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Delving into the Ramifications of Pakistan's Monetary Policy during the Different Phases of Business Cycle

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Abstract: This study is an inquiry of the issue which in previous years is being discussed in the developed economies at various levels and crucial implications have been drawn from the results of those discussions. That issue is "regime switching", regarding business cycle fluctuations and its relationship with the monetary policy. This study empirically investigated whether monetary policy in Pakistan has equal impact during recessions and expansions or different and if the impact of monetary policy during different times is different than in which times, monetary policy is more effective? A non-linear framework has been employed to study the business cycle. Two state Markov-switching regime model is used to identify the recessions and expansions. After the successful identification of two regimes in case of Pakistan it has also been witnessed that monetary policy has much larger effects during recessions than expansions. Another interesting finding from the empirical investigation has revealed that expansions are expected to stay longer than recessions in Pakistan's business cycle. Financial accelerator may be announced as the reason of asymmetry. Hence, financial sector and its stability is crucial for Pakistan's economy along-with the good mix of fiscal and monetary policies in order to supplement one another in case of ineffectiveness of one policy in a specific regime.

Keywords: Monetary Policy, Markov-Switching Regime, Business Cycle, Monetary Policy Shock, Regime Probabilities.

INTRODUCTION

After going through few crises in the past, a debate got much attention that whether the effect of monetary policy is same in different regimes? As it is still unclear that whether monetary policy is less effective or more during the recessions and expansions, there are bright chances that monetary policy might behave asymmetrically during different times. As far as literature is concerned, mixed results are found. Movement of some macroeconomic variables might behave in an asymmetric manner across the business cycle, this discussion was started few years ago. Famous theory economists like Mitchell and Keynes have also supported this concept. Despite of development of this concept in macroeconomic field, researchers have mostly used linear mechanisms,

in both empirical and theoretical modelling. In the studies of shocks or responses of shocks, linear adjustment means that responses are symmetric and continuous as well. Whereas the situation/ response might not be that simple/ linear or symmetric.

A wide range of nonlinear models of different types have been seen being employed in the recent past and have got much importance in the time series econometrics especially when dealing with the economic, financial, or socioeconomic analysis. As it is obvious that linear models are unable to capture the impact of many insights of the variables/ series or results. If we are dealing with the financial series, then we can expect the unobserved high volatility of some series. Likewise, and most importantly asymmetric behavior of business cycles is not captured by the linear models, as they capture only linear, continuous, and symmetric part.

Among these various nonlinear models, a well-known model was introduced by Hamilton. Hamilton argued that there is "accumulated evidence that departures from linearity are an important feature of many key macro series". As Hamilton was convinced that many macro series are non-linear in nature, so he presented and applied "Two-Regime Markov-Switching Model with endogenous structural breaks to analyze the behavior of Gross Domestic Product (GDP) data". The findings of Hamilton were interesting as the results obtained from the estimations of his model were exactly the same as shown by the National Bureau of Economic Research (NBER). The turning points of the Recessions and Booms of both NBER and Hamilton model were same.

After the successful empirical findings of Hamilton, this model was widely used by the economists in various fields of applied economics. Bekdache (1999) and (Garcia & Perron, 1996) empirically investigated the behavior of Real Interest Rate using Markov-Switching Model. Diebold and Rudebusch (1996) and (Kim & Nelson, 1999) used the same model to empirically test the dynamic factor models in business cycles. Engel and Hamilton (1990) employed the said model to define the long swings in exchange rates. Ravn and Sola (1999) inquired the variables which can affect the transition variables of the models. Pagan and Schwert (1990) employed this to explain the conditional stock volatility in stock returns. The afore-mentioned studies are among those studies which were conducted following the Hamilton

In this study, we have also followed Hamilton and have employed his model to examine the asymmetric effects of monetary policy of Pakistan. Once the existence of two-regimes was proved in this study (in the case of Pakistan), we further investigated that whether the effect of monetary policy is same during recession and expansion periods or there is asymmetric effect. For this purpose, an extended model has been employed in this study which contains a measure of monetary policy shock as suggested by (Garcia & Schaller, 2002).

Results of our study have indicated the existence of two-regimes in the case of Pakistan's economy and the results of extended model used in this study has clearly evidenced the asymmetric effects of monetary policy of Pakistan over the business cycle i.e., effect of monetary policy is not same during the recessions and expansions. Results of our study imply that money supply shocks have larger effects during recessionary periods than expansions. Most interestingly transition probabilities indicate that time span of recessions is shorter as compared to the expansions.

Findings of this discussion can play a vital role in policy making and eventually it can be proved as stabilizing policy moreover, this information can help in improving the models which are used to examine it. These types of categorical results might provide better understanding and insights of the variables and their behavior during different times and eventually a better policymakers would be able to form a better stabilizing policy to stabilize the economy and to handle the recessions in a better manner.

