressures is stable and can comfortably be used for generating impulse responses of different variables to different structural innovations.

Figure 5: Inverse Roots of AR Characteristic Polynomial



5.4 Assessment of effectiveness of monetary policy in controlling exchange market pressures

Pakistan has a history of using monetary policy to control exchange market pressures. Country has repeatedly used instrument of rate of interest to impact the exchange parity in the economy. This study aims to assess whether such use of monetary policy remained successful in controlling exchange market pressures for Pakistan or not. There is no previous study available for Pakistan on such subject and the literature available for other countries provide mixed findings on the effectiveness. Fiador and Biekpe (2015), Panday (2015) and Tanner (2000) conclude that monetary policy is effective in controlling exchange market pressures while Kyin, Chin and Habibullah (2013) and Akosah and Dasah (2015) highlight ineffectiveness. Studies concluding ineffectiveness highlights that use of monetary policy in

the countries where it is not effective, can complicate the scenario. The serious repercussions of using monetary policy while it is not effective, necessitates a country specific study before using this tool to control exchange market pressures. This study has assessed effectiveness of monetary policy in controlling exchange market pressures through a well-defined dynamic macro-economic model, which has been solved through exactly identified Structural VAR. The study has contributed in Pakistan specific literature on the subject – as this is the first study on assessment of effectiveness of monetary policy in controlling exchange market pressures for Pakistan.

5.4.1 Estimated Results

First equation in the model explains the behavior fiscal discipline of the government. Due to data availability issues, borrowing of the government through the banking system is taken as proxy to fiscal discipline. Fiscal discipline is modeled by taking output growth, interest rate and trade deficit as its determinants. Estimated result $\boldsymbol{\alpha_{12}}$ indicates that fiscal discipline and output growth have a statistically significant positive relation for Pakistan. This is quite consistent with the economic situation in Pakistan. Pakistan does not have a good tax culture – only one percent of the population is tax payers. People do not prefer to pay taxes, and tax collection mechanisms are inefficient and provide opportunities for corruption. This tax deficiency leads the country to more borrowing from the internal sources during high growth periods to fund the regular maintenance work in the economy.

Pakistan has a huge debt burden – over 70 percent of its GDP. Major part of this debt is from domestic sources, mainly from the banking system. An increase in interest rate adversely affects the debt servicing for the domestic debt of the country. Estimated result $\boldsymbol{\alpha_{15}}$ indicates

a statistically significant positive effect of rate of interest on government's borrowing from the banking system. Result is consistent with the economic intuition, high interest rates makes domestic debt and its servicing costly and more financial resources are needed to meet the obligated debt servicing. This leads the government to borrow more from the banking system to meet its debt servicing obligations.

Pakistan traditionally has a negative balance for its trade account – country imports more while exports little. In effort to promote its exports, country has generally relied on provision of subsidies, tax reliefs or rebates to the local industry. This approach, either subsidy which is an increase in expenditure or tax relief which is a cut in revenue, puts additional pressure on the fiscal side and leads government to borrow more from the banking system. Estimated result $\boldsymbol{\alpha_{16}}$ indicates a statistically significant positive impact of trade deficit on government's borrowing from the banking system. Results are consistent with domestic economic policy making of Pakistan.

Second equation in the model explains the dynamics of output growth. Due to data availability issues, index for large scale manufacturing is taken to proxy output growth and its trajectory. Output growth is modeled by taking fiscal discipline, private sector credit demand and interest rates as its determinants. High government borrowing means in future country has to allocate further for debt servicing. This means that government is left with low financial leverage for its developmental plans – only few schemes could be financed as major chunk is taken by debt servicing. Estimated result $\boldsymbol{\alpha_{21}}$indicates a statistically significant negative impact of government's borrowing on output growth. When government borrows more, private sector is crowded out and hence economy slows down.

