Monetary Policy Regimes: Exchange Rate and Inflation Dynamics in Pakistan

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ABSTRACT

This study investigates the impact of monetary policy on the dynamic relationship between inflation and exchange rate in Pakistan. The major macroeconomic goals are also considered which stabilize the domestic and external value of the currency and enhance the economic opportunities in the economy; namely openness of the economy, interest rate, inflation, money supply and economic growth. Markov-switching technique of Hamilton (1989) is used for estimation of dynamic relationship among these variables using quarterly data during 1982-Q1 to 2016-Q4. The study compares the relationship dynamics during managed floating exchange rate and floating exchange rate periods. The results clearly indicate the significance of openness of the economy on the exchange rate, as openness increase the value of exchange rate decrease in both managed floating as well as in free floating regimes. All other variables have significant impact on exchange rate during free float regime only. The filtered probability diagram clarified that the exchange rate in Pakistan is more volatile during managed floating regime than free floating regime. For policy makers these results are of relevance as it indicates that the magnitude of impact of various policy indicators shift during the two regimes on the exchange rate is consistently matching with the monetary policy episodes and current account situation in Pakistan.

Keywords: monetary policy, inflation rate, exchange rate.
JEL Classification: E52; E31; F31
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1. Introduction

In early 90s due to currency and financial crisis in many emerging economies, governments moved away from inflexible exchange rate system and adopted flexible exchange rate along with inflation targeting policy. Due to that monetary policy issues related to inflation target and exchange rates received more attention in research. While switching from exchange rate, rigidity was taking place, at the same time many countries were cuddling inflation targeting as a way of conducting monetary policy. The juxtaposition of inflation targeting and flexible rates brought the role of the exchange rate in monetary policy rule; volatility and the relationship between exchange rate changes and inflation became the center of discussion. Increase in the value of currency via sluggish effects of exchange rates conduct in the presence of monetary policy rule hampers the current interest rate, despite the fact that exchange rate is not directly in the policy rule, Taylor (2001). The exchange rate and inflation have important link in the process of monetary policy transmission. As the openness of the emerging markets exposes the economy to foreign shocks in both commodity and financial markets, it introduces additional channels for policy concerns. Since Pakistan’s economy has a considerable degree of openness to foreign trade, the domestic price level cannot remain unaffected to external price shocks i.e. exchange rate changes and variation in import prices. Any appreciation or depreciation of the exchange rate does not only result in significant changes in the prices of imported finished goods but also in imported inputs that affect the cost of the finished goods and services. For controlling inflation in Pakistan, the central bank’s policy instruments namely interest rate, affects the output directly, as well as indirectly and influence the exchange rate behavior. As expected, direct interest channel dampens investment and employment through the high cost of borrowing. However, the indirect channel will reduce the net export demand by appreciating the exchange rate. So there must be a strong setup of possible interrelationship among the interest rate, exchange rate, and inflation rate along with other related variables.

In Pakistan managed /dirty floating exchange rate system monetary policy focused and gave more attention to maintain currency value. However, the other related variables which were responsible for economic stability became more volatile such as inflation rate, interest rate and money supply growth. Due to high inflation and interest rates there was discouragement for investors. That reduced GDP growth and increased unemployment rate. On the other hand, more reliance on imports and reduction in exports created a negative impact on the value of currency, which resulted in continuous devaluation during 80s and 90s. That process continued till May, 2002. When all caps were removed from exchange rate control, monetary policy became more active in achieving macroeconomic goals via inflation targeting and used interest rate as monetary rule. Which not only controlled the excess money supply but also reduced the uncertainty for investors and savers. Now economy is reliant more on market forces as compared to the policy discretion. For the achievement of sustainable economic growth, price stability is the main tool that depends on efficient information mechanism. Inflation targeting is a monetary policy approach for achieving and sustaining price stability. New Zealand is the trend setter in
adopting inflation targeting regime which is then followed by different emerging economies from Asia, Latin America and Central Europe.