REVIEW OF LITERATURE

Yang and Hamori (2014) assessed spill over impacts to some ASEAN stock markets from the monetary policy of the USA as well as excess liquidity, through Markov switching models. Over the last many years, ASEAN stock markets have become more developed and experienced integration with global capital markets. Nevertheless, most ASEAN countries are developing economies, and owing to the fact that they bear the characteristics of small open economies, ASEAN stock markets are more vulnerable to fluctuations in the monetary policies of the USA. Economic theory talks about an association between performance of the stock market, and information. On the basis of univariate Markov switching models, the presence of two separate regimes has been confirmed for both,

stock markets as well as monetary policy of the USA. Interest rates in the USA have been found to adversely affect the chosen ASEAN stock markets while the economy experiences expansion, by employing multivariate Markov-switching models. This sort of impact cannot be seen during periods of economic crisis. Results showed that only during periods of tranquility, the ASEAN stock markets are affected by spill over impacts from influences of monetary policy in the USA. This leads to important consequences in terms of asset price related transmission mechanisms, for instance the trade channel, balance sheet channel and credit channel. As globalization takes place and financial markets around the globe experience integration, other markets are affected owing to shocks from markets that are developed, such as the USA through different transmission mechanisms such as trade channel, credit channel and balance sheet channel.

Owyang and Ramey (2004) measured monetary policy through application of regime switching methods. Structural factors as well as policy preferences have been parametrically specified to be independent Markov processes. Two processes are identified by the interacting of preference parameters with structural parameters within policy rule. Policy episodes started by switching towards dove regimes have been uncovered by the estimates. The monetary policy's real effects are implied by these episodes which are smaller compared to the ones discovered in other studies. Starting with a study by (Hamilton, 1989), related to the dynamics of business cycles, it has been proven that regime switching methods are very useful in financial as well as macroeconomic applications. It is also extremely useful for measuring monetary policy, as policy is mostly thought of in terms of variations among regimes that have weak or strong anti-inflation postures. An exploratory study was conducted regarding regime switching use for the purpose of estimation in terms of preferences of monetary policy. The strategy is avoidance of theoretical details through adoption of a stylized model with respect to determination of policy capturing the trade-offs between inflation and unemployment in a simple manner. This allows estimation issues to be resolved simply, and these results can be considered as the first assessment in terms of how useful regime switching is for the measurement of monetary policy. The policy parameter's posterior anticipated values find episodes that involve switching for two years to dove regime, after which movement was made again towards the hawk regime. Monetary tightening may be considered as best response to the dove shocks experienced earlier. The policy episodes that were estimated showed that smaller impacts were experienced with respect to real variables compared to what has been discovered in other studies employing various other policy measures. The objectives of policymakers and policy instruments may be used in combination for creation of synthetic analysis that links policy regimes and specific instruments that are useful in implementation of such regimes.

Petursson (2001) examined monetary policy's transmission mechanism, as in how the variation in policy rate of the central bank is transmitted in the country's economy, influencing inflation expectations, rate of inflation and aggregate demand. For the implementation of monetary policy, Iceland's Central Bank must make an assessment of the effects of its decisions as well as the time needed before the economy is impacted. This has more relevance considering that formal inflation target has been adopted by the bank, calling for a monetary policy that is forward looking (Petursson, 2000). This is quite a complicated process, and its effects can fluctuate from time period to time period. However, impacts of Iceland's monetary policy actions as well as time lags prior to the impacts being felt, are in agreement with other countries' experiences. The monetary policy of Iceland is based upon setting of interest rates in terms of transactions carried out with the money market's other financial institutions so that behavior with respect to individuals as well as firms can be affected, and aggregate demand may be made consistent with growth potential while also keeping inflation expectations in line with an inflation target of 2.5% set by the bank. This research work examined the process as well as lags in terms of monetary policy decisions with respect to impacts on the country's economy. Results found that variations in monetary policy made by Iceland's Central Bank are initially transmitted nearly six months later to domestic demand, while the impact is on its peak after twelve months. Initially, inflation is affected by policy after twelve months, while the impact is on its peak nearly eighteen months following a rise in interest rate. However, the real economy remains unaffected by monetary policy in the long run.

Shen et al. (2016) examined China's monetary policy reaction function and two hypotheses were proposed, called the dove regime and the hawk regime hypotheses. The hawk regime says that inflation rate is the main cause of concern for the central bank instead of output, while the dove regime suggests the opposite. These hypotheses were examined by making use of endogenous switching model by (Hu & Schiantarelli, 1998) allowing

threshold index to be created which leads to the sample being divided into low and high price regimes based on growth rates of asset prices and inflation. People's bank of China does not give much value to output, while high coefficient with respect to inflation in terms of a high price regime as well as a low-price regime that are in agreement with hawk regime and dove regime in turn.