Private sector credit demand has generally positive effect on output growth. Private sector is generally known for efficient implementation of its plans. As private sector mainly works on profit business model, generally credit disbursed to private sector is generally used for productive and efficient purposes and leads to high output growth. Estimated result $\boldsymbol{\alpha_{24}}$indicates a statistically significant positive effect of credit to private sector on output growth. Interest rate is another important determinant of output growth. Generally, high interest rate slows down the output growth. Estimated result $\boldsymbol{\alpha_{25}}$ also indicates a statistically significant negative effect of rate of interest on output growth. Result is consistent with the association of rate of interest and output growth defined in economic literature.

Third equation in the model explains the dynamics of inflation in the country. Inflation is modeled by taking output growth, rate of interest and index for exchange market pressures as its determinants. Inflation is calculated by using consumer price index – which is an official measure and standard for inflation calculation. Estimated result $\boldsymbol{\alpha_{32}}$indicates a statistically significant negative impact of economic growth on inflation. Theoretical justification for the result is that when economy has more growth, it can produce more and impact prices negatively. However, this justification only fits in for the supply side dynamics of inflation. If inflation is primarily demand driven, high output growth could lead to further inflation.

Interest rate is an imperative determinant of inflation. Entire mechanism of monetary policy works through this relationship. Typical interest rate channel advocates that high interest rate will slow down the economy, reduce individual's purchasing power and hence reduce inflation in the economy. One can also categorize this as a demand management tool and strategy for inflation control. Estimated result $\boldsymbol{\alpha_{35}}$ indicates a statistically significant negative

effect of rate of interest on level of inflation for Pakistan. Result is consistent with earlier work on the issue for the country as well as with the theory on the issue.

Exchange rate and its management are also important determinants of inflation in Pakistan. As discussed earlier, almost 50 percent of basket of goods for consumer price index is consisted of imported items and hence any change in exchange parity brings direct effect on level of inflation in the country. Section on construction of exchange market pressure index highlights that during the sample period every attempt to manage exchange market pressures have ended up with overshooting of exchange rate. This advocates a positive relation between inflation and exchange market pressures. Estimated result $\boldsymbol{\alpha_{37}}$ also indicates a statistically significant positive effect of exchange market pressures on the level of inflation for Pakistan.

Fourth equation in the model explains the dynamics credit to the private sector in the country. Dynamics of credit to the private sector are modeled by taking fiscal discipline of the government, output growth and interest rate as its determinants. Credit disbursements to the private sector through the banking system are used to proxy the dynamics of private sector credit in the country. Banking system lending to the government sector is generally a risk free investment. High appetite of the government to borrow from the banking system leads lesser availability of funds for private sector credit. Estimated result $\boldsymbol{\alpha_{41}}$indicates a statistically significant negative impact of government's borrowing on credit to the private sector in the country.

Output growth is another important determinant of private sector credit. Generally, high trajectory of output growth leads to more credit demand by the private sector. Higher output growth improves the financials of the private sector firms and reduces the element of risk for

the banks regarding private sector. Chances of liquidation or closure of private sector firms are more in tough growth periods as compared to the times when economy is on high growth trajectory. Estimated result $\boldsymbol{\alpha_{42}}$indicates a statistically significant positive impact of output growth on credit to the private sector. High output growth also leads to more credit disbursements to private sector. This result is consistent with economic intuition and theory on impact of output growth on private sector credit.

Interest rates are also vital determinant of private sector credit in the country. Private sector generates its demand for credit through vertical or horizontal expansion of its different operations. Level of interest rate is a defining factor while taking the decisions for such expansions – as it has a direct impact on the economic feasibility. High interest rates adversely affect the feasibility of such projects – and only few of them remain profitable. Such scenario forces private sector to reduce its demand for credit. Estimated result $\boldsymbol{\alpha_{45}}$indicates a statistically significant and negative impact of rate of interest on credit to the private sector. Finding is well aligned with the economic intuition and findings of Tahir *et al.* (2015).