Pakistan has similar major macroeconomic goals as that of any developed country. Which includes stabilizing the value of currency and enhancing economic growth with high employment rate. Khalid (2005) focused on inflation targeting as a policy choice opted by emerging economies and compared their experiences with Pakistan. Husain (2006) founded that Pakistan’s economy features did not match with fixed exchange rate regime and suggested flexibility of exchange rate expected to improve economic performance of Pakistan. Malik (2007) estimated the monetary policy reaction function and concluded that output gap, budget deficit, inflation, foreign reserves, lagged interest rate, foreign interest rate, trade deficit and exchange rate were significant instrument of monetary policy in Pakistan. Trade deficit had significant impact on the policy action. Conversely, empirical literatures did not consider it as a policy objective. Hanif (2014) evaluated the making and conduct of monetary policy and identified that inflation, budget deficit, money supply, prices of import goods, and expected inflation played an important role in generating inflation while real income growth and openness influenced the inflation downward. It supported the strength of monetary policy controlling inflation and stabilized the exchange rate in Pakistan.

Recent phenomenon of pressure and serious uncertainty on the value of Pakistan’s currency results in higher inflation rate and widening position of fiscal deficit. In addition to this, imports are increasing and exports are declining in recent years. This creates pressure on exchange rate expectation as there is a need to understand the linkages between various policy channels, either it is rationally built, or it is a bandwagon expectation kick in (Husain, 2017). No empirical study has attempted in Pakistan to capture and compare the two exchange rate regime through non-linear dynamic process. This study uses the Markov regime switching model to explain monetary policy regimes, exchange rate, and inflation dynamics in Pakistan during managed floating and free floating eras. The rest of the paper is organized such that section 2 discusses the literature review. The data description and econometric methodology is given in section 3 followed by discussion of results in section 4. The summary and concluding remarks is provided in section 5.

2. Monetary Policy in Pakistan

Monetary policy in Pakistan impacts aggregate demand and maintains macroeconomic stability and growth sustainability of the economy. Main objectives of monetary policy are to maintain stability in financial markets and prices in Pakistan by using interest rate and money supply as instruments. Moderate level of inflation is prerequisite for sustainable growth and generation of employment. It condenses uncertainty about future and enhances the confidence of business community as well as consumers. State Bank of Pakistan is responsible for monetary policy and gives signals to the economy through the changes in policy rate to impact aggregate demand. SBP used broad money M2 as intermediate target, which is composed of M1, the time deposits, and the RFC deposits. Both the indirect (credit ceilings, credit / deposit ratio, fix margin requirements and the control of the rate of return) and the direct instruments (the 3-day repo rate, Treasury bills auction rate, OMO, reserve requirements, liquidity ratio) are used by SBP for achieving monetary policy goals.
During the fixed and managed exchange rate regimes, the aggregate money supply was an endogenous variable and was not directly controlled by SBP. It only controlled the volume of credit as a base of monetary expansion. However, when the rate of domestic credit creation deviated from the changes in money demand it created an equivalent change in net foreign assets and created surplus or deficit in the balance of payments account. The transmission mechanism of monetary policy through which changes in policy affect inflation and the GDP. In Pakistan this mechanism works with five channels. In 1990s, due to financial globalization the importance of interest rate as monetary policy instrument has increased in Pakistan. However, Ahmed et al (2005) found the importance of credit and interest rate channels in monetary transmission in Pakistan and Aleem (2005) found the importance of exchange rate channel. After May 1999, State Bank of Pakistan has been following a market determined exchange rate regime. Sporadically SBP intervenes in foreign exchange market to suppress unnecessary fluctuations, but does not try to maintain exchange rate at certain level. The intention to intervene in foreign exchange market is optimistic, just to encounter the activities of informal sector such as alternative remittance systems, informal value transfer systems or informal funds transfer systems (Hundi and Hawala in Pakistan).

Monetary rules have been based on the behavior of monetary instruments. But due to large capital flows (via formal and informal ways) with financial innovations and more sensitive stock markets, rules based monetary policy has become more difficult to implement in Pakistan. However, the continuous inflation targeting approach keeps the monetary policy effective, rational, clear, and trustworthy. If this inflation-targeting approach is also supported by fiscal measures, it will help policymakers to maintain low rate of inflation and stabilize output (Khan 2009). In sum, SBP should opt this monetary regime to fulfill its role as guardian of monetary and financial stability in Pakistan.

