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VALIDITY OF MCCALLUM RULE IN MONETARY POLICY REACTION FUNCTION: EVIDENCE FROM PAKISTAN.

Dr. Fouzia Jamshaid[1], Sharafat Afzal[2], Dr. Muhammad Masood Anwar[3]

[1] Assistant professor Department of Economics AIOU Islamabad Pakistan:

[2]Applied Economic Research Centre University of Karachi Pakistan. Email:

[3]Department of Economic and management Sciences Women University Bagh Azad Kashmir

Email:[1]fouzia.jamshaid@aiou.edu.pk, [2]Sharafatafzal573@gmail.com

[3]Smasood_ajk@yahoo.com

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ABSTRACT

This article empirically analyzes the operational performance of the McCallum rule in Pakistan's monetary policy framework by applying the auto distributed lag (ARDL) bound testing approach over the period of thirty eight year .The results demonstrate that the positive and significant response of monetary base factor (e.g.as policy instrument) with the potential output, whereas, the negative and significant association with velocity, it indicates that varied monetary base enhance the growth at cost of low inflation rate. Thus, the stable output in case of long run, hence supports the application of McCullum rule by the State Bank of Pakistan (SBP). This study suggests to introduction of additional monetary variable (monetary base) to the rule make it more robust as well as the consistent observe the velocity of monetary base considering the observed volatility of variables during the entire studied period. Furthermore,

[1] Assistant professor Department of Economics AIOU Islamabad Pakistan: Email: fouzia.jamshaid@aiou.edu.pk

[2] (Corresponding Author Applied Economic Research Centre University of Karachi Pakistan. Email: Sharafatafzal573@gmail.com

[3] Assistant Professor Department of Economic and management Sciences Women University Bagh Azad Kashmir Email:Smasood_ajk@yahoo.com

study shows that change the monetary base according to specified rule could be used as an optimal benchmark for State Bank of Pakistan (SBP) policy decision.

JEL classification numbers: E58, E52, C22, O47.

INTRODUCTION

The unending arguments among; academics, market players and policy makers as per whether framework of monetary policy mechanism would relayed on rule rather than discretion. The Policy makers tried to encourage exploration and successive expansion of advancement in model to predicts and decide the probable forthcoming path of transmission mechanism of monetary policy, using expansions in external as well as domestic segments of entire economy.

The rule base monetary policy Supporters judge that, the reliability of monetary policy case doubt without undertaking any identify rule. According to their point of view that policy rule base rises accountability and every aspect of stakeholder policy makers responsible of any deficiency. While, the policy makers agree to follow the rule due to its abundant advantages in ability to communicate with public, hence, their opinion help to facilitates fair judgment about monetary policy objectives.

However, policy makers favor discretion, with this impression that Central Banks unable to handle such a serious and complicated issue of money policy to a simplest instrumental rule. Thus, the policy maker's favor, in worst situation of economy the mixture of rule and discretion both are complementary to each other. It is a big challenge to policy maker to simultaneously follow the rule and discretion in case of policy mix economy. So, here is come to know that not only how to decide on the rule base policy but also check it performance over the time. (McCallum, 1987 and Taylor, 1993) contribute to best rule base monetary policy implication in economy. In 1990s case of united state economy Taylor rule attain more reputation because of its simplicity as well as its outstanding performance. The latter on it reliability diminishing because the policy instrument interest rate use in rule is not appropriate. So, now a days a monetary aggregates targeting is suitable instrument in monetary policy rule instead of conventional rate of interest[4]. McCallum, (1987) used money growth rate to target the inflation rate and gross domestic product.

The prime objective of this rule to adjust the monetary policy according to assessment of actual level of gross domestic product which deviated from its target. For example, if GDP of any country lies below the target level, the Central Bank use the expansionary monetary policy to stimulate the economy to achieve the desire level and vice versa. Whereas, (Taylor, 1993) viewed that Central Banks decrease the nominal rate of interest, if the output and rate of inflation below the target level, on the other hand if output and inflation rate above the desire target level (e.g. Overheated economy) banks increase the nominal interest rate. So, McCullum rule focus on monetary base a policy instrument, whereas, Taylor rule preferred the rate of interest instead of the money growth rate.

[4] See Bernanke and Blinder, 1992

Generally, in content of modern macroeconomic that rule base monetary policy have edge over the discretion to enhance the economic growth and assess the macroeconomic variables performance (Taylor, 1993). (Prescott and Kydland, 1977 and Gordon and Barro, 1983) viewed through influential papers that discretion in monetary policies are time varying. While, if private market players perceived the adverse selection plenty higher inflationary monetary policy, which may be loss of reputation of monetary authority. Otherwise, the independency of Central Banks might be inflationary bias (Wallace and Sargent, 1981, summers and Alesina, 1993, Rogoff, 1985 and Walsh, 1995 amongst other once).