Fifth equation in the model represents central bank's reaction function for monetary policy decisions. Similar to the reaction function used for the SVAR on construction of exchange market pressure index, this SVAR has also relied on the seminal work of Taylor (1993). Following Taylor (1993) monetary policy reaction function is explained through deviations of interest rate and output from the implicit or explicit targets. De Paoli (2009) highlighted that exchange rate dynamics are an important element for central bank's reaction function of monetary policy, as they prefer to keep the exchange rate at some presumed level. This model incorporates dynamics of exchange market pressures in the Taylor rule. Estimated result

$\boldsymbol{\alpha_{52}}$indicates that whenever economy has a positive output gap, the central bank go for high interest rates as it believe that economy is on a heated path. Previous literature on this relationship for Pakistan is bit ambiguous. Mushtaq and Siddiqui (2016) found a positive while Malik and Ahmed (2010) found negative relation between output gap and interest rate for Pakistan. Findings of the study are aligned with the findings of Mushtaq and Siddiqui (2016).

Estimated result $\boldsymbol{\alpha_{53}}$ indicates a statistically significant positive relation between inflation and policy instrument of interest rate. Results indicate that whenever inflation is on rise, central bank responds by increasing interest rate. Results are consistent with findings of Malik and Ahmed (2010) and Mushtaq and Siddiqui (2016). Estimated result $\boldsymbol{\alpha_{57}}$ indicates a statistically significant positive relation between exchange market pressure and policy instrument of interest rate. Results validate the hypothesis that central bank use monetary policy to protect exchange rate. Similar to the findings regarding interest rate and inflation, these results are also consistent with findings of Malik and Ahmed (2010) and Mushtaq and Siddiqui (2016).

Second last equation in the model explains the dynamics of trade account of the country. Trade dynamics are modeled by taking output growth and domestic inflation as its determinants. Estimated result $\boldsymbol{\alpha_{62}}$ indicates a statistically insignificant impact of output growth on trade dynamics of the country. This validates that trade dynamics are more of a response to the mixed factors from internal and external accounts. Estimated result $\boldsymbol{\alpha_{63}}$ indicates statistically significant effect of inflation on country's trade dynamics.

Last equation of the model explains the exchange market pressures in the economy. Exchange market pressures are modeled by taking fiscal discipline, dynamics of private sector credit,

interest rate and trade dynamics as its determinants. Weak fiscal position of the government impacts the efficient use of financial resources and hence contributes in building the additional exchange market pressures in the economy. Estimated result $\boldsymbol{\alpha_{71}}$ also indicates a statistically significant positive impact of government's fiscal discipline on exchange market pressures in the economy.

Private sector credit is another important determinant of exchange market pressures in the economy. Generally higher private sector credit enable high growth, improve demand and supply forces of foreign exchange markets and hence help in reducing exchange market pressures in the economy. Estimated result $\boldsymbol{\alpha_{74}}$ indicates a negative impact of private sector credit on exchange market pressures in the economy. However, this relationship is statistically insignificant and hence need further explanations in the case of Pakistan. Trade dynamics have an express effect on the exchange market pressures in the economy. As the variable of trade dynamics in this model is defined as import minus export – hence increase in trade dynamics means more gaps between demand and supply. Such enhanced gap leads the country to building more exchange market pressures. Estimated result $\boldsymbol{\alpha_{76}}$ indicates a statistically significant positive effect of trade dynamics on exchange market pressures in the economy. However, the value of coefficient for this relation is almost negligible.

Effect of rate of interest on the exchange market pressures in the economy is the most important variable of the model for this study. This part of the study is dedicated to assessment of effectiveness of monetary policy in controlling exchange market pressures for Pakistan. Hence the estimated result for monetary policy interest rate effect on exchange market pressures is the most important information from the model. Theoretically, contractionary monetary policy – high interest rates – has a negative consequence for

exchange market pressures. It slows down the economy and hence reduces the import bill – which improve demand-supply mechanism in the market and reduce exchange market pressures in the economy.