3. Literature Review

To maintain macroeconomic stability, emerging economies adopted inflation targeting as a major macroeconomic policy. Mishkin and Posen (1998) analyzed the experience targeting monetary policy regime in UK, Germany, Canada and New Zealand and concluded that inflation target successfully increase the transparency of monetary policy making and achieved this target without hurting the economy’s growth. Leiderman and Bar-Or (2000) analyzed Israel’s inflation targeting policies and their role in the disinflation process in the 1990s., their estimation indicated that the overall pass-through might have remained unchanged in that episode, there has been an increase in the contemporaneous exchange rate coefficient, and a decrease in the lagged one. As a result the size of exchange rate shifts was so large that it prompted quicker price responses than that of before. Their result also provided support to the policy strategy of focusing on achieving the inflation target and allowing for market determination of the nominal exchange rate, with no intervention in the foreign exchange market (unless this market was not operating in an orderly fashion). Zettlemeyer (2000) checked the impact response of exchange rates to monetary policy shocks in floating exchange rate regime in Australia, Canada and New Zealand. Evidence supported conformist view about the directional impact of interest rates on exchange rates during stable and unstable time periods of the economy. Muco et al (2004)
examined monetary policy of Albania throughout the transition period and working of real variables. They concluded that monetary policy credibility and transparency increased after the adoption of formal inflation targeting but such type of moves should be adopted when condition of the economy is appropriate for it. Edward (2006) examined the relationship between exchange rate and inflation targeting in two advanced and five emerging economies. He found that pass-through declined from the exchange rate changes to inflation after the adoption of inflation target and floating exchange rate regime. This also increased the degree of volatility of exchange rates and evidence supported the role of volatility on monetary policy rule. Mishkin and Schmidt-Hebbel (2007) empirically verified that inflation targeting helps countries to maintain lower rate of inflation rate as compared to non-inflation targeting where inflation is very high and volatile. Walsh (2009) found that after the adoption of inflation targeting monetary policy, mean inflation along with inflation variance reduced in each country but not in the non-inflation targeting adopted countries. Roger (2010) examined impact of the price shock during 2006 and 2008 on inflation targeting and non-inflation targeting countries. His conclusion supported the findings of Mishkin and Schmidt-Hebbel (2007) and Roger (2010).

Audzei and Brazdik (2012) examined the role of exchange rate as either stabilizing or destabilizing the economy. They observed that the exchange rate shock was not harmful for the Czech Republic which was different from the other related studies. Ayubu (2013) studied the role of money supply in creating variations in inflation. He study found that inflation in Tanzania effected by the other real variables of the economy as compared to monetary variable. Ivrendi and Yildirim (2013) empirically evaluated that tight monetary policy shocks influence the major macroeconomic variables in emerging economies named BRICS_T. It appreciated the value of domestic currency of all member countries, with lowering the value of monetary aggregates and interest rates. Furthermore, they found that tighten monetary policy shock reduced output in Russia, India, China and South Africa but not in Brazil and Turkey. Carvalho and Nechio (2015) evaluated the impact of altered rules of monetary policy on real exchange rate dynamics under a sticky-price model. Results showed that the source of interest rate perseverance was crucial for policy inertia and persistence shock. Monetary authority concentrated on different particulars of the interest rate rule helped in identifying the impacts on transmission mechanism and the associated implications for real exchange rate subtleties. Ebeke and Azangue (2015) investigated the effects of the adoption of inflation targeting on the choice of exchange rate regime in emerging markets, subject to certain macroeconomic conditions. They used a large sample size of emerging markets and found that inflation targeting countries on average had a relatively more flexible exchange rate regime than other markets. Nonetheless, the flexibility of the exchange rate regime showed strong heterogeneity among inflation targeting countries that depended on their degree of openness and exposure to foreign exchange risks. They also found that the marginal effect of inflation target adoption on the exchange rate flexibility increased with the duration of the inflation target regime in place, and with the propensity scores to adopt it. Kumo (2015) investigated the impact of inflation targeting monetary policy and inflation volatility on economic growth in South Asia. His finding was supporting the previous research work and found strong negative correlation between economic growth and inflation instability during the pre-inflation monetary policy regime but not in the inflation targeting monetary policy regime. In sum, inflation targeting countries are in better position as compare to non-inflation targeting countries in abating the impact of external and internal shocks.
4. Data Description and Econometric Methodology

4.1. Data

The main objective of this study is to explore exchange rate dynamics and its fundamentals. This study uses six variables; exchange rate ($\epsilon$) as dependent variable, which takes the value of US dollar in terms of Pak Rupee. Three months money market rate, used as interest rate (r). Broad money (M2) used as money supply. For trade balance / net export (NX), first the unit value of import and export indices were obtained, then import index from export index was subtracted. Following this, net export (NX) was obtained. Consumer price index is used as inflation rate ($\pi$). Lastly, for GDP (y) of Pakistan, quarterly data from 1982Q1 to 2003Q2 were obtained from Arby and Kemal (2004) and by following their technique the series for the remaining period was generated.

