Optimal, Desirable and Threshold Inflation-Growth Nexus: An Empirical Assessment of a Typical Discretionary Monetary Policy Strategy

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Abstract

This paper proposes a new discretion-assessment approach instead of its relative-assessment with commitment in conduct of monetary policy. Benchmark long term optimal, desirable and threshold inflation-growth nexus rates are estimated from a baseline dynamic growth model through ARDL bounds testing and estimation strategy. The actual performance of the discretionary monetary policy maker is not consistent with the purpose for which discretion is granted. When assessed against the estimated benchmarks of 1%, 3% and 5%, the observed inflation remained in the non-performance range 92%, 82% and 62% of the 50 years' time respectively. Allowing discretion in conduct of monetary policy has produced overall negative effects on the economy in terms of lost real growth for 31 years out of 50 years owing to inflation bias.

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1. Introduction

There has been a long standing debate on the nature of the conduct of the monetary policy – the debate of rules versus discretion[1]. Although the arguments of this debate can be traced back to the 1920s (Hetzel, 1985) and 1940s (Simons, 1936) it has been extensively researched after the influential work of Kydland and Prescott (1977) and Barro and Gordon (1983). The proponents of rules/commitments[2] in monetary policy framework argue against the less efficient performance of discretionary monetary policy in the achievement of its objectives of inflation and output. They criticize discretion on the basis that it creates excess inflation (inflation bias) in the economy without any long term gains in terms of output.

The advocates of discretion, on the other hand, argue in favour of considerable flexibility with the central banker to adjust monetary policy as needed and as frequently as required to achieve its stated goals (Layton et al. 2005; Dotsey, 2008). The foundation of this argument hinges on the implicit assumption of a positive relationship between inflation and growth.

The empirical research on the nature of the relationship between inflation and growth is vast but inconclusive to some extent. For example, the empirical evidence about the long run nature and robustness of the relationship between inflation and output is mixed. Some papers have found a long run negative relationship (De Gregario, 1992-93; Fischer, 1993; Barro, 1995) while others have found that the relationship between inflation and output is not robust/fragile (Levine and Renelt, 1992; Levine and Zervos, 1993). Bruno and Easterly (1998) however, concludes that the long run relationship between inflation and growth is unclear. Yet another finding is that of the non-linearity of the effects of inflation on growth (see Sarel, 1996; Khan and Senhadji, 2001). The key conclusion of such studies dealing with non-linearity is that inflation affects growth positively until it attains a certain threshold point beyond which it becomes detrimental to growth.

Although discretion allows more flexibility and hence more room for adjustments in monetary policy to reap short term output gains but at the same time it is more challenging for the central banker as it is expected to stabilize the rate of inflation at such a level where its

[1] For some relevant discussions and reviews refer to Kydland and Prescott (1977), Barro and Gordon (1983a, b), Fischer (1988), Carlson (1988), Lear (2000), Drazen (2000), McCallum (2000), Dennis (2010) and Alesina and Stella (2010).

[2] McCallum (2000) notes that practically there is no rules based monetary policy strategy, however it's close to commitment in its essence.

effects on growth are optimal, desirable or at-least non-detrimental (below the threshold point). If the values of these three unknown inflation points/ranges are identified empirically they may be used as benchmarks against which the actual outcome of the discretionary monetary policy strategy over the period can be evaluated.

The central theme of this paper is therefore to adopt a more specific empirical approach for the evaluation of discretion on the basis of the aforementioned benchmarks instead of its relative-assessment in relation to the commitment based monetary policy frameworks. These benchmarks not only serve the purpose of evaluation of the performance of Pakistan's monetary policy strategy but also provide a basis for setting appropriate targets for inflation, which is one of the operational issues pertaining to inflation targeting.

Although a wide range of theoretical literature addressed the issue of the relative relevance of the two monetary policy frameworks of commitment and discretion in closed and open economy settings there is no conclusive and firmly established empirical evidence towards the justification of either (McCallum, 1999). Recently, Givens (2012) tried to bridge the aforementioned gap identified by McCallum using a forward looking New Keynesian model of output and inflation for the U.S. economy. First, he estimated the model representing discretion and then simulated it to produce counterfactual estimates for commitment and systematically compared their empirical effects.

