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Full Length Research Paper

Forward-looking monetary policy rule and economic stability

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A forward looking monetary policy rule has been estimated for the time period from 1991 to 2010 for Pakistan, an emerging economy. The estimated model explains a very clear shift in monetary policy objective across the sample period. State Bank of Pakistan, from 2000 onwards, seems to take insufficient measures for curtaining inflationary pressure. We also simulate a new Keynesian model to investigate the impact of such monetary policies. We show that policies in near past had a destabilizing effect on economy.

Key words: Monetary policy, forward looking monetary policy rule, generalized method of moments, accommodative monetary policy.

INTRODUCTION

The importance of monetary policy for macroeconomic stabilization is now widely acknowledged in the economic literature (Woodford, 2003; Clarida et al., 1999). In particular, the role of monetary policy in containing inflationary pressure has been of much interest to the economist (Söderlind, 2001; Clarida et al., 2000; Leeper, 1991; Weiss, 1980). Clarida et al. (2000) argue that passive monetary policy can lead to inflation outburst mainly due to self fulfilling changes in expectations about future inflation[1]. Leeper (1991) also argues if central bank fails to follow 'active' monetary policy in countering inflation then it can result in inflation burst. Keeping this literature in view, monetary policy analysis has become one of important part while analyzing economic stability.

Empirical evidences about monetary policy rules and its impact on economic stability is largely available about developed economies especially about United States whereas findings about emerging economies are very rare[2]; therefore, we take Pakistan, an emerging economy, for such analysis. The monetary policy regimes adopted in Pakistan during the last two decades provide a natural setting for testing monetary policy rule and its implication on macroeconomic stability. We also believe the results and insights have relevance to other small emerging economies. This study investigates the role of monetary policy in macroeconomic stability. We do so first by estimating a monetary reaction function and then simulating a baseline New Keynesian close economy macroeconomic model. This study also explores the consistency of monetary policy stances over time, specifically, examining whether or not there has been change in the way monetary policy was conducted across different periods. Another characteristic is the incorporation of forward looking behavior in the monetary policy reaction function which is again not very common for emerging economies.

The paper has been organized as follows: salient features of Pakistan economy in specific reference to the time period under investigation; discussion of

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[1] As individuals assume that the central bank will follow passive policy and a rise in expected inflation will not be countered by increasing reasonable nominal interest rate thus resulting in decrease in short-term real interest rates that will again stimulates the rise in aggregate demand and inflation.

[2] For example, Robitaille (2003) presents analysis for Brazil and Hutchison, Sengupta and Singh (2011) discusses monetary regime switching in India. Both India and Brazil are considered emerging and developing economies according to the International Monetary Fund's World Economic Outlook Report, April 2010.

macroeconomic model that incorporates a forward looking monetary policy rule; estimation results and various robustness checks. The following part of the paper breaks the sample period into two sub-periods and then re-estimates the monetary policy rules for later period to allow for differences in policy objectives of monetary authorities, following changes in the laws governing the state bank of Pakistan. Thereafter, we use the estimated monetary policy rules to simulate the New Keynesian macroeconomic model. Finally, we present conclusions.

SALIENT FEATURES OF PAKISTAN ECONOMY

During the 1990s, Pakistan's economy faced considerable volatility in output growth and inflation. The GDP growth rate was 4.4% during the decade but fluctuated between almost 8% in 1992 to about 4% in the year 2000. In the latter part of the decade, a combination of external and internal shocks – international sanctions following nuclear tests in 1998, military coup in 1999, rising fuel prices, and breakdown of negotiations with IMF – kept the economy under stress. Inflation remained in double digits for many years, reaching 13% in 1995. Inflationary pressures gradually started easing due to aggressive monetary tightening by the State Bank of Pakistan (SBP) after the mid 1990s. By year 2000, inflation declined to 3.6% and output growth leveled off at just below 4%. The hallmark of monetary policy during this period was that real interest rates remained positive for most years and averaged at 2.4% for the decade.

The resumption of US assistance to Pakistan following 9/11 coincided with higher inflows of remittances from Pakistani workers abroad. The remittances more than quadrupled from roughly 1 billion dollars in 1999-2000 to 4.2 billion dollars in 2002 to 2003. The growth rate of real GDP rose from a dismal 2% in 2001 to 9% by the middle of the decade. The relatively lower inflation at the beginning of the decade had set stage for monetary easing. The interest rate on the benchmark 6-month T-bill declined from 10.75% in 2001 to 1.93% in 2003. Inflation started rising. The first significant spike occurred in 2005 when CPI crossed 9%. The State Bank of Pakistan raised interest rates by about 450 basis points between 2004 and 2005. But inflationary pressures continued. Despite another 400 basis points increase in interest rate by 2008, inflation touched 12%, and spiraled out of control in the next year with the headline index crossing 20%. The GDP growth became negative at -1.6% in 2009.

In summary, the State Bank of Pakistan followed a tight monetary policy during the 1990s and was able to achieve price stability by raising real interest rates to counteract inflationary pressures. This, together with favorable external developments, set stage for a strong economic recovery. During the next decade, however, the SBP adopted accommodative monetary policy, which eventually led to very high rates of inflation and GDP actually contracted as result of this crisis.

Using a New Keynesian economics model, Clarida et al. (2000) simulated the impacts of alternative monetary policies for United States. They conclude that accommodative monetary policy could lead to high inflation as experienced, for example, during the pre-Volker era when the Fed followed such a policy. While there have been some similar research related developed countries (Sims and Zha, 2006), applications to emerging economies have been limited to large economies of India (Hutchison et al., 2011) and Brazil (Robitaille, 2003). To the best of our knowledge, the Gali model has not been tested for small emerging economy. Our paper aims to fill this knowledge gap. The monetary policy regimes adopted in Pakistan during the last two decades provide a natural setting for testing Gali's framework. We believe that, as stated earlier, the results and insights have relevance to other small emerging economies.