The estimation period is from first Quarter of 1982 to fourth Quarter of 2016. Manage/dirty floating period was from 1982-Q1 to 2000-Q2 and free floating exchange rate period was from 2000-Q3 to 2016-Q4. All quarterly data were obtained from IMF’s International Financial Statistics (IFS), except for money supply (M2) and GDP, M2 was obtained from Statistical Bulletin of State Bank of Pakistan and quarterly data of GDP was generated from Arby and Kemal (2004). All variables are transformed into logarithmic form except net export (NX) and then the changes of logs were multiplied by 100 to demonstrate the variables in percentage.

Figure 1
4.2. Econometric Model

After the adoption of flexible exchange rate system, since that era, efforts to elucidate the behavior of exchange rates received more attention in research. Although majority remained ineffective. Meese and Rogoff (1983) Meese and Rose (1991), Chinn and Meese (1995), Cheung et al. (2004), workings disclosed the weaknesses of exchange rate both in structural and in time series models. Due to that the use of Markov switching Regime model was introduced giving quite encouraging results. Engle and Hamilton, explorer of this technique, provided evidence that Markov Switching model of exchange rates outperforms the random walk.

Engel and Hamilton (1990), supported the application of Markov switching model which observes changes in the exchange rate dynamics between regimes. This model also performs well in-sample and out-of-sample periods for exchange rate series. Engel (1994) recommended this model that earns higher direction of change forecasts. The success of this model to exchange rate dynamics is also testified by Bollen et al (2000), Dewachter (2001), Cheung and Erlandsson (2005), Lee and Yoon (2013), Wu (2015) and Saji (2017). Marsh (2000), however, showed that Markov switching models for exchange rates are unstable over time and not suitable for forecasting.

Gray (1996) developed generalized regime-switching (GRS) model of the short term interest rate. This rate showed a different degree of mean reversion and a different form of conditional heteroskedasticity in each regime. This GRS model revealed that when interest rates are high (and volatile) strong mean reversion exists, while as when interest rates are moderate, the short rate follows a random walk. Cheung and Erlandsson (2005) empirically tested the presence of Markov switching dynamics in three exchange rates’ monthly and quarterly data. Evidence
supported the existence of Markov switching dynamic in monthly but not in quarterly data series. They also suggested that frequency of data and sample size are influential to decide the number of regimes. Bergman and Hansoon (2005) supported the existence of two states Markov switching model by using out of sample forecasting behavior as an indicator. Their study found that the mean varies between both the states, single regime and Markov regime random walk models. Goutte and Zou (2011) checked the possibility that exchange rates follow the regimes switching in the real world, when economy is taking off, occurring of financial crisis. Their results highlighted the significance of exchange rate dynamic between two regimes. Kumah (2011) illustrated exchange market pressure as a nonlinear Markov-switching model and its dynamics related to money growth and inflation. Results identified exchange market pressure and approved superiority of the model. In the presence of appreciation pressure, expansionary monetary policy may not be effective particularly when uncovered interest parity determined exchange rate as compare to purchasing power parity and thus aggravate the price instability. Khemiri, R. and Ali, M. S. B. (2013) used FTP and TVTP of Markov switching methodologies to examine the relationship between inflation and Pass-through level. Results supported the existence of transition probabilities in both the both cases. Lee and Yoon (2013) examined the holding of purchasing power parity sometimes in the full sample period by applying Markov Regime Switching Model. They found strong evidence about the existence of PPP in various time periods during the 100 years of sample period also that there exists stationary regimes that holds PPP. Wu (2015) examined the existence of Markov switching model with real interest rate differential model in the exchange rates of Asia-Pacific countries. Evidence supported the existence of two regimes and the nonlinear relationship between exchange rate instability and its fundamentals. Performance of MSM-RID-TVTP model was better than MSM-RID-FTP model. Saji (2017) tried to discover the establishment of currency union among BRICS countries by approaching Markov switching model. He compared the regime switching behavior of real exchange rate markets of member countries pre and post formation of BRICS. He concluded that effective policy interaction among the member countries, provide a chance of strong currency union.