The issue of empirical assessment of the two monetary policy strategies (of discretion and commitment) individually – on the basis of certain benchmarks or against each other is crucial because it warrants institutional changes. The latter approach is common but such empirical assessment is potentially undermined by two issues. This paper does not intend to extensively focus on these issues per se but pinpoint them for further research and to justify some merit into its proposed assessment-approach for discretion in conduct of monetary policy on the basis of pre-defined estimated benchmarks.

Firstly, a fair relative-assessment would require the two frameworks to co-exist in countries with similar macroeconomic conditions over a reasonable time frame that allows drawing reliable conclusions about their relative performance but practically there are no such real world examples. Secondly, counterfactual simulations (as conducted by Orphanides and William, 2005; Dennis, 2005 and Givens, 2012 for advanced countries) are likely to be model dependent, which may not necessarily have the correct structure and therefore, such simulations themselves may be misleading as is noted by Dennis (2005).

Nevertheless, the proposed discretion-assessment approach would require a typical case of discretionary monetary policy strategy with explicit twofold objectives[3] and the determination of the benchmark values. Pakistan is one such country that offers a typical case of discretionary monetary policy strategy for empirical examination due to its statutory twofold objectives of growth and inflation. Its empirical assessment would further the literature by introducing a new approach exclusively for the performance evaluation of a discretionary monetary policy strategy.

This paper identifies the optimal, desirable and threshold inflation-growth nexus rates by adopting the basic framework of Sarel (1996) and Khan and Senhadji (2001). Identifier dummy variables are simulated through a dynamic and stable baseline growth model estimated by the Auto Regressive Distributed Lag (ARDL) bounds testing and estimation approach of Pesaran et al. (2001) to avoid the spurious regression problem associated with time series data. Annual time series data spanning a 50-year period (1961-2010) was obtained from World Development Indicators (WDI). The results indicate that the 1 % inflation rate is optimal. The inflation in the range from 1% to 3% is desirable whereas the threshold inflation rate is 5%. Beyond the threshold rate, inflation affects growth negatively with moderately increasing intensity as the rate of inflation rises. The performance of the discretionary monetary policy strategy of Pakistan is not encouraging when the observed inflation rates are evaluated against the benchmark optimal, desirable and threshold values. For example, over the fifty years' time frame from 1960 to 2010, the observed inflation revolved around the optimal, desirable and the threshold benchmark levels 8%, 18% and 38% of the time respectively. Alternatively this suggests that the observed inflation has remained in detrimental range (where its observed effects on growth are negative) for 31 years out of the 50 years' time period, which is indicative of considerable welfare losses due to potential real growth loss. Only in 9 years out of the 50 years that the inflation rate was brought into the desirable range whereas the optimal inflation rate was hit only 4 times.

[3] Bec et al. (2002) noted that inflation bias, which is the key characteristic of a discretionary monetary policy strategy arises due to two features of monetary policy behaviour, one, twofold objectives of inflation and output and two, targeting output beyond potential level.

The rest of the paper is organized as follows: Section 2 briefly discusses the literature pertaining to growth and the theoretical and empirical nature of its relationship with inflation. Section 3 presents the methodological framework and estimation strategy, specifies the model and discusses the data and sample period. Section 4 brings in the results and the conclusion is drawn in the section 5.

2. Growth and the nature of its relationship with inflation

Since long output growth have been the objective of economic discipline towards the ultimate goal of high living standard. Several growth dimensions have been explored both theoretically and empirically while recently there has been a surge of interest in inclusive growth (for details see Ianchovichina and Lundstrom, 2009).

Broadly, growth sources can be classified as the ultimate, intermediate and proximate (for such classification see Bluhm and Szirmai, 2012).[4] The ultimate sources of growth mainly cover institutions, geographic conditions, culture and attitudes, historical shocks, long run science and technology cycles, distance to technological frontier, demographic characteristics and class and power-relationships. The intermediate sources are economic, technology and social policies and economic cycles whereas proximate sources are the directly measurable sources/inputs of growth both in classical and endogenous growth theories/models.

The empirical research on growth mostly revolves around the determinants that are largely proximate by nature falling into broader policy areas including but not limited to monetary, fiscal, financial, trade and exchange rate (for specific indicators see Levine and Renelt, 1991). Inflation is one of the monetary indicators of considerable policy importance due to its direct effects on the standard of living of people, resource allocation, poverty, investment and growth.