METHODOLOGICAL FRAMEWORK

It has almost become standard in macroeconomic analysis to use some monetary rule (or policy reaction function) along the lines of seminal work by Taylor (1993). Taylor rule describes the short-term interest rate as a function of current inflation and the output gap.

$$i_t = r^* + \pi_t + 0.5(\pi_t - \pi^*) + 0.5y_t$$

OR

$$i_t = r^* - 0.5\pi^* + 1.5\pi_t + 0.5y_t$$

Where r^* and π^* represent target interest and inflation rates; i_t interest rate, π_t inflation rates and y_t current output gap.

This simple policy reaction function is motivated by "the stated dual objective of many central banks to achieve a sustainable growth in real activity while avoiding inflation" (Bryant et al., 1993). After influential contribution of by Taylor (1993), lot of researchers has contributed in this specific area of monetary economics (Ball, 1999; Clarida et al., 1999; McCallum and Nelson, 1999; Woodford, 2000). This body of literature assumes that central banks make decisions on the basis of past values of economic indicators.

The recognized importance of monetary policy and its impact on economic stability is evidenced from the increasing numbers of publication and conferences related to the same area of knowledge. But in specific context of Pakistan economy, numbers are not very promising. To the best of my knowledge, there is only one study available focused on monetary policy rule (Malik and Ahmad, 2010). Malik and Ahmad (2010) estimated monetary function rule, in context of closed economy. They used backward looking behavior while analyzing monetary policy behavior and use target variable of output gap and inflation. It can be easily argued that monetary policy needs forward looking dimension. Same argument is presented by Kohn (1995) as he argues that "policy makers cannot avoid looking into the future". This argument cannot be substantiated with logic as if policy maker wait for inflationary bomb to explode for taking corrective measures then it will be too late. That is why it is imperative to look into the future by analyzing

the expectations about future and then counteract. In other words, we can safely argue about the importance of forward looking behavior in comparison with backward looking behavior. Therefore, our point of departure is that monetary authorities may also anticipate future economic conditions and react to them. We investigate the Forward Looking Policy Reaction Function where central banks is supposed to broaden their information set and seem to make decisions on the basis of inflation expectation as controlling the future inflation is one of their major objectives (Batini and Haldane, 1999; Batini and Nelson, 2000; Nessen, 1999; Rudebusch and Svensson, 1999). These forward looking models provide basis and analytical framework for inflation targeting, an approach which is greatly discussed in Pakistan and elsewhere (Bernanke and Mishkin, 1997; Svensson, 1997, 1999; Saleem, 2010).

Our methodology consists of two steps. In first step, we estimate forward looking policy reaction function and obtain the coefficients. In the next step, we employ a conventional macroeconomic model and simulate it with various policy parameters which we estimate in first step.

We follow the basic model as well as notation provided by Clarida et al. (2000). Let nominal interest rate target be denoted by r_t^*, where this target rate is determined by the difference between target levels of inflation and output, and their respective actual values.

$$r_t^* = r^* + \beta(E\{\pi_{t,k} \mid \Omega_t\} - \pi^*) + \gamma E\{x_t \mid \Omega_t\} \quad (1)$$

Here, r^* is the desired interest rate if actual level of inflation and output are equal to their target levels. Therefore, target rate is equal to desired interest rate if inflation and output are at target level; otherwise keeping in view their variation desired interest rate will be adjusted. Here, $\pi_{t,k}$ is the inflation rate between 't' and 't + k', x_t is the output gap[3], and Ω_t is the information set at time 't'. Following Clarida et al. (2000), Equation 1 can be expressed as:

$$rr_t^* = rr^* + (\beta - 1)[E\{\pi_{t,k} \mid \Omega_t\} - \pi^*] + \gamma E\{x_t \mid \Omega_t\} \quad (2)$$

$where\ \ rr_t^* = r_t - E(\pi_{t,k} \mid \Omega_t)$, and $rr^* = r^* - \pi^*$. It is also assumed that rr^* is the long run real equilibrium real rate and due to identification problem we assume observed sample average as a measure of rr^*.

In Equation 2, the parameter β represents monetary policy response to inflationary expectations. A value of $\beta > 1$ means that monetary policy counteract inflationary expectations by increasing interest rate more than one-on-one basis. This response will generally result in stabilizing the economy. Alternatively, $\beta < 1$ implies that monetary policy is accommodative; even if there are some tightening by raising interest rates, it is not sufficient to completely counteract the rise in inflationary expectations, which will be de-stabilizing (Clarida et al., 2000). The parameter γ reflects how the monetary authorities react to output gap.

The aforementioned model implies instantaneous adjustment which is not plausible assumption empirically. The literature provides various justifications in favor of partial adjustment[4] known as interest rate smoothing. Sack and Wieland (2000) argues that uncertainty about monetary policy effects on economy encourages policy makers for interest rate smoothing. In other words, it helps to capture the effects of parameter uncertainty in the model. Goodfriend (1991) describes the fear of disruption in financial markets as one of the reason for such phenomenon. Mishkin (1999) views it as a tool for monetary policy credibility. One interesting reason, we also use, for including interest rate smoothing as residual capturing all what is not specified in the model (Castelnuovo, 2002).

$$r_t = \rho(L) r_{t-1} + (1 - \rho) r_t^* \quad (3)$$

Where coefficient ρ describes the degree of interest rate smoothing and $\rho(L)$ is lag polynomial

$$\rho(L) = \rho_1 + \rho_2 L + ... + \rho_n L^{n-1}.$$

After incorporating interest rate smoothing into main model, we can get the following equation[5], which can be estimated econometrically:

$$r_t = \rho(L) r_{t-1} + (1 - \rho)[rr_t^* - (\beta - 1)\pi^* + \beta\pi_{t,k} + \gamma(x_t)] + \varepsilon_t \quad (4)$$