Ehrmann et al. (2003) used a combination of Markov-switching as well as structural identifying restrictions with respect to vector auto-regression model. As a result, the impulse response functions that are regime dependent give a summary of information given by the vector auto-regression model together with Markov-switching effects as well as structural identifying assumptions. A set of impulse response functions can be derived characterizing various economic patterns in various regimes. This approach may be applied to a number of different situations, for instance, business cycle regimes were identified by (Ehrmann, 2000) in Germany, while regime dependent analysis was used for the demonstration of the effectiveness of monetary policy during recession.

Ellison and Valla (2001) have found evidence that persistent regimes exist in G7 economies. There is no interpretation regarding individual switching parameters. Impulse response functions that are regime dependent show that there is association between regimes and periods where output is affected by demand shocks.

Moolman (2004) modelled South Africa's business cycle by making use of a Markov Switching model. This model may be employed for estimation of the real GDP growth's data generating process while simultaneously classifying every observation into either low growth regime or high growth regime. Business cycle asymmetries cannot be captured by linear models. As a result, interest has been developed in nonlinear models including the Markov switching regime for business cycle modelling. The Markov Switching model is flexible in that it can allow application of various relationships over phases of business cycle expansion and recession.

Hamilton (1989) proposed an approach that is tractable, for the purpose of modelling regime changes. Auto-regression parameters are taken to be the result of a Markov process of a discrete-state. For instance, mean growth rate with respect to non-stationary series given discrete and occasional shifts. Econometricians usually observe such shifts through drawing of probabilistic inferences regarding their occurrence on the basis of observed series behavior. This research work presented algorithm so that probabilistic inferences could be drawn as nonlinear iterative filter. Estimating population parameters is also possible through the filter by using the maximum likelihood method, providing the basis for forecasts in terms of the series' future values. This technique was empirically applied to USA's real GNP post war, and it was suggested that a recurrent aspect of the business cycle of the USA is a shift from positive to negative rates of growth from one period to another and may be considered as an objective criterion for definition and measurement of economic recessions. Parameter values that have been estimated suggest that a permanent fall in GNP levels by 3% is associated with typical economic recessions.

Lo and Piger (2005) examined regime switching as a reaction to USA's output with respect to monetary policy action. It was found that time variation is statistically significant and substantial corresponding to high response as well as low response regimes. It was then examined whether or not timings with respect to regime shifts was in agreement with three specific examples of asymmetry through modelling of transition probabilities which govern switching processes that are functions with respect to state variables. It was also found that during recessions, policy actions have greater impacts compared to those taken when expansion is taking place. Less evidence was found with respect to asymmetry linked to size as well as direction of policy action.

Medhioub (2015) proposed a Markov switching model with three regimes for the analysis of Tunisian business cycle. Much attention is paid to non-linearities when economic time series are modelled. In the context of this, (Medhioub, 2007, 2010, 2011) provided evidence that asymmetries in Tunisia's business cycle and economic activity can be captured by the Markov switching model. Results have shown that three separate phases of growth rates characterize Tunisia's business cycle: a regime characterized by recession, a regime characterized by moderate growth and a regime characterized by high growth. On the basis of filtered probabilities found by Markov switching models, it was concluded that models characterized by three states show a good out of sample performance in terms of forecasting compared to two state one. Moreover, prior recognition with respect to economic transition linked to a novel phase related to economic cycles, may be taken as sufficient dating

evaluation in terms of economic cycles for presentation of forecasts concerned with fluctuations of real economic activity with Tunisia's industrial production.

Auerbach and Gorodnichenko (2013) addressed an important issue arising from economic events, which is the fiscal multiplier's size, given that an economy is going through recession. Initially, multipliers have been estimated for a lot of OECD countries, instead of the USA only, while also considering state dependence as well as controlling information given by predictions. A previous methodology has also been adapted so that direct projections can be used instead of SVAR approach for the estimation of multipliers, as well as economization of degrees of freedom as well as relaxation of assumptions with respect to SVAR method's impulse response functions. Lastly, responses were estimated not only for output but also for rest of the macroeconomic aggregates. Results show that government purchases related multipliers are higher during periods of recession while controlling government purchases related real time predictions leads to a rise in estimated multipliers with respect to government spending during recessions.

Considering Hamilton's Markov switching model, (Garcia & Schaller, 2002) examined a number of questions including, is the effect of monetary policy the same during expansions as well as recessions? If the economy is going through a recession, does the likelihood of expansion rise as a result of decrease in interest rate? In a given state, is the growth rate affected incrementally by the monetary policy, or is the economy only affected if the monetary policy is powerful enough to cause a state change (a move towards expansion from a recession). In line with models that have finance constraints or sticky prices, changes in interest rates have greater impacts during periods of recession.

Tan and Habibullah (2007) empirically assessed impacts of monetary policy in terms of four ASEAN economies in various states. Asymmetry has been examined by employing nonlinear modelling, which is a relatively famous technique, called the Markov regime switching model by Hamilton. The presence of two regimes has been confirmed in every economy that was studied. In addition, null hypothesis suggesting symmetry was rejected for four economies, while it was confirmed that monetary policy had greater impacts during recessionary periods. Thus, these results show that credit market imperfections have an important role to play with respect to investment behavior of a firm. This also shows that financial accelerator may be relevant mechanism which underscores observed asymmetry.