Interest rate increase also discourages the speculative demand of foreign exchange in the economy. With low interest rates in the economy, there is general tendency that individual can borrow in local currency, get that converted in foreign exchange and can earn through relatively higher depreciation as cost of interest rate is relatively low. But high interest rate increase this cost of borrowing and reduces chances of making money through speculative demand of foreign exchange and hence reduce exchange market pressures in the economy. High interest rates also incentivize local currency denominated investments in the economy and hence increase the demand for local currency – this help in mitigating exchange market pressures in the economy.

Estimated result $\boldsymbol{\alpha_{75}}$ indicates a statistically significant negative effect of interest rate on exchange market pressures in the economy. This result advocates that use of monetary policy for controlling exchange market pressures in Pakistan is successful. Result is in line with the findings of Fiador and Biekpe (2015), Panday (2015) and Tanner (2000). Although, monetary policy is found significant in controlling exchange market pressure for Pakistan, nature of significance in time perspective still needs further investigation. Structural VAR estimated in this study for effectiveness of monetary policy in controlling exchange market pressures found two lags as optimal lag length. The selected lag length suggest that impact of monetary policy is transitory in nature and could only work for the short term and not having any consequence for exchange market pressures in the medium to long run. It indicates that use of monetary policy is effective for short term management of exchange market pressures;

however the long term management is only possible through structural reforms intending to improve supply and curtail demand for foreign exchange. Results also suggest the importance of monetary policy in controlling transitory pressures in the market, however, suggest weakness of the policy in controlling the sources originating market pressures of permanent nature. For permanent nature pressures, country needs to introduce reforms to improve its demand and supply equilibrium in the market instead of using monetary policy. Monetary policy can only work if the pressures are originating from the transitory sources. Monetary policy is also helpful in managing excess volatility in the short run.

Table 3: Results of Structural VAR for Monetary Policy Effectiveness in Controlling EMP

Coefficient	Value	t-test	P-value
α_{12}	0.0447	1.8838	0.0605
α_{15}	0.0115	3.1697	0.0018
α_{16}	0.0327	2.2208	0.0271
α_{21}	-0.0784	2.5925	0.0117
α_{24}	1.6246	6.8005	0.0000
α_{25}	-0.0119	-3.2314	0.0015
α_{32}	-0.0140	-3.0349	0.0026
α_{35}	-0.0111	-4.0492	0.0000
α_{37}	0.0013	2.9350	0.0038
α_{41}	-0.0959	-3.4189	0.0007
α_{42}	0.0779	6.8005	0.0000
α_{45}	-0.0116	-6.9129	0.0000
α_{52}	0.1239	2.2642	0.0274
α_{53}	0.0398	5.9349	0.0000
α_{57}	0.2715	8.0899	0.0000
α_{62}	62.0495	0.3804	0.7039
α_{63}	3905.6672	2.0406	0.0421

α_{71}	1.6788	1.1251	0.2614
α_{74}	-1.3272	-0.4823	0.6299
α_{75}	**-0.2348**	**-2.5422**	**0.0115**
α_{76}	0.0004	1.7915	0.0742