We employ generalized method of moments (GMM) for estimating Equation 4. Gali and Gertler (1999) and Clarida et al. (2000) argued that under rational expectations the error in forecast of 't+1' is uncorrelated with information at 't', so Equation 4 follows that

$$E\left\{\{r_t - (1 - \rho)[rr_t^* - (\beta - 1)\pi^* + \beta\pi_{t,k} + \gamma(x_t)] + \rho(L) r_{t-1}\} Z_t\right\} = 0 \quad (4A)$$

Where Z_t is a vector of instruments which are orthogonal to the inflation surprise. This orthogonality condition provides the reason for using GMM. Also in time series data, GMM seems to provide better results in presence of possible serial correlation and heteroskedasticity (Hansen, 1982; White, 1984; Newey and West,

[3] The difference between potential GDP and actual GDP is known as output gap, that is output gap is Y–Y* where Y is actual GDP (output) and Y* is potential GDP (output). If the output Gap turns out to be a positive number, it is called an inflationary gap thus indicating the growth of aggregate demand is outpacing the growth of aggregate supply and expected to create inflation and vice versa.

[4] Woodford (2001) argues that it will be efficient to use inertial effect while working with forward looking model. He states that "*When the effects of policy depend crucially upon private sector expectations about future policy as well, it is generally optimal for policy to be history-dependent, so that the anticipation of later policy responses can help to achieve the desired effect upon private sector behavior.*" [Woodford, 2001: 15]. Although the possible reasons for occurrence of partial adjustment is out of the scope of the paper but various justifications can be found in the literature, for detail please see Sack and Wieland (2000).

[5] After incorporating interest rates smoothing into reaction function

$$r_t = \rho(L) r_{t-1} + (1 - \rho)[rr_t^* + (\beta - 1)(E\{\pi_{t,k} \mid \Omega_t\} - \pi^*) + \gamma E\{x_t \mid \Omega_t\}] + \nu_t$$

Eliminating the unobserved forecast variables will help us to present above model as follows

$$r_t = \rho(L) r_{t-1} + (1 - \rho)[rr_t^* - (\beta - 1)\pi^* + \beta\pi_{t,k} + \gamma(x_t)] + \varepsilon_t$$

where

$$\varepsilon_t = \nu_t - (1 - \rho)\{\beta(\pi_{t,k} - \underset{t}{E}\,\pi_{t,k} \mid \Omega_t) + \gamma(x_{t,q} - \underset{t}{E}\,x_t \mid \Omega_t)\}$$

1987).

In the second step of our methodology, we intend to investigate the implication of these rules on economic stability. For this purpose, we intend to use the famous New-Keynesian[6] economic model with sticky prices and monopolistic competition. For the sake of simplicity, we use model with close economy perspective thus exchange rate, exports etc have not been incorporated in the model. The scope of this paper does not allow us to go for detailed explanations[7] of such model. Our basic model, after log linearizing around steady state is as follows:

$$\pi_t = \delta E(\pi_{t+1} \mid \Omega_t) + \lambda x_t + z_t \quad (5)$$

Forward-Looking Phillips curve (supply curve)

$$x_t = E(x_{t+1} \mid \Omega_t) - (1/\sigma)(r_t - E\{\pi_{t,1} \mid \Omega_t\}) + g_t \quad (6)\text{-IS}$$

curve (demand curve)

$$r_t^* = r^* + \beta(E\{\pi_{t,1} \mid \Omega_t\} - \pi^*) + \gamma x_t \quad (7)$$

Monetary policy rule

$$r_t = \rho r_{t-1} + (1-\rho) r_t^* \quad (8)$$

Interest rate smoothing

Equation 5 is a forward-looking Phillips curve which also describes the supply side of the economy, also called aggregate supply (AS) curve. This forward looking Philip curve is highlighting the relationship between inflation, gap of economic activity from its potential level and expectations about inflation. So, if economic activity will be higher, higher wages will be paid to labor resulting increase in marginal cost which will ultimately result in rise in inflation. Equation 5 is derived from the behavior of rational entrepreneurs who intend to maximize the profits of monopolistic firms with the help of price rigidity. To incorporate the price rigidity[8] in production function, Calvo prices (Calvo, 1983) are introduced. Here, z_t can be interpreted as supply shocks and having an autoregressive process of order 1.

Equation 6 is derived from consumption Euler equation which also describe demand side of the economy, also known as IS curve. As seen from Equation 6, current output gap can be determined from expected future output gap and ex ante real interest rates. Here, g_t can be interpreted as demand shocks and it follows an AR (1) process.

After representing demand side and supply side equation which represent, respectively, the households sector and firm/production sector, now it is important to include monetary authorities into model so that equilibrium can be attained in output-inflation space.

Equations 7 and 8 are the monetary policy rules with interest rate smoothing function, identical to previous, which we have estimated. The only difference here is that we have restricted our model to forecast horizon of a single period.

This study uses quarterly data from 1991Q1 to 2010Q4. The variables include gross domestic product, inflation rate, Treasury bill rates, money supply (M2), commodity inflation, and REPO rates. The baseline variables are output gap, Treasury bill rates and inflation. Output gap has been constructed by de-trending the de-seasonalised GDP. Quarterly GDP has been taken from Arby[9] (2008). Inflation variable has been constructed from CPI which has been collected from Federal bureau of Statistics. Treasury bill rates have been taken from State bank of Pakistan. The variables selected as instruments are lags of output gap, inflation rate, growth in money supply (M2), and commodity inflation. Another important issue regarding variables is that we maintain the assumption that output gap, growth in money supply, commodity inflation, Treasury bill rate and inflation rate are stationary[10].