This paper analyzed the disconnected qualities of exchange rate for following reasons; firstly, exchange rate performs in a different way when sudden changes are occurred in different periods, secondly the Markov-switching modelling approach imposes a simple structure on the exchange rate process within any given regime, with a power to fitting the previous statistics by allowing regimes to change, and thirdly, this methodology has been modified by the patterns of exchange rate for Pakistan that have switched from managed/dirty floating to free floating exchange rate. This model permits the changes in mean and variance, for multiple break and detects outliers in time series. The monetary fundamental-based exchange rate model, Frenkel (1976), explain the relationship between exchange rate and its fundamentals. The Markov Switching Model basically originated by Goldfeld and Quandt (1973), but disseminated by Hamilton’s (1989) research paper about business cycle dynamics. This model States that the resultant change in variables between two periods is an unsystematic draw from one of two scatterings. Which scattering is suitable depends on an undetected state variable.

Regime Probabilities:
The first order Markov assumption requires that the probabilities of being in a regime depend on the previous state,

\[ P \{ s_t = j | s_{t-1} = i \} = P_{ij} \]

Assumed that these are time invariant so that \( P_{ij} (t) = P_{ij} \) for all \( t \)

This can be written in matrix form

Let’s define a simple constant only model with two states:

\[ Y_t = \kappa_s + \epsilon_t \]

Where

\[ \kappa_s = \kappa_1 \text{ if } s = 1 \]
\[ \kappa_s = \kappa_2 \text{ if } s = 2 \]

No certainty about the current state, but probability can be estimated. Transition probabilities are estimated: \( P_{ij} \). Probability of being in state \( j \) in the current period given that the process was in state \( i \) in the previous period.

Now obtain the matrix with the transition probabilities:

\[
\begin{pmatrix}
P_{11} & P_{12} \\
P_{21} & P_{22}
\end{pmatrix}
\]

Where:

\[ p_{11} + p_{12} = 1 \]
\[ p_{21} + p_{22} = 1 \]

This study is also concerned about the expected duration for each state and execute examination to compare parameters between states.

The model can be written as:

\[ Y_t = \kappa_{st} + \chi_t \alpha + \kappa_t \beta_s + \epsilon_{s,t} \]

Where:

\( Y_t : \) Dependent variable  \\
\( \kappa_{st} : \) State-dependent intercept  \\
\( \chi_t : \) Vector of exogenous Variables with state invariant coefficients \( \alpha \)  \\
\( \kappa_t : \) Vector of exogenous Variables with state-dependent coefficients \( \beta_s \)  \\
\( \epsilon_{s,t} \sim \text{iid } N(0; \sigma_s^2) \)

To investigate the relationship exchange rate and its fundamentals, the considered equation is given by:

\[ \Delta E_t = \alpha_{sj} + \beta_{1s} \Delta r_t + \beta_{2s} \Delta m2_t + \beta_{3s} \Delta NX_t + \beta_{4s} \Delta \pi_t + \beta_{5s} \Delta y_t + \epsilon_{ts} \]
Where:
\[
\Delta e_t = log e_t - log e_{t-1},
\]
\[
\Delta r_t = log r_t - log r_{t-1},
\]
\[
\Delta m2_t = log m2_t - log m2_{t-1},
\]
\[
\Delta NX_t = NX_t - NX_{t-1}
\]
\[
\Delta \pi_t = log \pi_t - log \pi_{t-1}
\]
\[
\Delta y_t = log y_t - log y_{t-1}
\]

This study lets each coefficient to switch. All coefficients \(\alpha_s, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \epsilon_t\) relay on the state variable which may take the values 1 or 2. The switching condition between these states are difficult to predict. By using this model present study find out the probabilities of regimes change.