In the content of Pakistan, there is enrich literature available between the relationship of inflation rate and money supply but studies is limited in the case of rule based monetary policy.

Qayyum (2006) highlights that money play significance role to predict the inflation. Chaudhary and Choudhary (2006) and Hussain, (2020) stated that inflation comes from outsource rather than monetary phenomenon. Khan and Schimmelpfennig (2006) and Awan, H. M., Hayat, S., & Faiz, R. (2018) find that in long run money comes inflation while, in short run the government prices plays a significant role. Omer and Saqib (2009) and Malik, M. F., Rasheed, R., & Ishaq, M. N. (2020) identifies invalidity of quantity theory of money in Pakistan as with inconstant velocity. Agha et al (2005) and Iftekhar, U., Mamoon, D., & HASSAN, M. S. (2016). explain that the interest rate channel along with assets price and credit channel are active in case of Pakistan, whereas Khan and Qayyum (2007) and Bordo, M. D., & Landon-Lane, J. (2013) indicates that rate of exchange channel and shocks of supply side play an important role compared to demand side shocks. For the role base monetary policy, to our entire knowledge, only two studies available that, constructed on simulation analysis, propose adoption of rule, (e.g. Malik and Ahmad 2010, and Tariq 2010). However, studies interest rate as intermediate monetary policy instrument with assumption of backward looking behavior of monetary policy. Moreover, the rate of inflation and output gap are taken as targeted macroeconomic indicators. Malik (2007) and Choudhri, E. U., Jan, A., & Malik, H. (2015) categorizes, however, entire five basic objectives stabilized output, smoothing of inflation, and management of rate of exchange, smoothening of rate of interest, and attain trade balance of monetary policy objectives in Pakistan. However, it is only positive analysis and there is need of normative analysis for further research.

Therefore, it is essential to known that the State Bank of Pakistan may or not has been follows the simple rule base monetary policy for the simple cause that in history of Pakistan has experienced cycles in inflation and economic growth. In year of 1974, pre financial reform the inflation rate touch its peak of 23 percent while in 2002 reached its lowest level of 2.4 percent post financial innovation. Correspondingly, the economic growth rate 1.7 percent in 1995 which is lowest level while it reach the peak level 8.6 percent in 2005 (see appendix).

In case of Pakistan Malik and Ahmed (2010) has been estimated the Taylor rule but McCallum rule with the monetary base as a policy intermediate target, has not been estimated However, since monetary targeting is still in trend in Pakistan, Omer and Saqib (2009) and Shafiq, H., & MALIK, W. S. (2021) stated that State Bank of Pakistan used monetary targeting as a policy instrument to predict the inflation and output. So, it would not be out of place to think that McCallum rule is suitable for Pakistan. This study is, therefore, an attempt to examine the relevance of McCallum rule to the State Bank of Pakistan (SBP) as transmission mechanism of monetary policy framework5. This paper organizes in follows sections; Section 2 describes the theoretical review of McCallum rule in Pakistan. Section 3 explains the data description and methodological framework. While the Section 4 discussion of the empirics and results. The last segment summarizes the key conclusions and further research gap.

Theoretical Review of McCallum Rule

McCallum (1987, 1993) put his viewed that the central banks adopt the rule in formulation of monetary policy. He further suggested that main objective of Central banks to target the nominal growth rate of gross domestic product (GDP) with the help of monetary base as an intermediate policy instrument. The mathematical representation of proposed rule as follows;

$$\Delta mb_t = \Delta y_t^p - \Delta vmb_t + \partial(\Delta y_{t-1}^p - \Delta y_{t-1}) \quad (1)$$

Whereas, mb mean the monetary base, vmb is the average velocity of monetary base, Δy_t^p represent the potential level of growth rate in long run, ∂ indicate factor that adjust the monetary components and Δ shows the difference term of these indicators. Each variable in this equation in logarithms form.

The McCallum opinion for, equation (1) that monetary base affected by the change of expected level of output growth rate and velocity of growth rate of money, which comes from the effect of advancement in money supply .He applied the stagey to forecasting the future path of velocity of monetary base to stabilize the inflation which comes possibly from the money demand shocks. Shuzhang (2010) examined that the neutrality of monetary policy in long run exist, if the velocity of money stable and growth rate of output shows at desire rate, then inflationary trend goes downward. In this scenario the monetary policy of any central bank derived from the growth rate of monetary base. The growth rate of money supply adjusted by central banks due to the response of either the deviation of output or the inflation rate from its desired level. So, if the actual GDP growth rate lies below the potential or target level, the central bank used the expansionary growth rate of monetary base, while if the actual growth rate of GDP, above the potential output then contractionary monetary policy strategies is being applied.