METHODOLOGY

Markov Switching Regime

The Markov regime switching model is used where we want to cater the probabilistic nature of business cycle fluctuations in which state of the economy is kept as an unobserved variable. The model was initially used by (Hamilton, 1989). Model takes the form as given below:

$$\Delta y_t - \alpha_0 - \alpha_1 S_t = \emptyset_1(\Delta M_{t-1} - \alpha_0 - \alpha_1 S_{t-1}) + \ldots\ldots + \emptyset_r(\Delta y_{t-r} - \alpha_0 - \alpha_1 S_{t-r}) + \varepsilon_t \qquad (1)$$

Where S_t is the state variable, ΔM_t is the growth rate of money supply, and $\alpha_0 + \alpha_1$ are the mean growth rate conditional in state S_t, the parameters $\emptyset_1 \ldots\ldots \emptyset_r$ represent the autoregressive component of money supply and ε_t is the normally distributed error term with mean 0 and variance 1.

In this model, employed in our study, there are two states $(S_t = 0 \text{ and } 1)$. these two states have ability of probabilities of changing from one regime to the other and lies in the matrix as given below:

$$\begin{bmatrix} P_{00} & P_{01} \\ P_{10} & P_{11} \end{bmatrix}$$

Here,

$$P_{ij} = \Pr[S_t = j | S_{t-1} = i], \text{where } \sum_{j=0}^{1} P_{ij} = 1 \text{ for all i.} \qquad (2)$$

The element of the ith row and jth column indicates the P_{ij}, which are the transitional probabilities. Each P_{ij}s, indicates the likelihood of the switching of the economy from the ith state to jth state. For example, P_{10} represents the probability of shifting the economy from state 1 to state 0, if economy is in state 1.

In the case where number of state are two, there will be a 2*1 vector, representing the transition probabilities, $\varphi_{t|t}$, its first element is $P(s_t = 1|m_t)$ where $M_t = (M_{t-1}, m_t)$ and M_{t-1}contains previous values of m_t, given the value $\varphi_{t-1|t-1}$ a forecast of the regime t given the information at t-1 can be shown for the states s_t=1 and 2, presented by $\varphi_{t|t-1}$ van be summed up in a vector shown below:

$$\varphi_{t|t-1}=\begin{bmatrix}P(s_t=1|M_{t-1})\\P(s_t=2|M_{t-1})\end{bmatrix} \quad (3)$$

The probability densities of the interest variable m_t conditional on s_t and m_{t-1} can be shown with a (2*1) vector δ_t as depicted below:

$$\delta_t=\begin{bmatrix}f(m_t|s_t=1,M_{t-1})\\f(m_t|s_t=2,M_{t-1})\end{bmatrix} \quad (4)$$

The joint probability of m_t and s_t is then as given below:

$$f(y_t, s_t=j|\,M_{t-1}) = f(m_t|s_t=j, M_{t-1})P(s_t=j|\,M_{t-1}),\ j = 1, 2. \quad (5)$$

The conditional density of the tth observation will be the sum of these terms over all values of s_t. For a case in which there are two states, it will be as:

$$f(y_t|Y_{t-1}) = \sum_{s_t=1}^{2}\sum_{s_{t-1}=1}^{2} f(y_t|s_t, Y_{t-1}) = \delta'\varphi_{t|t-1} \quad (6)$$

By following this, the output $\varphi_{t|t}$ can be get from the input $\varphi_{t-1|t-1}$.

Hamilton's classical model is consisted of two sections. First part is used to estimate the population parameters along with the joint probability density function of unobserved states whereas the second part uses non-linear filter and smoother which helps to draw probabilistic inferences about the unobserved states.

Estimation Techniques

The maximum likelihood method is used to jointly estimate the transition probabilities and the equation parameters. Likelihood function and estimation maximization methods are used for estimation. The probabilities of the hidden states are estimated in the first step which is called expectation step, probabilities obtained from this step are used to estimate the parameters.

Filtering and Smoothing

After obtaining parameters estimates, next step is to estimate filtering probabilities $P(s_t|\ M_t)$ and smoothed probabilities $P(s_t|\ M_T)$. Filtered probabilities $P(s_t=j\ |M_t)$ are inferences about s_t conditional on information up to time t whereas smoothed probabilities $P(s_t=j\ |\ m_T)$ are inferences about s_t by using all the information available in the sample where t= 1,2, ..., T. These probabilities help us to find out that at which point of time, y_t belongs to which regime.

Extended Model 1: Money Supply Shock Extended Model

Model that closely resembles to the one used by (Garcia & Schaller, 2002) is used in this study to check the effect of a monetary shock irrespective of the state of the economy at that time. Extended model is used to check the effect of shocks to the output growth rate.