5.4.2 Effectiveness of Monetary Policy in Controlling Exchange Market Pressures

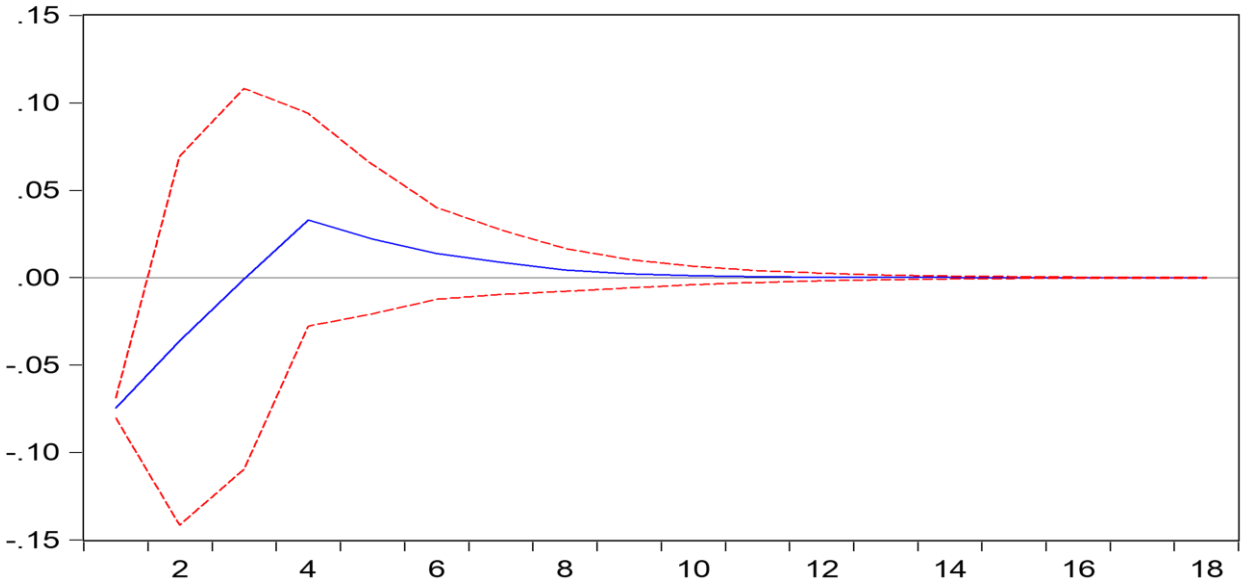
Pakistan has a history of using monetary policy to control exchange market pressures. In the past, no work has been dedicated to assess whether such policy of using monetary policy remained effective in controlling exchange market pressures or not. This study is first of its nature, trying to unearth this relationship for Pakistan. Estimated results established a negative effect of monetary policy on exchange market pressures – however such results are based on anticipated changes in monetary policy. As discussed earlier, with the increased access to information by the stakeholders and rational expectation formation, impact of anticipated policy changes is always muted as stakeholders always incorporate such policy changes in advance. In this backdrop, it is essential to analyze the response of exchange market pressures to the unanticipated change in monetary policy rate.

Impulse response is mechanism which unearths the responses of exchange market pressures to the unanticipated changes in monetary policy rate. Impulse responses generated from Structural VAR allows the imposition of economic structure while generating such responses. Figure 6 explains the reaction of exchange market pressure to structural one standard deviation shock in monetary policy rate. Response in figure 6 clearly indicates the effectiveness of monetary policy in short run and states that the impact tappers off within 2 months. Results also indicate that use of the monetary policy restricts exchange market pressures within 2 months of the policy intervention, while further exaggerate the pressures

from 3rd to 6th month of the policy intervention. It is therefore, essential to carefully use monetary policy and also to bring desired structural reforms in the exchange market to harvest full fruits of monetary policy tightening. Use of monetary policy in isolation could only yield some cosmetic benefits and could further add in creating market pressures.

Results from impulse response are consistent with actual happenings in the economy of Pakistan. Every time monetary policy is used to control exchange market pressures, it brings immediate relief to the parity. However, in medium to longer term such policy either becomes neutral and in some instance become counter-productive – in some instances instead of restricting exchange market pressures, use of monetary policy actually contributes in building such pressures. Results unearth some important information which has great value for the policy makers. As mentioned earlier, there is no previous study for Pakistan intending for the assessment of use of monetary policy for controlling exchange market pressures. While there is strong evidence available suggesting frequent use of monetary policy by Pakistan's central bank to control exchange market pressures. Results of this study provide a theoretically robust and technically correct mechanism for evaluation of use of monetary policy in Pakistan for last three decades. Key pronouncement of this study is that monetary policy is effective in controlling exchange market pressures in the short run – up to 2 months – while remains neutral for the longer run and counterproductive for the medium run.