McCallum (1988) highlighted some critical requirement about the formulation procedure of equation (1).Firstly, the behaviors of monetary indicators

[5] McCallum used the monetary base as a policy instrument to predict in inflation rate and nominal GDP growth as the target

considered in rule accordingly by the action of central banks. Secondly, the impact of the modernizations in the financial system on the model is adequate. Thirdly, the comparative importance of either the stock of money or rate of interest depends on their comparative impact on the vital goal of monetary policy.

METHODOLOGY AND DATA DESCRIPTION

The equation (1) determine that, if negative output gap, the central banks should be used the construction in monetary base, which diminishing the overheating economy system[6]. Correspondingly, the actual inflation lies above the desired level also point out to reduction in monetary of money supply. Now from equation (1) is as:

$$\Delta mb_t = logmb_t - logmb_{t-1} \quad (2)$$

So, the velocity of monetary base can be retain from the fisher equation as

$$MV = PY \quad (3)$$

Whereas, the right hand side of equation contain the P is the price level (e.g. Consumer price index) and growth rate of gross domestic product, while, the left side contain the money supply as broad money aggregates and velocity of money in market circulation. For V consideration:

$$V = \frac{PY}{M}$$

As given that; $PY = GDP$ (4)

So, the GDP becomes a nominal Gross Domestic Product. So, the equation (4) is become now:

$$V = \frac{GDP}{M} \quad (5)$$

In context of targeting the inflation rate of central banks$\Delta y_t^p$is the sum of long run growth of real Gross Domestic Product as well as the inflation target.

The Boali (2010) modified the equation (1) to avoid the possible description of McCallum rule that only predict the inflation rate in policy reaction function:

$$\Delta mb_t = \Delta y_t^p - \Delta vmb_t + \rho\left(inf_t^p - inf_{t-1}\right) + \partial(\Delta y_{t-1}^p - \Delta y_{t-1}) \quad (6)$$

Where the $inf_t^p$and inf is the actual and targeted inflation rate. The state Bank of Pakistan use inflation targeting strategy in last decade. While Hodrick-

[6] The negative output gap mean if the actual output lies above the desire one, the economy overheated at that situation so, and the state bank of Pakistan used contractionary monetary policy.

Prescott (HP) filter (1997) applied to formulate the Gross Domestic Product growth rate, the gap between the actual and potential growth[7]. The $inf_t^p - inf_{t-1}$ is represented by if_g and $\Delta y_{t-1}^p - \Delta y_{t-1}$is show with the notation of $y_g$the equation rewrite is as follows:

$$\Delta mb_t = \Delta y_t^p - \Delta vmb_t + \rho if_{g,t} + \partial y_{g,t} \quad (7)$$

The analysis used the auto distributed lag (ARDL) model which developed by the (Parren et al 2001) to regress the equation (7). The optimal choice of that model is based on the following attentions. Firstly, this model is applied irrespective of whether the variables level of integration I (0) or I (1) or mix integration. On the other hand it is not requirement of model that data is stationery at level. Secondly, it outcomes show the high and significance results even the sample size is too much small (e.g. it has a small sample property). Third, it provides unbiased estimate of the long-run model as well as valid t-statistics even when some of the regressors are endogenous (Harris and Sollis, 2003). Following Pesaran et al, (2001) the ARDL version of equation (8) becomes:

$$\Delta mb_t = \beta_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta mb_{t-i} + \sum_{i=1}^{p} \alpha_{2i} \Delta Ly_{t-i}^p + \sum_{i=1}^{p} \alpha_{3i} \Delta lvmb_{t-i} + \sum_{i=1}^{p} \alpha_{4i} \Delta if_{g,t-i} + \sum_{i=1}^{p} \alpha_{5i} \Delta y_{g,t-i} + \beta_1 mb_{t-1} + \beta_2 Ly_t^p + \beta_3 lvmb_{t-1} + \rho if_{g,t} + \partial y_{g,t} + \mu_t$$

So, the β_4 and β_5 is replaced by the ρ and ∂ on the above given equation. The general equation of error correction (ECM) model is as follows:

$$\Delta mb_t = \beta_0 + \beta_1 If_{t-1} + \beta_2 Ly_t^p + \beta_3 lvmb_{t-1} + \rho if_{g,t} + \partial y_{g,t} + \beta_4 ECM_{t-1} + \mu_t \quad (9)$$

Table: 1 Summary Statistics of Indicators used in Estimation

	mb	Ly	Inf	vmb
Mean	6.012	4.632	1.669	0.076
Median	6.051	4.631	1.662	0.037
Maximum	6.999	4.759	2.372	0.286
Minimum	5.019	4.476	1.060	0.005
Std. Dev.	0.598	0.081	0.409	0.079
Skewness	-0.015	-0.160	0.169	1.190
Kurtosis	1.812	2.030	1.788	3.325
Jarque-Bera	1.998	1.477	2.242	8.179

[7] Output gape measure as business cycle in case of Pakistan. There is no official data, positive value show boom.