5. Estimation and Discussion of Results

Descriptive statistics results describe basic features of the data distinguished from inferential statistics. Some measures that are commonly used to describe a data set are measures of central tendency and measures of variability or dispersion. Measures of central tendency are the mean, median and mode. Measures of variability or dispersion are standard deviation, variance, the minimum and maximum variables, kurtosis, skewness and Jarque Bera.

Table 1: Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>(\Delta e)</th>
<th>(\Delta r)</th>
<th>(\Delta m2)</th>
<th>NX</th>
<th>(\Delta \pi)</th>
<th>(\Delta y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-1.64</td>
<td>0.39</td>
<td>-3.40</td>
<td>-0.06</td>
<td>1.93</td>
<td>-505.14</td>
</tr>
<tr>
<td>Median</td>
<td>-1.07</td>
<td>0.00</td>
<td>-3.34</td>
<td>0.03</td>
<td>1.75</td>
<td>-509.22</td>
</tr>
<tr>
<td>Maximum</td>
<td>5.17</td>
<td>102.9</td>
<td>0.88</td>
<td>30.0</td>
<td>7.64</td>
<td>-416.29</td>
</tr>
<tr>
<td>Minimum</td>
<td>-11.16</td>
<td>-86.3</td>
<td>-9.77</td>
<td>-28.33</td>
<td>-1.31</td>
<td>-565.13</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>2.56</td>
<td>24.9</td>
<td>1.88</td>
<td>4.56</td>
<td>1.36</td>
<td>37.82</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1.26</td>
<td>0.76</td>
<td>-0.45</td>
<td>0.59</td>
<td>0.97</td>
<td>0.41</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>5.44</td>
<td>7.14</td>
<td>3.65</td>
<td>26.02</td>
<td>5.72</td>
<td>2.11</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>70.95</td>
<td>111.8</td>
<td>7.09</td>
<td>3054.11</td>
<td>64.14</td>
<td>8.39</td>
</tr>
<tr>
<td>Probability</td>
<td>0.00</td>
<td>0.00</td>
<td>0.03</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
</tr>
</tbody>
</table>

The data used in empirical section of the paper is in the first difference form because the data was not stationary at level as shown in table 2. Unit root test result shows that out of six variables series only two series, inflation rate and GDP growth rate, are stationary at level I(0) and remaining four series, change in log of exchange rate, change in log of interest rate, change in log of M2 and net export become stationary at first difference I(1).

Table 2: ADF Unit Root Test Results
Stationarity of all variables’ series is the pre-requisites for the application of Markov Switching regime model. Results are presented in Table 3. This model permits the value of currency to switch from one regime to another regime. One regime is conforming a high volatility period and other one a low volatility period.

Table 3: Markov Switching Estimation Results

<table>
<thead>
<tr>
<th>Regime 1</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>z-statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_1$</td>
<td>0.003</td>
<td>0.006</td>
<td>0.493</td>
<td>0.621</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>-0.061</td>
<td>0.069</td>
<td>-0.885</td>
<td>0.376</td>
</tr>
<tr>
<td>$\beta_3$</td>
<td>-0.067</td>
<td>0.022</td>
<td>-3.047</td>
<td>0.002</td>
</tr>
<tr>
<td>$\beta_4$</td>
<td>-0.103</td>
<td>0.099</td>
<td>-1.033</td>
<td>0.301</td>
</tr>
<tr>
<td>$\beta_5$</td>
<td>-0.006</td>
<td>0.003</td>
<td>-1.752</td>
<td>0.079</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>-3.589</td>
<td>1.554</td>
<td>-2.309</td>
<td>0.020</td>
</tr>
<tr>
<td>Log Sigma Variance</td>
<td>-0.072</td>
<td>0.103</td>
<td>-0.698</td>
<td>0.485</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>State 2</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>z-statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_1$</td>
<td>0.036</td>
<td>0.019</td>
<td>1.938</td>
<td>0.052</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>-0.667</td>
<td>0.286</td>
<td>-2.334</td>
<td>0.019</td>
</tr>
<tr>
<td>$\beta_3$</td>
<td>-0.480</td>
<td>0.133</td>
<td>-3.599</td>
<td>0.000</td>
</tr>
<tr>
<td>$\beta_4$</td>
<td>-0.988</td>
<td>0.015</td>
<td>-2.652</td>
<td>0.008</td>
</tr>
<tr>
<td>$\beta_5$</td>
<td>-0.048</td>
<td>0.372</td>
<td>-3.137</td>
<td>0.001</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>-28.188</td>
<td>8.054</td>
<td>-3.499</td>
<td>0.000</td>
</tr>
<tr>
<td>Log Sigma Variance</td>
<td>0.930</td>
<td>0.133</td>
<td>6.970</td>
<td>0.000</td>
</tr>
</tbody>
</table>