To define the monetary policy shocks, methodology is used which was used by (Ammer & Brunner, 1995) etc. According to the model used in our study, monetary policy shocks are the residuals obtained from the money supply equation as given below:

$$\Delta m_t = \gamma_0 + \sum_{i=1}^{n1}\gamma_{1i}\Delta m_{t-i} + \sum_{i=1}^{n2}\gamma_{2i}\Delta y_{t-i} + \sum_{i=1}^{n3}\gamma_{3i}\pi_{t-i} + \sum_{i=1}^{n4}\gamma_{4i}r_{t-i} + \varepsilon_t \quad (7)$$

where,

Δm = M2 money growth rate at time t.

Δy_t = Real GDP growth rate at time t.

π_t = Inflation rate at time t.

r = Difference between the treasury bill rate at time t and $t-1$.

ε_t = Residual.

Estimates of the model are as follows:

$$\Delta y_t - \alpha_0 - \alpha_1 S = \varphi_1(\Delta y_{t-1} - \alpha_0 - \alpha_1 S_{t-1}) + \ldots + \varphi_r(\Delta y_{t-r} - \alpha_0 - \alpha_1 S_{t-r}) + \beta_{0q}\varepsilon_t + \beta_{1q}\varepsilon_{t-1} + \ldots\ldots + \beta_{rq}\varepsilon_{t-r} + \beta_{0q}S_t\varepsilon_t + \beta_{1q}S_{t-1}\varepsilon_{t-1} + \ldots\ldots + \beta_{rq}S_{t-r}\varepsilon_{t-r} + \varepsilon_t \quad (8)$$

The coefficient β_{iq} can be defined as the effect of a 1%-point increase in the monetary shock at time t on the current output if the economy is in recession. While $\beta_{iq} + \beta_{ip}$ measures the effect of a 1%-point increase in the monetary shock on the current output at time t if the economy is in expansion.

In order to test the asymmetry, two hypotheses are tested with several restrictions imposed on β_s.

Hypothesis 1: $\beta_{iq} + \beta_{ip} = 0$

Hypothesis 2: $\beta_{iq} = 0$ i=0,1,2,3 and 4.

Former hypothesis ($\beta_{iq} + \beta_{ip} = 0$) tests the effect of monetary shock on the output growth when the economy is in expansion at time when policy action was taken.

The later hypothesis ($\beta_{iq} = 0$) tests the effect of monetary shock on the output growth when the economy is in recession at time when policy action was taken.

The above-mentioned hypotheses are supposed to be a weak philosophy regarding asymmetry that monetary shocks are supposed to be neutral when economy is in a state of expansion and having a significant effect if economy is in recession.

RESULTS AND DISCUSSIONS

The data used in this research work is based on semi-annual data of Pakistan spanning from 1995 to 2020. Data is taken from various sources which includes WDI, IFS, SBP and Economic Survey of Pakistan. Discount Rate, Money Supply, Real Gross Domestic Product and Inflation are used, all variables are used in growth form.

First of all, descriptive statistics of the variables are estimated which are shown below in the Table 4.1:

Table 4.1: Descriptive statistics

	R	GM2	GRGDP	GINF
Mean	-0.188	0.063	0.020	0.035
Median	0.000	0.065	0.021	0.031
Std. Dev.	1.43	0.021	0.014	0.022
Skewness	-0.265	-0.394	-0.870	1.673
Kurtosis	3.805	2.435	4.161	8.141
Jarque-Bera	1.901	1.923	8.946	76.84
Probability	0.386	0.382	0.011	0.000

The above Table4.1 shows various statistics of our interest variables.

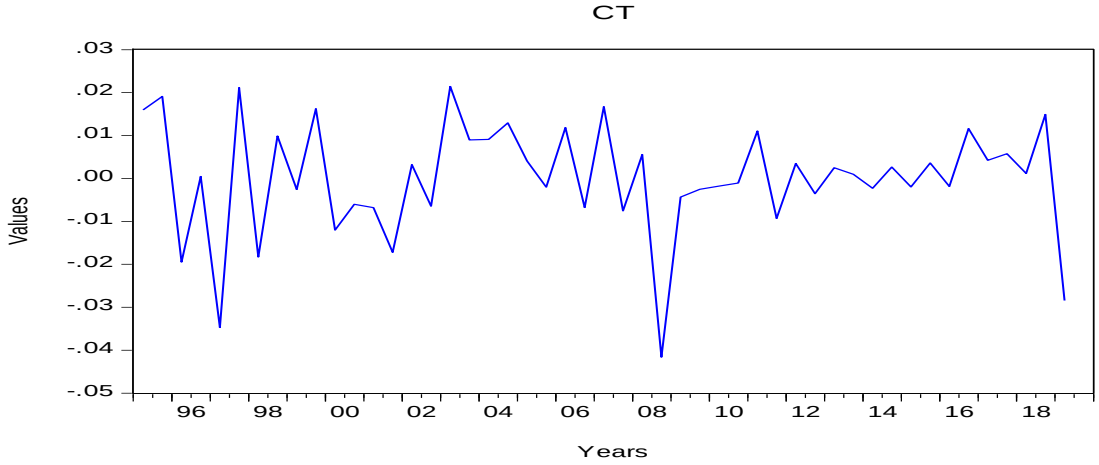

Figure 4.1: Cyclical trend component

Above given Figure 4.1 is the pictorial presentation of the cyclical trend component estimated from the series of Real Gross Domestic Product of Pakistan. HP filter is used to estimate the trend.