Probability	0.368	0.477	0.325	0.001
Sum	204.54	157.501	56.777	2.587
Sum Sq. Dev.	11.801	0.221	5.537	0.210
Observations	36	36	36	36

Source: Author's calculations from hand book of Statistics, State Bank Bulletin and WDI

The equation (8) estimated in two stages; the null hypothesis indicate that there is no long run relation exist among the variables define through null hypothesis Ho: $\beta_0 = \beta_3 = \partial = \rho = 0$. Against testing of Ho is alternative of H1 not Ho by conducting F-test or Wald. If value of F-Statistics lies above the upper band critical values in (Pesaran et al, 2001), then null hypothesis is rejected, indicating that there is co-integration and vice versa.

Choice of Variables

This study uses the time series data set entire monetary and macroeconomic variables (e.g.; monetary base as broad money supply, gross domestic product, Inflation, and velocity of monetary base over the period of 1980-2018. Data is taken by "Statistical Bulletin, Hand book of Statistics", published by State Bank of Pakistan (SBP). Sectors are selected on the basis of completeness and consistency in data series. Macroeconomics variables such as GDP, Inflation data also available at World Development Indicator (WDI) and IFS CD-ROM and Federal Reserve (FED) Bank.

RESULTS AND DISCUSSIONS OF THIS ANALYSIS

Statistical Properties of Data

Beforehand, estimating econometric regression model, it is essential to check the statistical properties (e.g. summery statistics, correlation and correlation of coefficients).The execution of unit root tests in the (ARDL) procedure is necessary to ensure that none of the variables is integrated at an order of I (2) or beyond. For this purpose, the study uses the conventional Augmented Dicky Fuller (ADF) test. As evident from the results shown in table (1) to (3). In table (1) contain the summary statistics of the given variables, which are used in estimation process. The table 1 shows that there is thirty four observations. The growth rate of monetary base factor mean value is 6.012, while the growth rate of gross domestic product mean value is 4.632 and minimum value of it is 4.473. The log value of growth rate of velocity maximum value is 0.286 and minimum is 0.005, which shows the volatility of variable in entire time span. The table 2 shows the correlation coefficient among the entire variables:

Table 2. Correlation Matrix

	mb	Inf	Ly	Vmb
Mb	1.000	0.995	0.987	-0.906
Inf		1.000	0.973	-0.871

Ly			1.000	-0.921
Vmb				1.000

Note: mb) monetary base as broad money supply, Inf) inflation rate actual and target, Ly) Growth rate of Gross Domestic Product the average volume of prices and real GDP, vmb) is the velocity of money supply, calculated by quantity theory of money.

Source: Author's calculations from hand book of Statistics, State Bank Bulletin and WDI

The coefficients of inflation rate (inf) and gross domestic product (GDP) has positive and highly correlated with monetary base at the values of 0.995 and 0.987 while, the velocity has negatively related at -0.906 respectively. The execution of unit root tests in the (ARDL) procedure is necessary to ensure that none of the variables is integrated at an order of I (2) or beyond (Usman et al., 2021; Shaheen et al., 2022). For this purpose, the study uses the conventional Augmented Dicky Fuller (ADF) test. As evident from the results shown in table (3) that the entire monetary and macroeconomic variables (e.g. monetary base, GDP, inflation rate) are significant at difference while, the velocity of money integrated at level.

Table 3. Unit Root Test

Variables	**ADF test**					
	t-state	P-value	Remarks	t-state	P-value	Remarks
Mb	-0.298	0.914	I(0)	-5.184***	0.000	I(1)
Ly	-1.015	0.375	I(0)	-3.691***	0.009	I(1)
Inf	1.252	0.997	I(0)	-5.192***	0.000	I(1)
Vmb	10.442***	0.000	I(0)	-2.378	0.156	I(1)

Note: t-state or p-value reported the following regression results through ADF-test (**), (*) & (***) indicate significance at 5%, 10% and 1% levels as above given (Ly) Stand for Gross domestic product (inf) mean inflation rate,(mb) mean monetary base of broad money supply and (Vmb) mean velocity of monetary base .

Empirical Results

To conform the reliability of McCallum rule, which demonstrated in equation (8), there is direct relation between the growth rate (GDP) and change in monetary base show that the effects of nominal GDP growth rate on monetary

growth rate are significant only when nominal GDP is above its threshold value i.e. there is boom in business activity[8]. The existence relation directed to as the monetary aggregates response component, which is most essential and important terms in McCallum rule, it is crucial for the stabilization of prices and enhance the output (Shuzhang et al, 2008).therefore, ∂ term represent the difference between the actual and desire growth rate, if the actual growth rate falls below the desire one then the State Bank of Pakistan (SBP) adopted the expansionary monetary policy to close this gap. The positive sign of GDP indicated that economy still has capacity and space to produce goods and services, hence, the signal goes to State Bank of Pakistan that more money (e.g. component of monetary aggregates, money in circulation) needed to improve the productive capacity of entire sectors of economy, which ultimately enhance the output. The result of this positive coefficient authenticates with Koviu et.al (2014) and Sunder.et.al (2012). The table (4) present long run results is as follows:

Table.4: Estimates Long Run through, ARDL (1, 0, 2, 2)

Dependent Variable: mb				
Variables	**Coefficients**	**Std. Error**	**t. Statistics**	**Prob. Values**
$\boldsymbol{\beta_0}$	-6.942	2.149	-3.229***	0.003
$\boldsymbol{\beta_3}$	-1.697	0.382	-4.439***	0.000
$\boldsymbol{\rho}$	0.871	0.079	10.946***	0.000
$\boldsymbol{\partial}$	2.525	0.494	5.102***	0.000

Note: t-state or p-value reported the following regression results through ADF-test (**), (*) & (***) indicate significance at 5%, 10% and 1% levels as above given; (∂) Stand for the coefficient of Gross domestic product, (ρ) is the coefficient of inflation(consumer price index), (β_3) mean velocity of monetary aggregates.

Source: Author's calculations from Handbook, monthly bulletin, and WDI.

In actual principal of McCallum rule, highlights that both actual output and potential level of out gap directly related with monetary base. On another aspect, monetary base response direct and positively associated with output yield in settlement with the mechanisms of the McCallum rule. The inverse association between monetary base and velocity (the second most critical term in the rule) is in line with the principles of the rule as described in equation (08).

McCullum's interpretation is dissimilar the reasonable argument of the monetarists on either constant or a perfect elasticity of velocity (V), as protected in the quantity theory of money (QTM) in the innovative Fisher equation, or the modification of the Cambridge equation by incorporating k, led by A. C. Pigou, to change in supply of money (M), such that as M raises, velocity responds

[8] See Saghir and malik,(2017)

absolutely and proportionally. The following suggestions strongly support the converse association between money supply and velocity as confined in the McCallum rule. The outcomes of this interaction term authenticates Abubakar and Yaaba, (2014), Sun et.al, (2009) and Patra and Kapur, (2012).

While, the rise in supply of money diffidently indicates surplus money in the hands of economic agents(households, organizations and financial institutes), out of which some portion could consume for precautionary, speculative and transaction motive demand of money proposed by Keynes. Therefore, it create hindrance in response of velocity to increase the money supply. According the Keynes arguments that the gap arise from non-proportionate response of velocity or k to changes in money stock, which caused by other factors outside the QTM such as production and trade.

Hussman (2011) stated that expansionary money supply tends to lower short term rate of interest. The fall in rate of interest lead to preference for liquidity, thereby diminishes velocity. Therefore, the changes in monetary base inversely changes in the velocity of money. This is also the basis for the structuralists proposition of the inverse relationship between M and V. The money will lose the direct relationship, with passage of time, with respect to the other components of currency. Hence, the velocity of the money inversely proportional to monetary base.

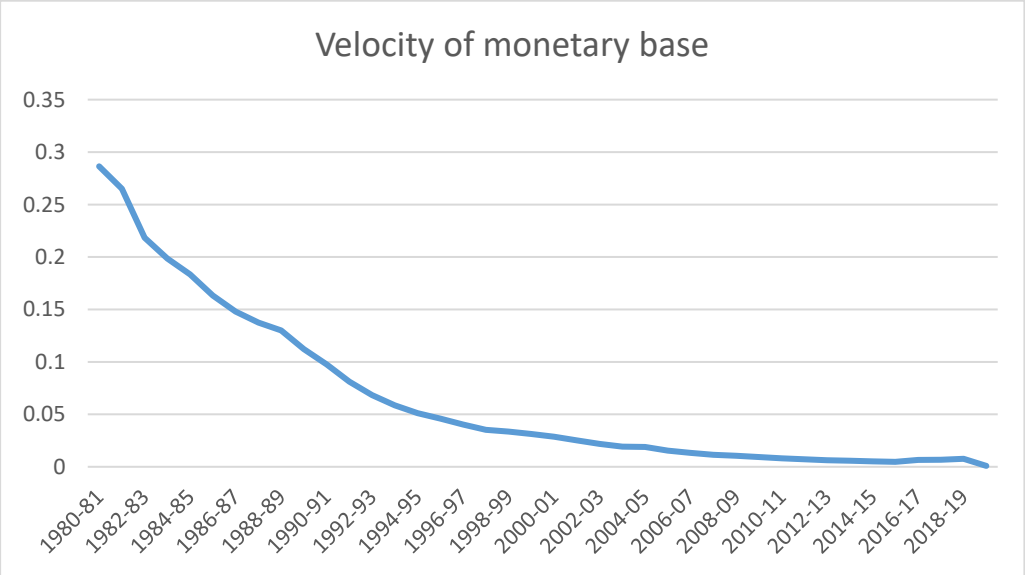
According to the assumption of Quantity theory of money that changes in money base do not alter the velocity or positive effect but does not form part of the building blocks of the McCallum rule. The evidence prove from the equation (8) whereas the velocity of money contain with inverse sign, the results conform to (Saqib and Omer 2009) the velocity of money might not be considered a constant in Pakistan. Our results consistence with the global crisis of US which, started from 1940s. The stock of money in United State raise sharply during the World War, meanwhile, the velocity of money goes downward trend. Correspondingly, both monetary aggregates (e.g. narrow and broad money) increased sharply with opposite velocity in the US after the most recent global financial crisis (Lothian, 2009 and Shahani, 2012).