ESTIMATION RESULTS

Very first problem researchers are facing in Pakistan is unavailability of Quarterly GDP. There are some techniques available for transforming annual GDP into Quarterly GDP (Lisman and Sandee, 1964; Boot et al., 1967; Fernandez, 1981; Litterman, 1983). It needs to be in mind that none of the earlier mentioned techniques is a substitute of actual compilation of quarterly GDP from original data sources. Arby (2008) has transformed annual GDP into Quarterly GDP but the data set was available until 2004. We have extended the series for remaining years. We need to estimate output gap from GDP data. The literature provide more than one methodology for estimating the output gap, that is de-trending of the seasonally adjusted GDP data, Hodrick-Prescott (HP) filter, and through production function approach. We estimate output gap for our study by de-trending GDP and by using HP filter. First, we adjust GDP series seasonally by introducing dummy variables for seasons and regress it on time trend and name the resulting residual series as LSGAP. Second, we apply HP filter on seasonally adjusted GDP and name the resulting series HPGAP. Our baseline estimation thus major analysis is based on de-trended GDP that is, LSGAP. In Figure 1, these three series have been drawn and we can see that, generally, all series show similar dynamics. As a start, we perform our base line estimation with LSGAP and then for checking robustness of analysis, we use other series as well.

Table 1 reports estimates of parameters of the policy reaction function rule (Equation 4). At a start, target horizon for inflation is taken Quarter one whereas for Output Gap the current value has been taken. Later on,

[6] These types of model can be seen in King and Wolman (1996), Yun (1996), Gali and Monacelli (2005), Monacelli (2005), Woodford (1994), Rotemberg and Woodford (1999) etc

[7] For reasonable detail and explanation, please see Saeed et al (2011) and references therein.

[8] This phenomenon has been discussed at length, please see Bils and Klenow (2004), and Nakmura and Steinsson (2008)

[9] Data in Arby (2008) has been provided until 2003-04, Remaining series has been generated by authors.

[10] Although it is very hard to reject the Null hypothesis of unit root in Inflation and Treasury Bills rates at reasonable significance level. This kind of assumption has been taken in literature, Please see Clarida et al. (1999, 2000)

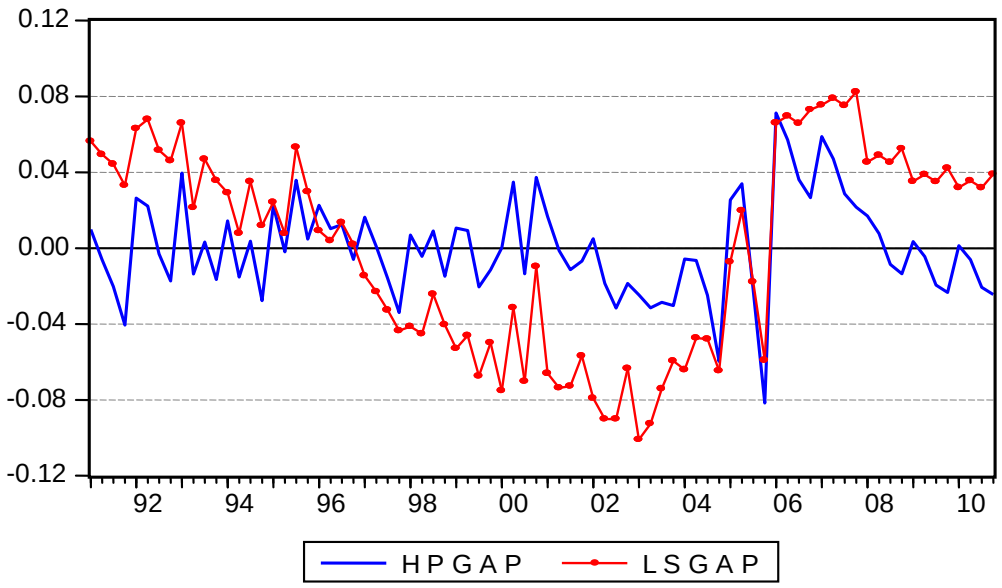

Figure 1. Output gap – Two proxies.

Table 1. Estimation results for the period 1991 to 2010.

Forecast horizon (no. of periods)		ρ	α	β	γ
Inflation = 1, Output gap = 0	J-Stat = 0.1283	0.9572	-0.0934	2.4741	0.1045
Adjusted R^2 = 91.42%	Obs = 71 Inst = 21	(p = 0.0000)	(p = 0.0997)	(p = 0.0011)	(p = 0.6146)
Inflation = 2, Output gap=0	J-Stat = 0.1220	0.9448	-0.1548	3.2050	-0.0418
Adjusted R^2 = 90.05%	Obs = 71 Inst = 21	(p = 0.0000)	(p = 0.0520)	(p = 0.0013)	(p = 0.9025)

we change target horizon for inflation and estimate the model.

Another important econometrics issue is to see that whether instruments used were right instruments in terms of their relevance and also in terms of their numbers. For this purpose, we use Hansen's J-test, commonly known as test for over-identifying restrictions[11]. This test also helps us in assessing whether some important variables have been omitted. In both estimations, four lags of the instruments were used. J-test cannot reject the validity of the instruments in all cases.

According to conventional wisdom, monetary policy should stabilize both inflation and output. Our results indicate γ is insignificant at 5% for all specifications. It implies that State bank of Pakistan has been primarily concerned with the inflation and does not seem to target the output gap. Also, the coefficient of β is more than 1 in both tables, showing that SBP has been following an active policy to countering inflationary expectation. The coefficient for interest rate smoothing is very high (almost 95% in both cases), which is according to conventional wisdom.