| AIC | 4.168937 | Log likelihood | -271.66 |
Estimated results of Markov Switching Models are showing that the variance and intercept coefficients are significantly different between two regimes. In regime 1, variance is 0.847 which is lower than the regime 2 variance 8.511. The intercept coefficient (mean value) is lower in regime 1, as compared to regime 2. This suggests that the exchange rates anticipate a downward trend about 3.6 percent quarterly in the regime 1 and 28.2 percent quarterly in the regime 2. The coefficients of the parameters are different in the two regimes with sizeable deviations, but their signs remain same. In regime 1 the coefficients of net export and GDP growth rate are significant but coefficients of interest rate, M2 and inflation rate are not significant. On the other hand, all coefficients of the covariates are significant in regime 2.

The results show that the interest rate and money supply affect the exchange rate only in regime 2. They are statistically insignificant in regime 1 may be due to a shift of monetary policy from inflation targeting to interest rate targeting. The regime episodes (shown in figure 3) almost match to the monetary policy regimes in Pakistan. In regime 1 the monetary policy tool was comparatively relaxed as compared to regime 2 where we observed tight monetary policy and monetary rule was interest rate. The impact of net export is negative and statistically significant in both regimes, however the magnitude is reasonably stronger in regime 2 than in 1. The time line of the impact can be linked to the current account status in Pakistan’s economy. During the regime 2 the current account was under the severe deficit pressure and the policy maker in the central bank were intervening in the foreign exchange market to alter the exchange rate to improve the current account balance. Moreover, the results indicate that the impact of inflation rate and real GDP growth rate do not affect the real exchange rate in regime 1, however the impact is negative and highly significant in the 2 regime. The time duration (indicated in figure 3) for the regime 2 shows that during this episode the Central Bank policy was using the inflation targeting policy. In summary, the results show that the magnitude of impact of various policy indicators shift during the two regimes on the exchange rate is consistently matching with the monetary policy episodes and current account situation in Pakistan.

Table 4: The Transition Matrix

<table>
<thead>
<tr>
<th>Constant Transition Probabilities:</th>
<th>Regime 1</th>
<th>Regime 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regime 1</td>
<td>0.828</td>
<td>0.172</td>
</tr>
<tr>
<td>Regime 2</td>
<td>0.380</td>
<td>0.619</td>
</tr>
</tbody>
</table>

| Constant Expected Durations:      |
Table 4 represents that probabilities of remaining in the current states are 0.828 and 0.619. This means the expected durations of the states are between 2.629 and 5.816 quarters. The probability at time (t), given that the economy was in the same state at time (t-1), is $\rho = 0.828$. The probability in (t), given that the economy was in the same regime at time (t-1) is low at 0.619, which is quite lower than $\rho$. These probabilities are indicating that if economy is in dirty floating exchange rate regime or in free floating regime, it is unlikely to remain in that regime:

$$\rho_{11} + \rho_{12} = 1,$$ same as $$\rho_{21} + \rho_{22} = 1$$

Expected durations values represent that variation occurred in regime 1, which is high, after almost 6 quarters as compare to in regime 2 which is low, where changes occurred only after 2.6 quarters. Thus, the expected duration of each state remains persistent during the course of sample period. The greater the transition probability in regime 1, the lengthier the expected duration for the same state. On the other hand, relative low transition probability of regime 2, keep the lower expected duration in second regime.

Figure 3  Smoothed Regime Probabilities

<table>
<thead>
<tr>
<th>Regime 1</th>
<th>Regime 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.816</td>
<td>2.629</td>
</tr>
</tbody>
</table>
Figure 3 shows the regime 1 smoothed probabilities of Markov Switching Model and the currency volatilities of the Pak Rupee in against of Dollar. The evidence is consistent with the fluctuations of currency. When the probability of being in regime 1 is near or equal to 1, Pak Rupee tends to appreciate against the US dollar. Contrary, when the probability of being in regime 1 is near to or equal to zero, Pak Rupee tends to depreciate against the US dollar.