[4] For the distinction between proximate and ultimate growth sources see Maddison, (1988); Abramovitz, (1989) and Rodrik, (2003) and for intermediate sources see Szirmai, (2008) and Szirmai, (2012a).

Historically, the empirical evidence about the long-term relationship between inflation and growth has varied over time. In the 1960s the advent of the Phillips Curve and its subsequent popularization by economists such as Paul Samuelson and Robert Solow brought into the limelight the positive relationship between inflation and growth. There was a widespread belief that the monetary policy maker could reduce unemployment by accepting high levels of inflation. Nevertheless, the proceeding stagflation of the 1970s led to the emergence of the popular work of Noble prize winners such as Milton Friedman and Robert E. Lucas who criticized the Phillips curve relationship. Friedman argued that the positive relationship between inflation and output is a short run phenomenon.

The research of Kydland and Prescott (1977) furthered the literature on the way monetary policy should be conducted based on the insignificant relationship between inflation and growth. They maintained that with the help of activist monetary policy growth cannot be pushed beyond its natural rate in the long run. This line of research led to the emergence of commitment based monetary policy frameworks, which assume a negative relationship between inflation and growth (see for example Dotsey, 2008).

Several empirical studies such as De Gregario (1992-93); Barro (1995) and Bullard and Keating (1995) validate the negative relationship between inflation and growth. Another strand of empirical research has found evidence of a non-linear relationship between inflation and growth (see for example the pioneering study of Fischer, 1993). Sarel (1996) and Khan and Senhadji (2001) are the key studies extending this line of research with their prime focus on identification of the threshold levels of inflation (inflection points) for a cross section of countries using similar framework but different econometric approaches.[5] Their and the findings of other studies are mixed. For example, Sarel (1996) found 8% inflation as threshold; Khan and Senhadji (2001) found 12% for developing countries and 3% for developed countries. Ghosh and Phillips (1998) found the threshold at 2.5% for a sample larger than Sarel’s. Drukker et al. (2005) and Pollin and Zhu (2006) found high threshold levels at around 19% and 18%, respectively. Burdekin et al. (2006) however arrived at a threshold of 3% for developing countries. The literature is yet to be furthered in explaining the differences in empirical findings pertaining to the diversity in threshold estimates between developed and developing countries.

[5] Sarel (1996) used ordinary least squares (OLS) whereas Khan and Senhadji (2001) used nonlinear least squares (NLLS).

Indeed, driven by the mixed nature of findings for a cross section of countries, a number of case studies have been undertaken to analyze country-specific data. For example, Kannan and Joshi (1998), Samantaraya and Prasad (2001), Singh and Kalirajan (2003) and Mohanty et al. (2011) investigated the issue of non-linearity and threshold levels for India, Hayat and Kalirajan, (2009) for Bangladesh, Munir and Mansur (2009) for Malaysia, Lee and Wong (2005) for Taiwan and Japan and Salami and Kelikume (2010) for Nigeria.

Similarly, in the case of Pakistan, the studies that attempted to explore the issue of non-linearity and threshold levels are Mubarik (2005), Hussain (2005), Nawaz and Iqbal (2010) and Akmal (2011) who reached different conclusions. For example, Mubarak (2005) found 9% as threshold, Hussain (2005) is suggestive of 6% inflation as threshold, Nawaz and Iqbal (2010) concludes at two threshold levels of 6% and 11% whereas Akmal (2011) presents 4% as the inflection point. These differences, in part, may be due to the differences in sample periods and estimation techniques.

The empirical literature reviewed in the previous two paragraphs primarily deals with turning points (threshold levels) of inflation. The focus of the present study, however, is not only to determine the threshold but identify the range of desirable inflation rates along with the optimal rate of inflation. Surprisingly some of the studies (see for example, Seleteng, 2005; Juhasz, 2008 and Ahortor et al, 2012) treat 'threshold' and 'optimal' rate of inflation synonymously and indistinctively. The distinction between the two is important for appropriate empirical investigations and for laying down a sound basis for research. Threshold level of inflation is the rate beyond which the effects of inflation on growth turn harmful (see Sarel, 1996 and Bruno and Easterly, 1998). Technically, one would expect the signs of the coefficients of inflation as positive below and inclusive of the threshold level of inflation and negative otherwise.