The opposite coefficient sign of velocity indicate in table (4) strongly supported by Figures 1 and 2, specifies not only that velocity is neither constant nor stable in Pakistan, but varies inversely with money within the studied period. Behind, the reason that when the money supply increase, rate of interest decease, the economic agents hold the huge share of liquid money in their hand, hence which lead to decline the velocity of money. So, this indicate that interest rate sensitive with cash balance, results authenticates with Omer and saqib, (2010).

In case of long run the positive sign of monetary base with output and negative coefficient sign of velocity, enhance the reliability of McCallum rule as policy tool in Pakistan. On the other hand, the direct association between the monetary base mb and ∂ and negative influence of mb with $\beta 1$ which, make good choice of McCallum rule as a monetary policy rule in Pakistan[9].

[9] See McCallum ,(1987a) and McCallum,(2002)

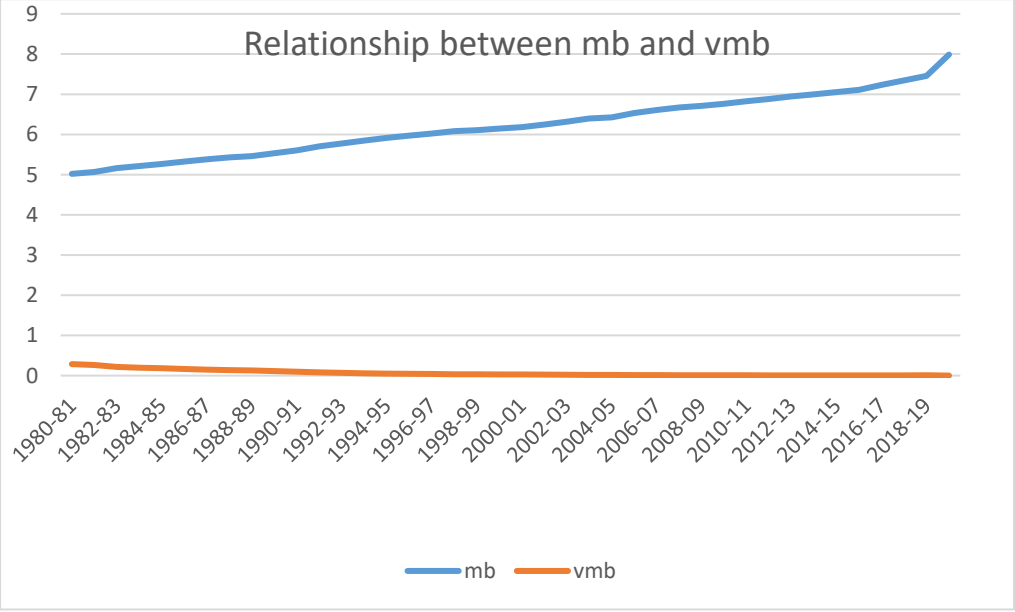
Figure 1. The Velocity of Monetary Base in Pakistan



Source: M_2 is used as monetary base taken from the State Bank of Pakistan Annual reports available on WDI

The author calculated by using the Quantity theory of money given by Fisher.

Figure 2. The Velocity of monetary base and trend of monetary base in Pakistan



Source: M_2 is used as monetary base taken from the State Bank of Pakistan Annual reports available on WDI

The author's calculated by using the Quantity theory of money given by Fisher.

Table.5 Error Correction of Auto Distributed Lag (ARDL) Model

Dependent Variable :Δmb				
Variables	**Coefficients**	**Std. Error**	**t. Statistics**	**Prob. Values**
$\boldsymbol{\beta_1}$	-0.237	0.114	-2.075***	0.004
$\boldsymbol{\beta_2}$	0.962	0.214	4.482***	0.000
$\boldsymbol{\beta_3}$	-3.000	0.530	-5.657***	0.000
$\boldsymbol{\beta_4}$	-0.381	0.108	-3.508***	0.001
$\mathbf{R^2}$	0.996			
D.W	2.1			
F. Value			4.657	0.003

Note: t-state or p-value reported the following regression results through ADF-test (**), (*) & (***) indicate significance at 5%, 10% and 1% levels as above given.β_1) is represent the inflation, .β_2) shows the growth rate of (GDP), β_3) velocity of money and β_4) present the error correction term along with significant and negative values.