The important finding of this study is capturing frequent changes observed from low to high value of Pakistani currency during managed floating period, particularly during later period after which we switched to free float exchange rate during 2000. These changes were observed during 1982 when managed floating system was adopted after the revision of exchange rate policy and 20 percent devaluation of Pakistani rupee occurred. During fiscal year 1985 there was a huge decline in exports which was below the 21% of its target and almost 12% decline in worker remittances. On the other hand, imports were increased by 3.7% and debt servicing was about 11.3% of total exports which created a 58% increase in current account deficit followed by a severe reduction in foreign reserves and net capital inflow. As a result downfall of the value of Pakistani rupee drastically. After 1986-89 huge capital inflow maintained stability in exchange rate, but after that it created structural imbalances especially in the external sector account. During 1988 Pakistan’s government signed two agreements with IMF (Extended fund facility) and World Bank (structural adjustment loan) for rescheduling of $160 million. The conditions were imposed to devalue currency, liberalize imports, deregulation in interest rate structure and reduction of tariff. The jump observed during 1993 was due to rupee convertibility on current account and maintenance of residential foreign currency account as a result huge devaluation of Pak rupee was observed. During that period curl virus attack on cotton crops not only collapsed the agriculture sector but also hampered the growth of industrial and export sectors. The instability observed during 1995-2000 was due to slow economic growth. Untimely and inappropriate implementation of financial reforms weakened the economic condition. Although monetary management was reformed and changed to market based system (OMO), credit ceiling were abolished, caps on interest rate removed and multiple exchange rate system was altered to unified exchange rate system and then exchange rate was integrated with monetary policy. During 1998 atomic explosion and freeze of foreign currency account associated with economic sanctions from the donor countries, discouraged overseas Pakistanis and they were sending their remittances through informal channels instead of proper banking sector reflected in sharp decline in foreign reserves and other related factors contributing to huge demand for repayments pushed the value of currency downward. Although free floating exchange rate system was adopted in 2000, but after 9th September, 2001 the heavy inflow of worker remittances via banking sector and appreciation of Pak rupee took place. Later during 2002-2007 war against terrorism helped military regime in many ways. The rescheduling of $ 12.5 billion and external loan of $ 1.5 billion relaxed the government from charges of debt servicing, arrival of $1billion to 1.5 billion grants after lifting sanctions and written off external debt relieved the military regime from any economic crisis, massive inflow of worker remittances during these periods improved the balance of payment position and also the economic growth rate. However, after 2008 the military government maintained value of currency drastically declined and again created the problem of foreign exchange shortage with the arrears of rental power projects. Situation continued till 2013 and again enormous depreciation of domestic currency was occurred after PPP government.
6. Summary and Concluding Remarks

This study investigates the empirical impact of monetary policy on the dynamic relationship between inflation and exchange rate in Pakistan. The major macroeconomic goals are also considered which stabilize the domestic and external value of the currency and enhance the economic opportunities in the economy; namely openness of the economy that is net exports, interest rate, inflation, money supply and economic growth. Markov-switching technique of Hamilton (1989) is used for estimation of dynamic relationship among these variables using quarterly data during 1982-Q1 to 2016-Q4. The study compares the relationship dynamics during managed floating exchange rate and floating exchange rate periods. The results clearly indicate the significance of openness of the economy on the exchange rate, as openness increase the value of exchange rate decrease in both managed floating as well as in free floating regimes. All other variables have significant impact on exchange rate during free float regime only. The filtered probability diagram clarified that the exchange rate in Pakistan is more volatile during managed floating regime than free floating regime. The expected durations values indicate that variation occurred in regime 1, which is high, after almost 6 quarters as compared to in regime 2 which is low, where changes occurred only after 2.6 quarters. Thus, the expected duration of each regime remains persistent during the course of sample period. The results show that the magnitude of impact of various policy indicators shift during the two regimes on the exchange rate is consistently matching with the monetary policy episodes and current account situation in Pakistan. For policy makers transition from low to large and large to low volatility regimes will be of immense interest in assessing the overall economic scenarios in the economy.

References


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