For illustration, if there is only one threshold[6] say at 7% inflation rate, the signs for the coefficients of inflation rates ranging from 1% to 7% should be positive irrespective of its statistical significance. It is likely that some of them may be statistically significant and others may not. All the statistically significant inflation rates below the threshold level may be deemed as 'desirable' as they roughly approximate improvement in well-being because

[6] There could be more than one threshold points in a data (see Lee and Wong, 2005; Nawaz and Iqbal, 2010)

they are causing the economy to grow. In the set of ‘desirable’ inflation rates the ‘optimal’ inflation rate would be the one with relatively larger coefficient size and higher statistical significance as that particular rate is unique in the sense that it ensures the maximum welfare gain to the society.

This proposition is consistent with the argument of Garman and Richard (1989) that from a society’s point of view any change in inflation may be desirable that leads the economy towards the optimum. Pertinently, there is no specific and well established definition of ‘optimal’ rate of inflation in the literature as Friedman (1969) argued that a negative inflation rate is optimal. Billi and Kahn (2008) perceive it as a rate that maximizes the economic well-being of the public. Juhasz (2008) views optimal inflation as the rate at which the costs and benefits of inflation balance out. Nonetheless, in some of the monetary models the optimal rate is the outcome when the nominal interest rate is zero (Billi and Kahn, 2008).

Bernanke (2004) stressed the need for more research for the determination of optimal long term inflation rate due to the implicit or explicit crucial nature of such approximations in policy making. Billi (2010) estimated an optimal long run inflation rate using a small New-Keynesian model with short term nominal interest rate as the only instrument that may occasionally run against a zero lower bound. [7] Billi found optimal inflation rates as 0.2% and 0.9%, respectively while assuming scenarios of no misspecification and extreme misspecification under commitment. Since the results of such estimates are mainly derived from a Taylor-rule framework for the U.S they may not be relevant and generalized to assess the conventional typical discretionary monetary policy setups such as monetary targeting where money growth is determined exogenously instead of endogenous determination via interest rates.

3. Methodology and data

This section discusses the methodological framework adopted for empirical analysis, specifies the model, highlights the econometric approach and sheds some light on the data and its sources.

[7] Zero lower bound is typically considered a low inflation situation in the economy where the nominal interest rates reach the zero level. In such cases the conventional monetary policy no longer works as a further reduction in nominal interest rates to stimulate growth particularly in case of shocks to the economy is not possible (Billi and Kahn, 2008).

3.1 Methodological framework and estimation approach

The basic frameworks of Sarel (1996) and Khan and Senhadji (2001) are similar as they simulate growth models for potential values of threshold inflation using OLS and NLLS, respectively. The use of the NLLS, which assumes asymptotically normal distribution, is primarily motivated to determine if the threshold effect is statistically significant. The focus of this study however is not the determination of the statistical significance of threshold but to examine the magnitude and the direction of the effects of the range of observed inflation rates on growth, which is necessary for the identification of and distinction between the desirable, threshold and optimal inflation rate/s.

This study therefore adopts the basic framework of Sarel (1996) particularly its estimation technique for identification of the structural break through the variable expressed as $D_t.(\pi o_t - \pi a)$. Where, πo is the observed inflation rate and πa is the arbitrary value of inflation rate at which the structural break might occur. D_t takes the value 1, if $(\pi o > \pi a)$ and 0 if $(\pi o \leq \pi a)$. The expression $D_t.(\pi o - \pi a)$ captures the difference in the effects of inflation on growth between the two sides of the structural break and its significance is measured by the t-value.

This study estimates the cointegrating relationships as it is the most appropriate way to avoid spurious results (in a time series data) through the autoregressive distributed lag (ARDL) approach of Pesaran et al. (2001). None of the studies reviewed in the previous section (specifically the studies dealing with Pakistan) used the cointegration approach in their estimation, which is particularly important for the country case studies as they use time series data for their analysis. The ARDL allows estimation of long term coefficients based on the dynamic relationships among the variables. This econometric estimation and testing approach is preferred over the conventional cointegration approaches because it is suitable for variables integrated of order I(0), I(1) or both whereas the traditional cointegration approaches assume the variables to be integrated of order I(1). In case the variables are not integrated of order I(1) or even near integrated their estimates may be unreliable (Hjalmarsson and Osterholm, 2007).