For robustness analysis, we estimated the aforementioned model with different proxy of output gap, that is, HPGAP. But even with these different specifications, generally our results remained similar (Annexure).

ESTIMATION OF MONETARY POLICY RULE IN NEAR PAST

As a second step, we decide to investigate whether State Bank of Pakistan (SBP) changed the way it conducted

[11] For J-test, null hypothesis is 'Model is Valid'. J-test has a Chi-square distribution with degree of freedom (#of Instruments less # of parameters). $\chi^2_{(0.05,\ 17)} = 27.59$. J-Statistic * No of Observations = 0.1283* 71 = 9.11, so Null Hypothesis cannot be rejected and we conclude that there is not statistical evidence to reject validity of our model.

Table 2. Estimation results for the period 2000 to 2010.

Forecast horizon (no. of periods)		ρ	α	β	γ
Inflation = 1,Output gap = 0	J-Stat = 0.1766	0.8755	-0.0139	0.9428	0.4270
Adjusted R^2 = 88.41%	Obs = 40 Inst = 21	(p = 0.0000)	(p = 0.0008)	(p = 0.0000)	(p = 0.0000)
Inflation = 2, Output gap = 0	J-Stat = 0.1755	0.7412	0.0153	0.4266	0.5226
Adjusted R^2 = 76.84%	Obs = 40	(p = 0.0000)	(p = 0.0072)	(p = 0.0000)	(p = 0.0000)

monetary policy in recent times. The motivation for doing this comes from the fact that new government took over in October 1999 and due to retirement of existing Governor Yaqub, new Governor SBP, Ishrat Husain[12], has taken charge in December 1999. We call his and his successor's period as Post Yaqub era. We use this as basis for splitting our sample. Hence the model was re-estimated for this subsample: 2000Q3 to 2010Q4.

Table 2 reports estimation results of policy reaction function rule (Equation 4) for sub sample 2000Q3 to 2010Q4. Initially, target horizon for inflation is taken at Quarter 1 whereas Output Gap current value has been taken. Later on, target horizon for inflation has been set at two quarters. While estimating the model for this sample period, interesting differences have been noticed.

The model still seems to fit reasonably and the J-statistics results also confirm that the model is valid. The coefficient of β and γ are both significant at 1%. This is in contrast with the results for the full sample where only the coefficient β was significant. It means that State bank of Pakistan, in recent past, has also been considering business cycles in addition to targeting inflation. It is also important to note that now coefficient of β is relatively less in magnitude as compared with the previous values.

Another interestingly thing to notice is that coefficient β is now less than one. As already discussed that "less than one" means monetary policy has been accommodative and not providing enough measures to curtail inflation. It means that State bank of Pakistan has been, under the Governorship of Husain, not only focusing on business cycles but also had accommodative monetary policy. We re-estimate model by changing forecast horizons for inflation. Results remained similar and presented in Table 2. Hurnik et al. (2008) report similar results at Czech National Bank where they argue that "monetary policy shocks occur (in those period) whenever monetary policy is not set in accordance with the observed state of the economy and the inflation target. ……. (those periods were) characterized by relatively loose monetary policy".

Overall, our estimation reveals a considerable difference in monetary policy emphasis in post Yaqub era. Before 1999, the sole emphasis of monetary policy was on curtailing inflation. In that period, it seems business cycle and economic activities were not being treated as target variable at all; whereas, in Post-Yaqub era, the focus of monetary policy on business cycle and economic activity leads SBP towards accommodative monetary policy, which is de-stabilizing. In this time period, SBP let real interest decline or, conservatively, we can say that they did not try to increase them. Our results can also be corroborated with Figure 2, where inflation rates have been drawn with Treasury Bills rates. Our estimates are leading us towards conclusion that the recent surge in inflation, along with other factors, might be due to such policies in near past.

We were also interested in estimating the same model for earlier period, that is, from 1991Q1 to 2000Q2 but due to less number of observations[13] available, we found ourselves unable to estimate it. We decided to get help from descriptive statistics and graph for earlier period.

If we look at our major variables, that is, inflation and interest rates, for the period starting from 1991Q1 till 2000Q2, interest rates are higher than inflation rates. Even if we look at their maximum and minimum values, in Table 3, at neither point inflation rate was higher than interest rates.

In contrast, if we look at same variables that is, inflation and interest rates, for the period starting from 2000Q3 till 2010Q4, interest rates are less than inflation rates. Even if we look at their maximum and minimum values, in Table 4, at neither point interest rate was higher than inflation rates.

The same phenomenon can be seen in the graphs for inflation rates versus TB rates for both subsamples. Figure 3 is showing inflation-TB rates for the period from 1991 to 2000. We can clearly see that over all interest rate outweighs inflation rates, while reverse is true

[12] Ishrat Husain remained Governor, State bank of Pakistan, till December 2005.

[13] After adjustments and considering number of lags for various instruments, the number of observations for above sample period reduces to almost 30 only. Also, the data for Treasury Bills rate is available only from 1991 for Pakistan that is why we are unable to extend our sample earlier than 1991.

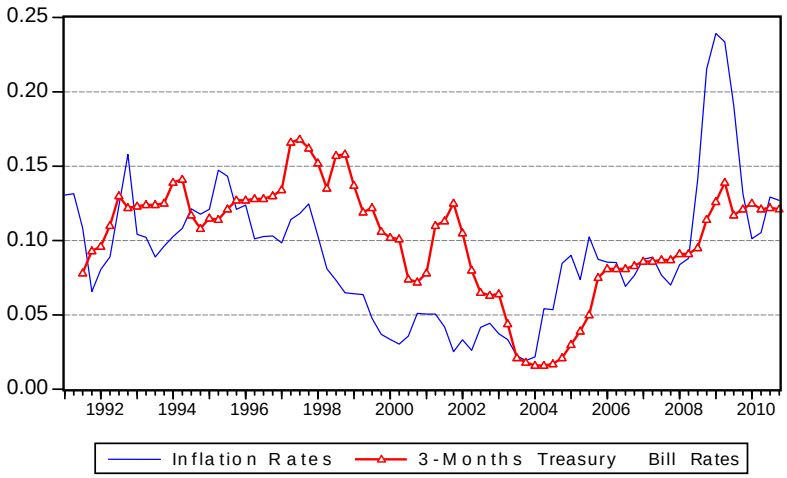

Figure 2. Comparison of inflation rates and T-bills rates.