Figure 6: Response of Exchange Market Pressure to Structural one SD shock in Monetary Policy Rate

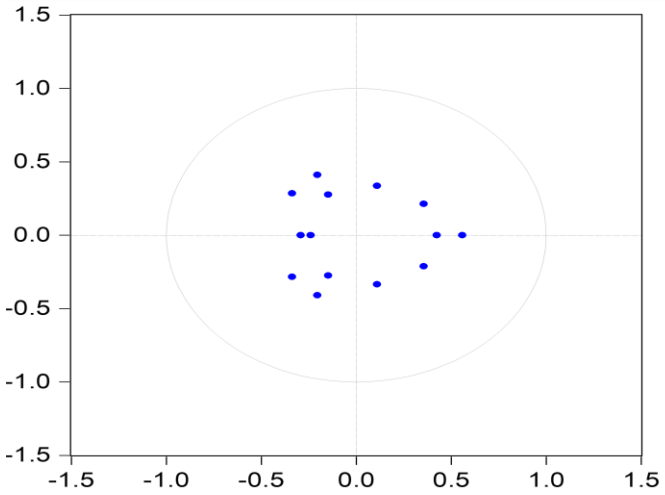


5.4.3 Stability Diagnostics for Structural VAR

Stability of Structural VAR model is a pre-requisite to have robust, correct and plausible information from the estimated model. AR characteristic polynomial Inverse Roots are used to conduct the stability diagnostics for Structural VAR. Estimated Structural VAR is treated as a stable or stationary if all roots from the test have modulus less than one and lie well inside the unit circle. If one or more roots like outside the unit circle, Structural VAR is treated as unstable. If the Structural VAR is unstable, results like impulse responses become invalid. As mentioned earlier that impulse response is an added advantage of such models and unearths useful information, hence invalidity of such puts serious question marks on use of Structural VAR model. Structural VAR model used for assessment of effectiveness of monetary policy in controlling exchange market pressures for Pakistan was tested for stability and inverse roots of AR characteristic polynomial found all the roots lying in the unit circle. Hence, it can be concluded that the Structural VAR used for assessment of effectiveness of

monetary policy is stable and can comfortably be used for generating impulse responses of different variables to different structural innovations.

Figure 7: Inverse Roots of AR Characteristic Polynomial



Chapter 6: Conclusion

Generally, the exchange rate parity is a reflection of relative economic progress of a country. Stable and gradual movements in exchange rate support economic growth whereas abruption and volatility slows down the growth. To hedge against the volatility, policy makers need to devise proactive policies – which is not straightforward and needs complete assessment of exchange market pressures in the economy. Exchange rate alone can depict the exchange market pressures only in free float exchange rate regime. In managed-float regime, countries need to construct a measure that can potentially account for the managed part of the pressures in addition to exchange rate. This type of measure is known as Exchange Market Pressure Index (EMP) in the literature of international finance.

Irrespective of level of development, there are very few countries following the purely flexible exchange rate regime in true spirit – with developing countries more addicted to overvaluation of currency. Literature doubts the sustainability of such overvaluation given the associated deep-rooted structural external imbalances. Literature also suggests that every such effort faces economic consequences like overshooting of exchange rate, loss of foreign exchange reserves and competitiveness and tightening of monetary policy.

Pakistan is no different from other developing countries – despite adoption of market based exchange rate regime in 1982 – country never allowed exchange rate to take its market value. The protection of exchange rate is so deep in the mindset of policy makers that billions of dollars wasted in last three decades to keep exchange rate at their *desired* levels. However, every such effort has resulted in a situation of "country requiring bailout packages to make balance of payment sustainable".

Pakistan has recently approached international Monetary Fund (IMF) for the third time in the last decade. Surprisingly, the sequence of economic events in the preceding years of every program remains so similar. Every time country attempted for overvalued currency for two to three years, followed by substantial depreciation, drastic decline in foreign exchange reserves and tightening of monetary policy in the year right before knocking on IMF's door.