The estimators of ARDL are superconsistent for the long run coefficients and perform well in small samples without losing long run information. The approach allows Schwarz Bayesian Criterion (SBC), Akike Information Criterion (AIC) and Hannan and Quinn Criterion (HQC) as model selection criteria and uses a two-step strategy for ascertaining the cointegrating relationships, which works even in the presence of endogenous regressors irrespective of the order of integration of the explanatory variables (Pesaran and Pesaran, 1997 and Pesaran and Shin, 1999). In the first step, the existence of the cointegrating relationship is established through an F- test. Since the asymptotic distribution of this F- test is non-standard, Pesaran et al. (2001) computed and tabulated its critical values for different orders of integration (for the number of regressors with and without intercept). Secondly, if cointegration is established in the first stage, the long and short run coefficients are obtained.

3.2 Model specification

The empirical analysis of the effects of the range of observed inflation rates on growth requires specification of a baseline growth model to simulate the variable $D_t.(\pi o_t - \pi a)$ for various arbitrary rates of inflation. Although research has identified a range of growth determinants (Levine and Renelt, 1991 provides summary of such variables) but not all of them have been found to be robust except investment (see Levine and Renelt, 1992). This study considered a number of variables consistent with key growth studies such as Barro (1990); Romer (1989); Romer (1990b); Barro (1991); Barro and Sala-i-Martin (1992); Levine and Renelt (1992); Barro (1995); Barro and Sala-i-Martin (1995); Sarel (1996) and Khan and Senhadji (2001) and specific country case-studies reviewed in the previous section. The specified baseline growth model in its general form is given as:

$$\dot{\mathrm{y}}_{\mathrm{t}} = \beta_0 + \beta_1 \mathrm{INF}_{\mathrm{t}} + \beta_2 \mathrm{P\dot{O}P}_{\mathrm{t}} + \beta_3 \dot{\mathrm{k}}_{\mathrm{t}} + \beta_4 FDI_t/Y_t + \beta_5 D_t.(\pi o_t - \pi a) + \epsilon_t.$$

Where, $\dot{\mathrm{y}}$ is the growth rate of real GDP, INF is the annual inflation rate based on consumer price index (CPI). $\mathrm{P\dot{O}P}$ represents the growth rate of population, $\dot{\mathrm{k}}$ is the investment indicator showing the growth rate of gross fixed capital formation and finally FDI/Y is the foreign direct investment to real GDP ratio. It is pertinent to mention that this equation was specified after several estimations while including other potential variables such as government debt to GDP ratio, export to GDP ratio, import to GDP ratio, export plus import to GDP ratio, exchange rate, trade balance and M2 to GDP ratio. Apart from these, various proxies for human capital were also introduced into the model[8]. These variables were dropped because they were either insignificant, did not show the appropriate sign or the estimated models (while retaining these indicators) could not pass either of the key diagnostics tests for normality, serial correlation, functional form and heteroscedasticity and stability tests such as CUSUM and CUSUMQ. Thus the specified model is robust in the sense that the relatively fragile variables were dropped.

3.3 Data and its sources

Annual time series data for the period 1961-2010 obtained from the World Bank Development Indicators (WDI) and State Bank of Pakistan (SBP) have been used for the purpose of empirical investigation. This is an extended data set as compared to the studies specifically dealing with the estimation of the threshold level of inflation in Pakistan, namely Mubarik (2005); Hussain (2005) and Nawaz and Iqbal (2010). Those studies used annual time series from 1973-2000, 1973-2005 and 1961-2008, respectively.

4. Relationship between variables and stationarity

Panels A to D of Figure 4.1 depict the relationships between the smoothed series of the dependent and explanatory variables. The series were smoothed using Hodrick and Prescott (HP) filter in order to obtain readily observable long term trends. The HP filter was

[8] For a review of the empirical growth literature see Levine and Renelt (1991). They surveyed 41 growth studies out of which 33 included investment, 29 included population growth, 18 included measures of initial income and 13 included measures of human capital.