Table 3. Descriptive statistics from 1991Q1 to 2000Q2.

Statistic	Inflation	Output gap (LS) (%)	Growth in M2 (%)	HPGAP (%)	Commodity Inflation	TB rates
Mean (%)	9.73	0.11	0.26	0.30	10.26	12.85
Median (%)	10.26	0.78	0.27	0.34	9.71	12.60
Maximum (%)	15.78	6.78	0.70	3.95	20.71	16.80
Minimum (%)	3.03	-7.52	-0.09	-3.39	0.20	9.60
Std. Dev. (%)	3.15	4.15	0.23	1.82	4.31	1.86
Observations	34	34	34	34	34	34

Table 4. Descriptive statistics from 2000Q3 to 2010Q4.

Statistics	Inflation	Growth in M2	Output gap (LS)	HPGAP	Commodity inflation	TB rates
Mean (%)	8.11	0.23	-0.52	-0.11	9.58	8.00
Median (%)	7.66	0.20	-0.62	-0.60	8.50	8.20
Maximum (%)	23.91	0.58	8.24	7.12	32.05	13.90
Minimum (%)	1.93	-0.06	-10.09	-8.16	-0.58	1.61
Std. Dev. (%)	5.52	0.19	6.18	3.10	7.66	3.58
Observations	42	42	42	42	42	42

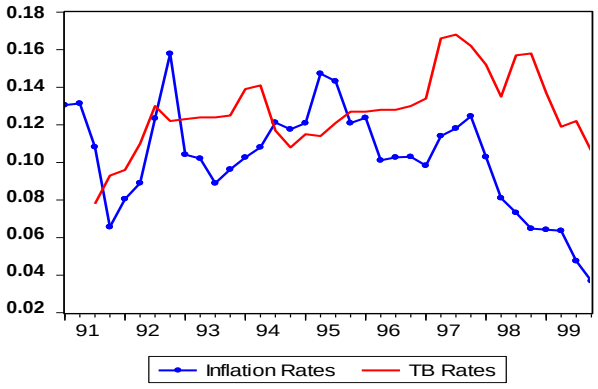

Figure 3. Graph depicting inflation rates and TB rates, 1991 to 1999.

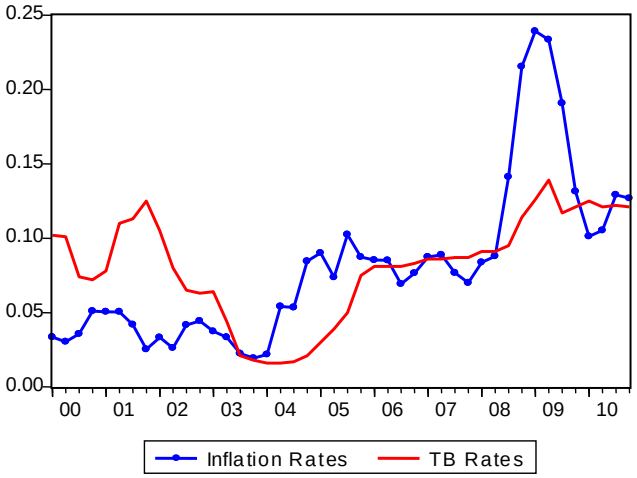

Figure 4. Graph depicting inflation rates and TB rates, 2000 to 2010.

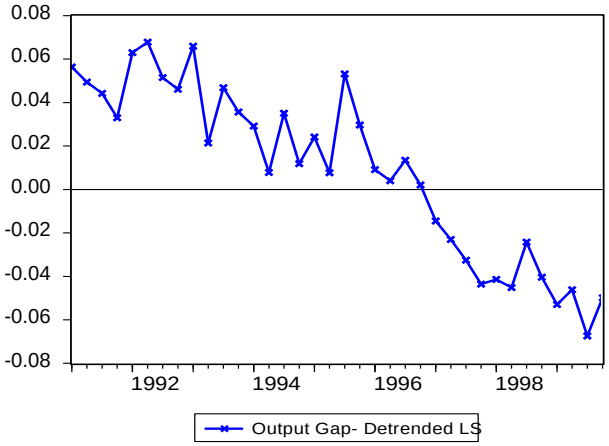

Figure 5. Graph depicting Output Gap, 1991 to 1999.

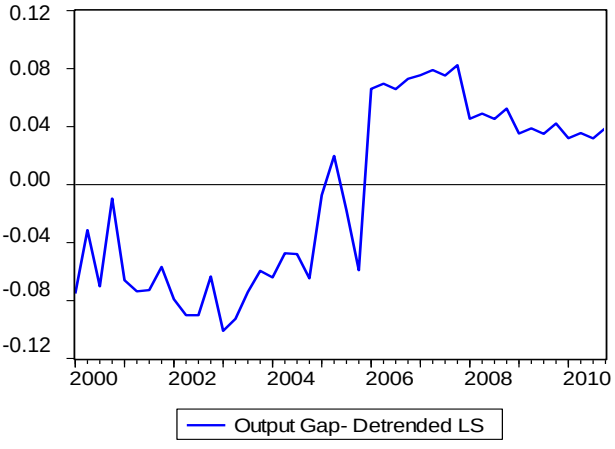

Figure 6. Graph depicting Output Gap, 2000 to 2010.

for subsample ranging from 2000 to 2010, in Figure 4. Figure 5 and Figure 6 are depicting output gap

Table 5. Parameter values used for simulation in literature.