It is evident that the monetary authority of Pakistan also intervenes through monetary policy in addition to the direct interventions to support exchange rate. However, there is lack of conclusive evidences on the effectiveness of monetary policy to achieve the objective of controlling exchange market pressure. Researchers have a lack of consensus on effectiveness of monetary policy. The ones concluding ineffectiveness raise some legitimate questions on using monetary policy while there is substantial evidence that it has no impact on exchange market pressures. They argue that use of contractionary monetary policy complicates the scenario by adversely affecting fiscal side and the growth trajectory because of high interest rates and increased cost of borrowing for the private sector. With these kinds of serious repercussions of contractionary monetary policy, one has to be very much sure about the impact of such policy on the exchange market pressure.

There is hardly any study on this topic for Pakistan. Specifically, Khawaja and Din (2007), Khan (2010) and Rao (2013) discuss the issue of construction of the EMP. However, none of them discussed the effectiveness of monetary policy on the EMP in the case of Pakistan. Moreover, the construction methodologies of constructing EMP in these studies can be questioned on the methods used for such construction and usage of change in reserves to proxy actual intervention data. The earlier studies construct EMP through a weak approach. Indeed, a weak approach will always lead to weedy conclusions. If the idea is to assess effect

of monetary policy on exchange market pressures and the calculated index for such pressures is not representative of actual pressures, then the conclusions from such studies cannot be reliable.

This study has bridged this literature gap for Pakistan by constructing exchange market pressure index through a dynamic macro model solved through Structural VAR, and by utilizing the actual interventions data. Study also constructed the intervention index for Pakistan that reflects the size of pressures wadded off by Pakistan's central bank from January 1991 to April 2019 on month to month basis. Constructed index clearly depicts the level of active management of exchange market pressures by the central bank of Pakistan. Study also reveals that Pakistan has exhausted around USD 112 billion to provide market support in order to keep exchange parity at some prescribed level. However, the policy failed miserably as support of billions of dollars has yielded management of exchange rate by only Rs. 35.92. Dollars exhausted in failed attempt to manage exchange rate are higher than total external debt of the country. Study also reveals that policy makers have blatantly used borrowed dollars to provide market support.

Another interesting finding of the study is that, had policy makers not attempted to manage exchange rate, the current parity level would have been around Rs. 177.43 per dollar – which is only Rs. 35.92 higher than the prevailing exchange rate of Rs. 141.51 per dollar. Study found that management of exchange market pressures and keeping parity at desired level is so deep in the mindset of the policy makers, that they keep on exhausting foreign exchange reserves in such attempt until the time country ran out of reserves. This is the time, country approach international financial institutions like IMF for a possible bailout package – which generally requires months to assessment of request. To create a buffer for the period of

assessment of request at IMF and to improve the negotiation power through improved reserve level, government starts purchasing foreign exchange from the market. It is the time where, government not only allows exchange markets to make corrections in the parity but also lead to overshooting of parity due to heavy buying by the government.

Study concluded that central bank's intervention approach failed to control exchange market pressures for Pakistan. Every effort to do so, resulted in exhausting reserves and overshooting of exchange rate. Study also found that to keep exchange parity in check, central bank needs to continuously bridge the supply demand gap of the exchange market. As soon as, central bank decides to refrain from bridging such gap, parity corrects itself through market forces. Study also concluded that, for the longer run, it is a loss-loss situation for the country – as billions of dollars spent only succeeded to manage exchange parity of Rs. 35.92.

Analysis of last three bailout requests to IMF reveals that Pakistan has aggressively used monetary policy to tackle exchange market pressures - 500 basis point increase in policy rate before 2008 program, 100 basis point increase in policy rate before 2013 program and 650 basis points in policy rate so far before the expected program. However, no effort has been made to assess the effectiveness of the policy. This study is pioneer work on assessment of effectiveness of monetary policy to control exchange market pressures in Pakistan. Study found that monetary policy is effective in controlling exchange market pressures in Pakistan for the shorter run, neutral for the longer run and counter-productive for the medium run. In the light of findings of this study, it is recommended that State Bank of Pakistan should limit the size of its interventions in the market.

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