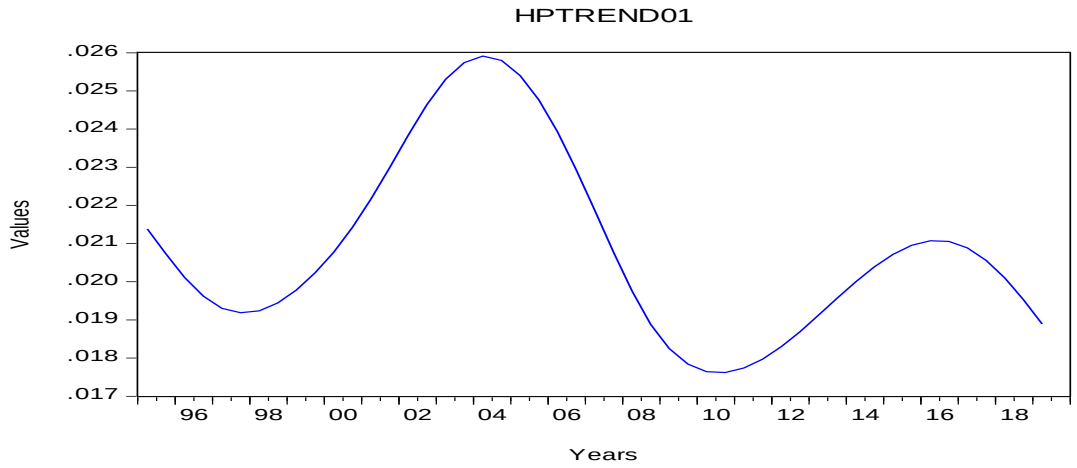

Figure 4.2: HP trend

This Figure 4.2 shows us the HP Tend of the Real Gross Domestic Product series of Pakistan. HP filter is used to estimate the trend of the series.

Following the shock equation, we calculated the monetary policy shock series. Graph is given below:

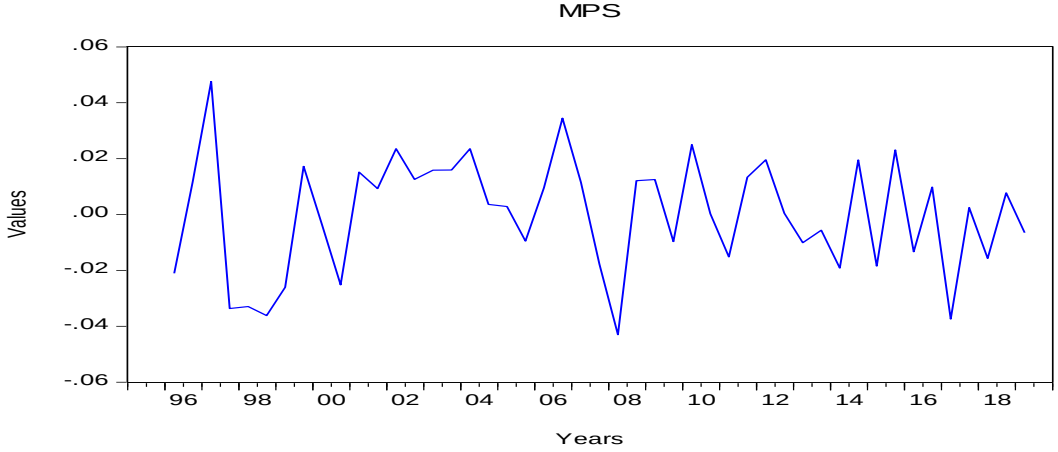

Figure 4.3: Monetary policy shock series

This shock will be used in the output equation in order to assess the impact of monetary policy shock in different phases of business cycle (recession and expansion), which is the main objective of our study.

1.1.1 Business Cycle and Phases of Business Cycle

First of all, to attain the objectives of the study, this study has run the univariate model to the growth rate of output in order to assess the dynamics of output growth to the different phases of business cycle. We have employed two methods to run the univariate model, first is using AR terms in the model and in second specification we have used lagged values of the dependent variable as non-varying regressors.