δ	Quarterly discount factor	0.99 McCallum and Nelson (2000), Saeed and Riaz (2011), Clarida et al. (2000), Gali and Monacelli (2005), Monacelli (2005)			
λ	Output elasticity of inflation	0.03 McCallum and Nelson (2000)	0.05 Taylor (1981)	0.30 Woodford (1996), Roberts (1995), Clarida et al. (2000), Gali and Monacelli (2005)	1.22 Chari et al. (1998)
σ	Coefficients of risk aversion	2.50 McCallum and Nelson (2000)	1.00 Clarida et al. (2000), Gali and Monacelli (2005), Monacelli (2005)		
z_t, g_t	Coefficients of AR (1) for supply and demand shocks	0.00	0.90		

for both subsamples. Figure 5 is showing output Gap for the period from 1991 to 2000 and Figure 6 is showing same for 2000 to 2010. As output Gap is the difference between potential output and actual output, we can clearly see lot of volatility in output, in both subsamples. If seen jointly, one can visualize that, generally, output gap seems to be above zero, that is, positive output gap. Same results can also be verified in Tables 3 and 4.

IMPACT OF MONETRAY POLICY RULE ON ECONOMIC STABILITY

Now after estimating monetary policy function in forward looking scenario, we intend to investigate the implication of these rules on economic stability. Our strategy here is to simulate[14] the stated macroeconomic model with some alternative monetary policy rules. We need to decide about policy parameters and non-policy parameters. Various values of parameters used in literature for simulation are given in Table 5. Use of such non-policy parameters[15] taking from literature to simulate macroeconomic model is now almost a standard practice for monetary policy analysis. We chose different values for policy parameters according to our estimated model; and according to the regime, we decided to investigate in our paper. We do understand that some of these parameters might not be true representative for Pakistan economy but we chose such values that can be reasonably justified. Although, we believe that specific Pakistan related parameters might lead to better results.

The values for non-policy parameters, in this paper, have been taken as follows:

δ = Quarterly discount factor = 0.99

λ = Output elasticity of inflation = 0.30

σ = Coefficients of risk aversion = 1.00

z_t = Coefficients of AR (1) for supply shocks = 0.90

g_t = Coefficients of AR (1) for demand shocks = 0.90

Quarterly risk free rate[16] of 0.99 has been taken from McCallum (2001), implying annual risk free return of about 4% in steady state. Output elasticity of inflation has been taken from Woodford (1996) and Roberts (1995); whereas, coefficient of risk aversion and AR (1) term for supply and demand shock also has been taken from Clarida et al. (2000).

As already discussed, monetary policy reaction function can lead to instability if the coefficient of inflation is below one, that is, $\beta < 1$. For this reason, we simulate our model for two extremes[17] only, first when beta is at 2.00 and second when beta is 1.01. The model moves to indeterminacy if tested for $\beta < 1$.

Figures 7 and 8 representing the impulse response

[14] Simulation has been conducted in DYNARE 4.1. It is a suite of programs, run on platform of MATLAB, for the simulation and estimation of rational expectation models.

[15] Please see McCallum and Nelson (2000), Clarida et al. (2000), Gali and Monacelli (2005), Monacelli (2005) and reference therein.

[16] Saeed and Riaz (2011), while estimating forward looking Phillips curve for Pakistan, come up with the similar coefficient.

[17] For both cases, we keep the coefficient γ at 0.5.

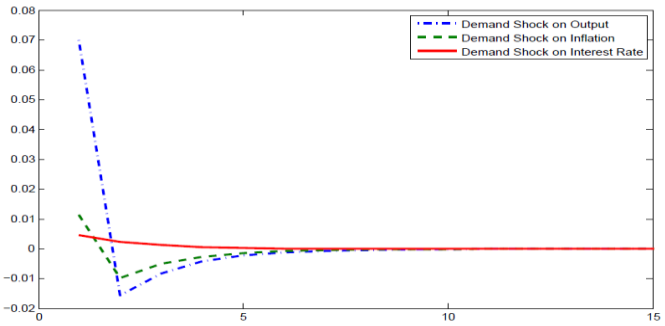

Figure 7. Impact of demand shocks if beta is 1.01.

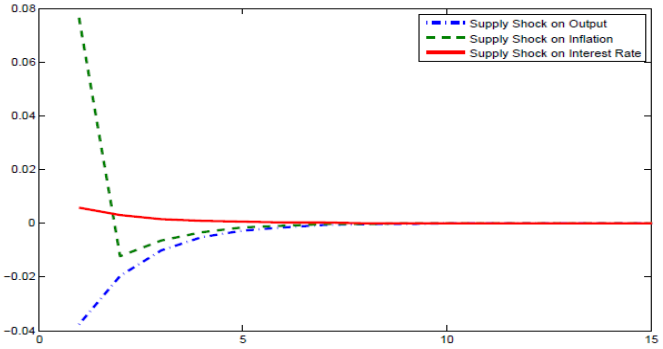

Figure 8. Impact of supply shocks if beta is 1.01.