The Author's calculation data taken from hand book of statistics, Statistical bulletins and WDI.

Figure 3. The Cumulative Sum of Residual test in Pakistan

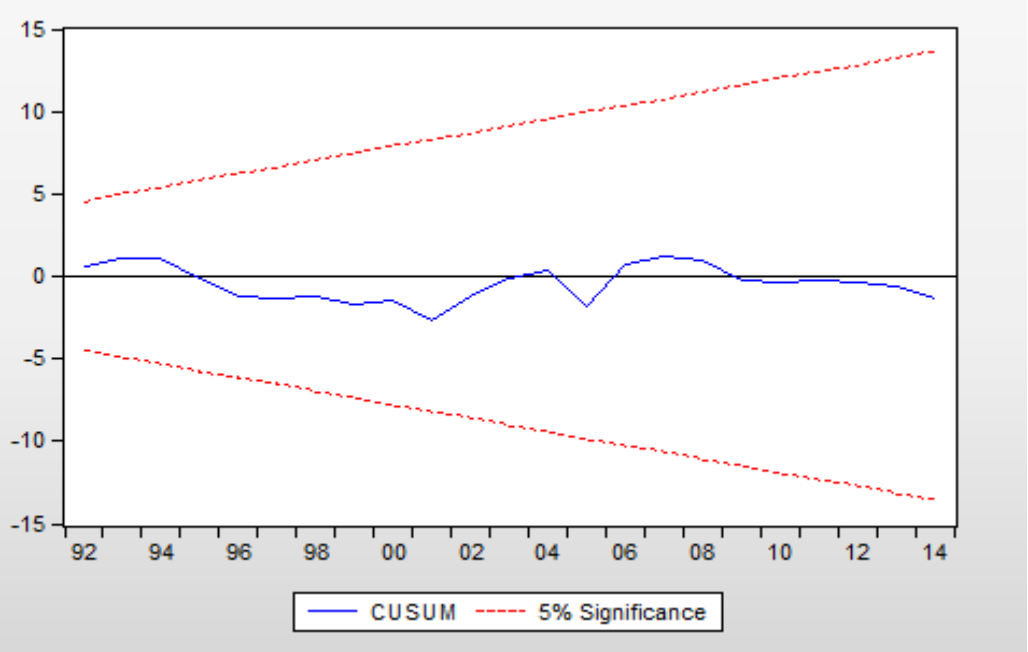
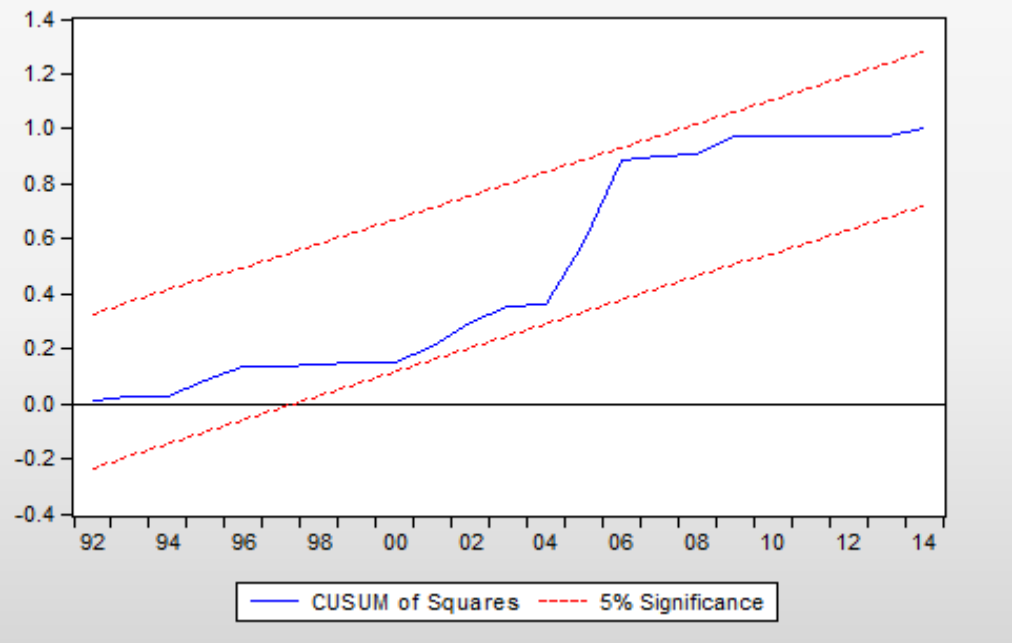