Table 4.2: Markov switching regime model with AR terms:

	Coefficients	P-values
C1	0.026	0.000
C2	-0.002	0.641
AR1	-0.004	0.975
AR2	0.617	0.000
Sigma	-4.732	0.000
P11	2.605	0.000
P21	0.113	0.918
LR	149.10	--

Table 4.3: Transition probabilities matrix

	1	2
1	0.931	0.068
2	0.528	0.471

Table 4.4: Constant expected durations

1	2
14.536	1.893

The first part of the section shows the outcome of the univariate model of the output growth for Pakistan. The results are separately reported for the expansion and recession periods. Later on, this model will be extended to estimate the effects of monetary policy shocks to the output growth in different phases of business cycle. Table 4.2 shows the results of our first specification. Uni-variate Markov switching regime model applied to the output growth. Results of the study strongly reject the linear model against Markov switching model. By looking at the results, we can observe an interesting finding that regime-dependent means of the model are statistically different. C1 & C2 are the point estimates of the regime-dependent model for the high and low growth regimes, respectively.

The mean value of the high growth regime is 2.6% and is statistically significant at 1% level of significance. While mean value for the low growth regime is -0.2% and this point estimate is not statistically significant. We can see that mean value for the high growth regime is positive whereas mean value for the low growth regime is negative, the reason behind this is that the model distributes the data into two phases, so growing aggregate output and declining aggregate output is shown for the two regimes of the economy. Next, by analyzing P_{ii} we can conclude that the recessions are expected to stay for a shorter period whereas expansions and supposed to continue for a longer period. Transition probabilities indicate that time span of recessions is short as compared to the expansions.

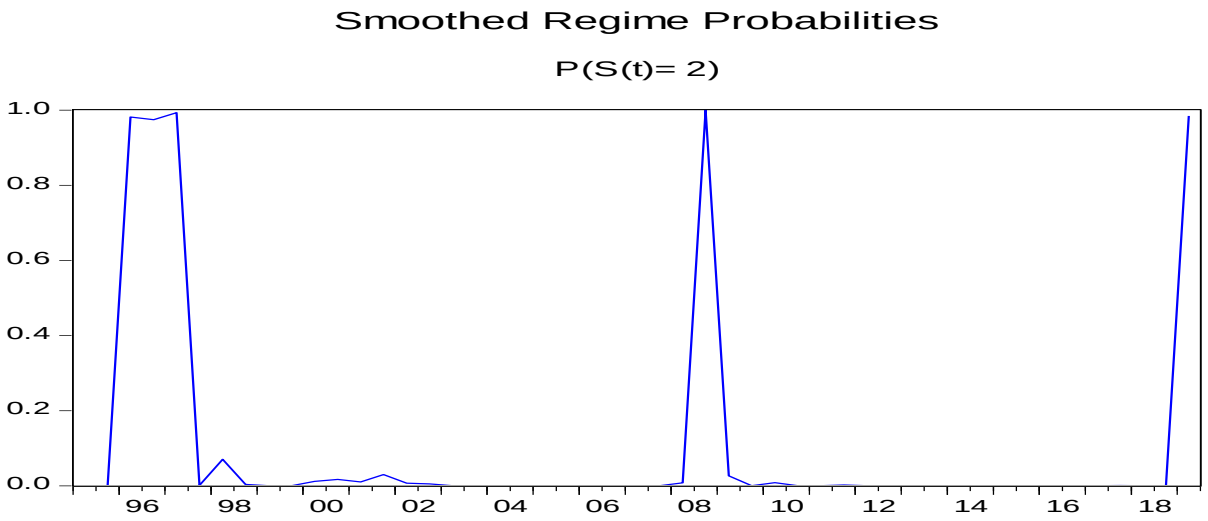

Figure 4.4: Smoothed regime probabilities of the model

Above given Figure 4.4 shows the probability of being in low growth regime. If prob is greater than 0.5 then the economy is supposed to be in a low-growth regime (recession). By analyzing the graph, we can witness the low growth regimes for the Pakistan economy. Low-growth regimes which can be seen in this graph are from 1997 to 1998, from 2008 to 2009 and after 2018. These probabilities are inferred on the basis of Markov-switching regime, and we can witness the good fit of the model.

Low-growth of 1997-1998 can be attributed as economic slow-down, 2008-09 can be attributed as the post financial crises impacts and impact of change of a political regime, and economic slowdown after 2018 is clearly an indicator of the impact of the political regime shift. This date wise indicator model seems exactly similar to the real happenings and can be declared as a good predictor of the business cycle so can be used to capture and analyze the business cycle chronology.

Money Supply Shock Extended Model

Table 4.5: Estimates of the money supply shock (Extended model)

	Coefficients	P-values
C1	0.015	0.000
C2	0.001	0.604
B0q	-0.058	0.201
B1q	0.042	0.324
B2q	0.037	0.425
B3q	-0.206	0.000
B0q + B0p	1.098	0.000
B1q + B1p	0.530	0.000
B2q + B2p	0.774	0.000
B3q + B3p	-0.460	0.000
Theta 1	-0.157	0.052
Theta 2	0.521	0.000
Theta 3	0.027	0.000
Sigma	-5.539	0.000
P11	1.437	0.016
P21	0.328	0.707
LR	161.92	--
A1		--
B1		--
A1=B1	-10.45	0.000