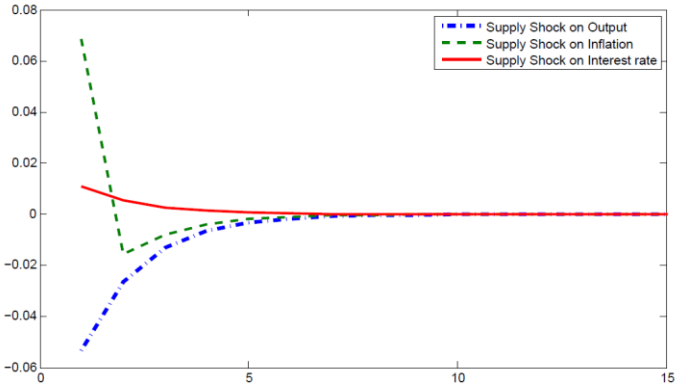

Figure 9. Impact of supply shocks if beta is 2.00.

functions of Output, Inflation and Interest rates in case of demand and supply shocks if monetary policy is said to be so-called Accommodative Monetary Policy that is, beta < 1 .

Figures 9 and 10 representing the impulse response functions of output, inflation and interest rates in case of demand and supply shocks if monetary policy, is said to be so-called aggressive, that is, beta > 1 .

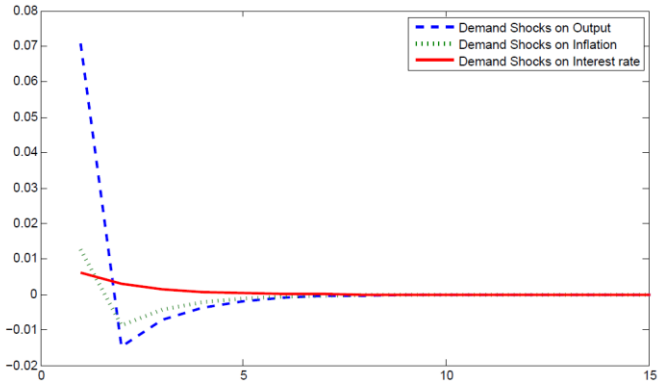

Figure 10. Impact of demand shocks if beta is 2.00.

Table 6. Simulated standard deviations from steady state level.

Variable	Beta = 1.01	Beta = 2.00
Output (%)	9.42	8.19
Inflation (%)	8.47	6.53

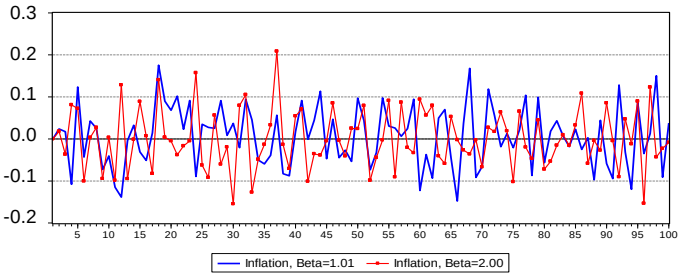

Figure 11. Response of Inflation for two extreme cases of beta, that is, when beta is 1.01 and 2.00.

In the same way, if we see the simulated standard deviations for two extreme cases that is, when beta > 1 and beta < 1. From Table 6, it is evident that when beta is almost at 2.00 then standard deviation in both cases is greater than the opposite case. We simulate same model using different non-policy parameter and expectedly results vary. This variation in results justifies our opinion that specific Pakistan related parameters will lead to better results. Some variations are shown in the appendix.

The preceding analysis can also be corroborated with the help of Figure 11, where simulated response of inflation has been drawn in both cases when beta is almost at 1.01 and beta is at 2.00. It can be clearly seen that in case of beta is at 2.00, the simulated response of inflation is relatively less volatile in comparison with other extreme.

Conclusion

In this paper, we estimated a forward looking monetary policy rule and analyzed the difference in the way monetary policy was conducted in 1990s compared to 2000s. We find that since Husain took over as Governor State Bank of Pakistan in 2002, the consideration of monetary authority has been to counter business cycles which resulted in less counter-inflation policies. From this, it can also be argued that those policies provided the seeds for surge of inflation which the country witnessed in 2008 onwards.

We do understand that explaining inflationary surge only as a result of accommodative monetary policy might be too simplistic view. As Frait et al. (2011) argue that “in a real, non-model economy, monetary policy decision-making is always complicated by other factors”. Augmenting the model with, at least, two aspects of economy may lead to better understanding of interaction between monetary policy and the economy. First, the model we simulate is for close economy where the impact of exchange rate is not included. Second, important aspect is non-existence of fiscal side in the model. We believe the inclusion of fiscal policy into an open economy model lead to better understanding of the consequences of monetary policy crisis in Pakistan.

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ANNEXURE

Estimation results for the period 1991Q1 to 2010Q4 (HP filtered output gap is used).

Forecast horizon (no. of periods)		ρ	α	β	γ
Inflation = 1, Output gap = 0	J-Stat = 0.1229	0.9618	-0.1151	2.5927	0.7661
Adjusted R^2 = 91.52%	Obs = 71 Inst = 21	(p = 0.0000)	(p = 0.1446)	(p = 0.0068)	(p = 0.3205)
Inflation = 2, Output gap = 0	J-Stat = 0.1187	0.9343	-0.1715	3.2131	-0.1679
Adjusted R^2 = 89.10%	Obs = 70 Inst = 21	(p = 0.0000)	(p = 0.0292)	(p = 0.0005)	(p=0.7448)
Estimation results for the period 2000Q3 to 2010Q4 (HP filtered output gap is used)					
Forecast horizon (no. of periods)					
Inflation = 1, Output gap = 0	J-Stat = 0.2297	0.8912	-0.0149	1.0847	0.5530
Adjusted R^2 = 89.42%	Obs = 41 Inst = 21	(p = 0.0000)	(p = 0.0145)	(p = 0.0000)	(p = 0.0014)
Inflation = 2, Output gap = 0	J-Stat = 0.2157	0.8650	0.0318	0.4405	0.7026
Adjusted R^2 = 87.34%	Obs = 41 Inst = 21	(p = 0.0000)	(p = 0.0111)	(p = 0.0005)	(p = 0.0006)