Figure 4. The Cumulative Sum of Squares of Residual test in Pakistan



The State Bank of Pakistan (SBP) inject monetary base (mb) in that manner, which push the output from its equilibrium without disturbing the inflation factor, subsequently, the velocity of monetary base moving its opposite direction. If coefficient of output ∂ is positive, it mean the actual output falls below it potential level, then the State Bank of Pakistan use expansionary monetary policy through increasing the monetary base mb to stimulate the economy. The monetary base mb also positive impact on inflation and velocity falls at any raise in monetary base mb. In general, the State Bank of Pakistan, increase the money supply to attain the desire level of growth rate with positive and significant sign of inflation. The positive term of inflation indicate that actual inflation lies the potential one, increase the monetary base positively and significant impact on inflation rate, which indicate the coefficient of low inflation rate in case of Pakistan economy (Qayyum, 2014 and Hasan, 1988). So, over all the results suggests that McCallum rule play a pivotal role in designing the monetary policy framework of Pakistan. The velocity of circulation also significant and inverse related with the monetary base, that boost the suitability of McCallum rule for Pakistan's economy, that shows all measures to achieve its potentials.

In table 5 coefficient of ECM is negative and statistically significant, provide the inflation of cointirgation among the variables in model (Sung-Hoon and Byoung-Ky, 2008). The ECM shows about the 38 percent disequilibrium is restore on yearly bases.

The generally, to test the stability of equation of the estimated parameters, cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) were used. The parameters of estimated equation are stable, if the sum of whole recursive error term lies within the critical region, between the two lines. Both Figures (3) and (4) indicate that the estimated parameters of the analyzed equation are stable, since the recursive errors lie within the two critical lines of CUSUM and CUSUMSQ tests.

CONCLUSION

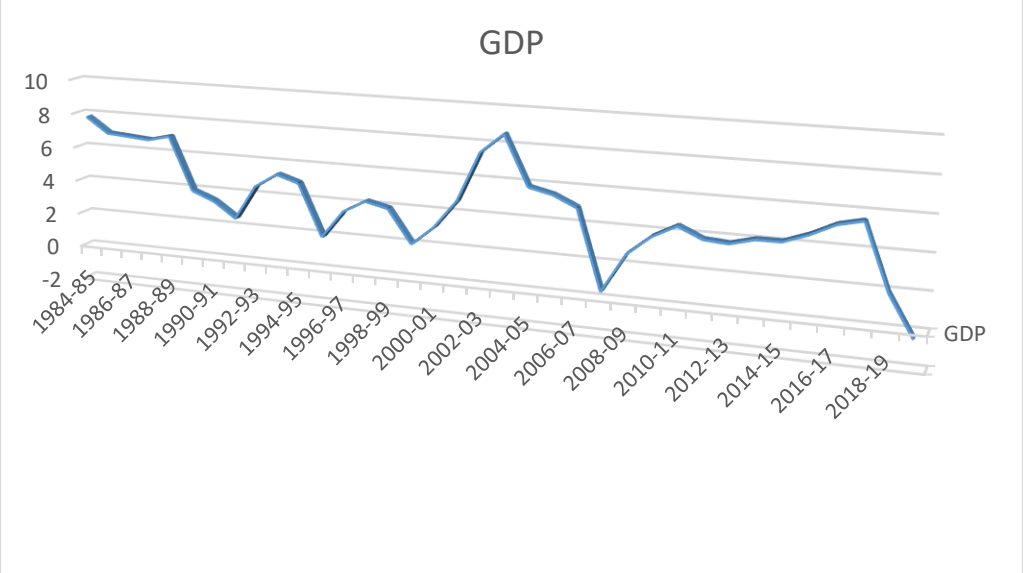
This study investigates the applicability McCullum rule to monetary policy framework in Pakistan? Outcomes of this study reveal that the coefficients of output gap is positive and statistically significant, while the velocity of circulation of the monetary base, is negatively signed and statistically significant in line with the workings of the rule. The potential output and the corresponding output gaps are positively signed, indicate that there is space available to enhance the output, through investment of entire sectors of economy.

Furthermore, the results show that McCallum rule can serve as an optimal monetary policy rule for the Pakistan's monetary policy framework, along with negative velocity and positively signed potential output, it provides promising signal for the possibility of variations in mb to enhance output growth at desirable level of prices, hence guarantees output stability perhaps in the long-run.

Policy implications that come out from this analysis that regulatory authority should closely observe the behavior of macroeconomic indicators through adopted McCullum-Rule to ensure the stability in prices and enhance economic growth more precisely. Furthermore, additional factors can be introduced to the rule. The current structure of the rule relies extremely on mb which is just one of the numerous instruments of monetary policy. Therefore, some other monetary policy variables can be introduced to the rule to make it more robust. Further, more research is needed to this area, through inclusion of entire macroeconomic indicators, which make its results more robust and applicable for policy making.

Appendix

Figure A.1 Growth rate of Gross Domestic Product in Pakistan



Source: Authors calculation from Pakistan Bureau of Statistics

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