Table 4.6: Transition probabilities matrix

	1	2
1	0.807	0.192
2	0.581	0.418

Table 4.7: Constant expected durations

1	2
5.208	1.719

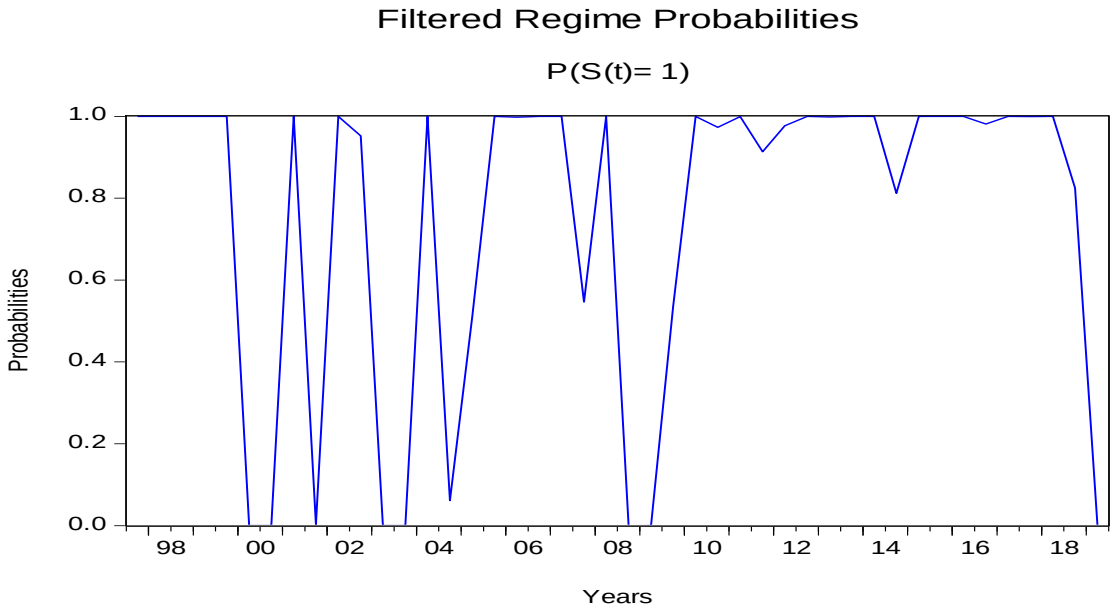

Figure 4.5: Filtered regime probabilities

This model gives us the results of an extended Markov-switching model which is developed to analyze the role of monetary policy variable in different phases of business cycle. This section reports the results of money supply shock on semi-annual output growth during recessions and contractions.

From the Table 4.5 we can observe the magnitudes and directions of B*iqs* & B*ips*, which show the impacts in recession periods for the economy of Pakistan. All the coefficients are positive except third lag and all coefficients are significant at 1% level of significance. This implies that money supply shocks have larger effects during recessionary periods (1995-1997, 2008-2009 and 2018 onwards) than expansions. Moreover, results also suggest that money supply shock has much delayed significant positive impact in recessions than that of expansions. Impact of a 1% monetary policy shock in the first period was 1.098 whereas it suddenly decreases to half (0.530) in the first lag. Overall impact of money supply shocks during recessions account for the size of 1.942. Interesting result is the significance level of the money supply shock, the significance levels remain at 1% level throughout up to the third lag. Cumulative impact of 1.942 is quit a big impact for 3 lags.

Now, coming towards the impact of money supply shock during expansion is also quit astonishing. In general, there is no impact of a monetary policy shock during expansions. We can see in our results that impact of money supply shock is not significant during expansionary periods. Impact of money supply shock during expansions is observed as -0.058, 0.042, 0.037 and -0.206 but all are insignificant except for the third lag which should not be considered as an important figure as it is the third lag and in the first three terms it was not significant, so it does not really matter in fact. Cumulative impact of money supply shock during expansionary periods is -0.185 with insignificant at even 10% level of significance.

POLICY IMPLICATIONS

For a developing economy like Pakistan, we can definitely declare financial accelerator as the relevant execution responsible for the asymmetry found. This implies that it is indispensable to manage financial system of the country. Efficient risk management policies are required in order to mitigate the vulnerabilities of financial sector to the crisis. It means that proper reforms of financial sector are necessity of the time so that financial intermediary practices can be improved. Hence, efficient regulation and supervision of financial sector is crucial to face the crisis and strengthen the economy of Pakistan. Last but not the least, financial liberalization must also be taken care prudently to guard the economy from the bigger risks from the threats which may not be handled by the existing state of economy.

The most important policy suggestion is that a good mix of monetary and fiscal policies is crucial in order to achieve the required targets and sustainable growth as results of this study have already shown that in certain

time periods, monetary policy becomes ineffective, so when monetary policy is ineffective, it is the fiscal policy which can give a support to achieve the required outcomes. So, coordination of monetary and fiscal policy is vital for an economy and its sustainable growth and to achieve its desired targets of other macroeconomic indicators.

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