Figure 4.1A. Time plots of trends in inflation and real growth

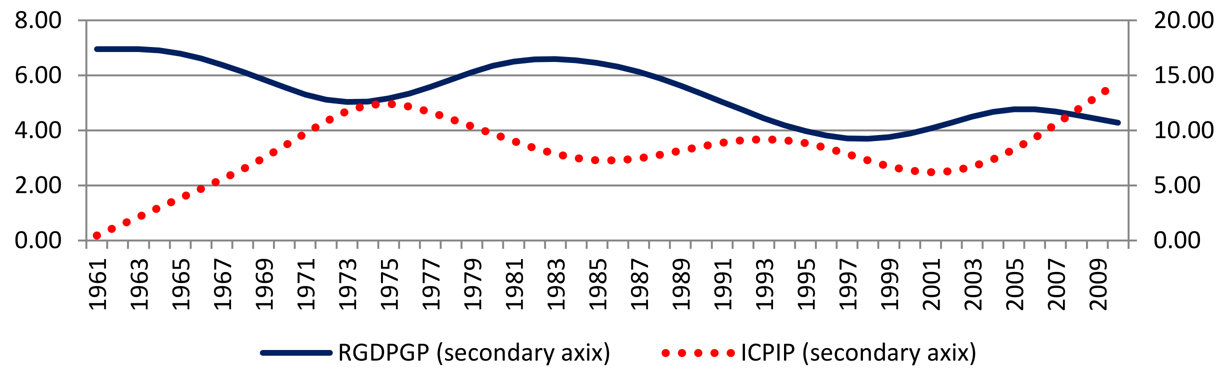


Figure 4.1B. Time plots of trends in population and real growth

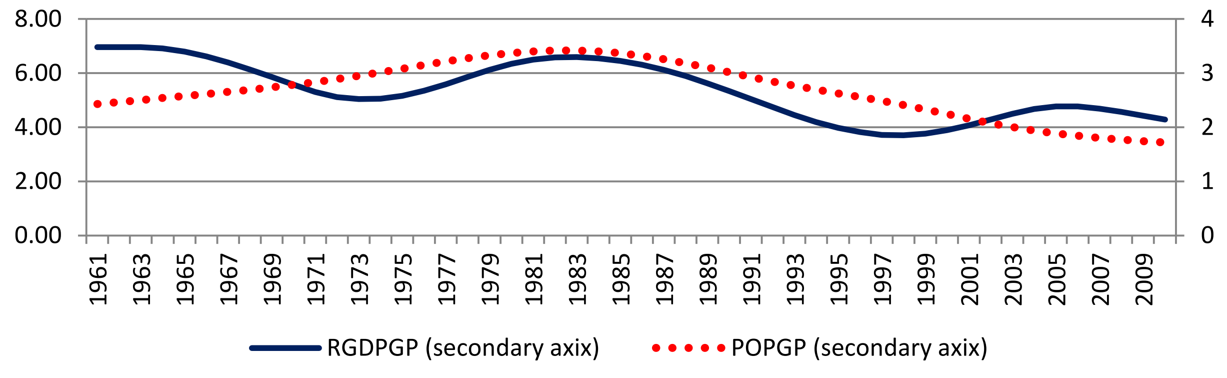


Figure 4.1C. Time plots of trends in investment and real growth

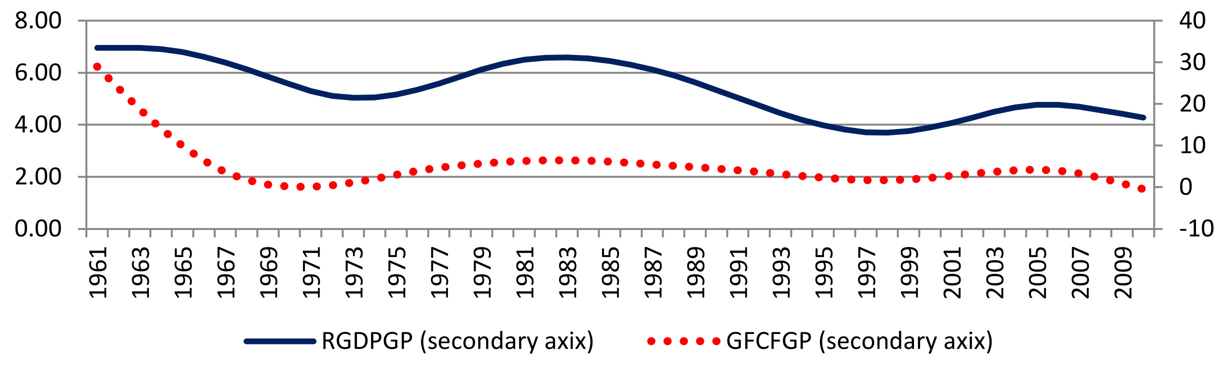
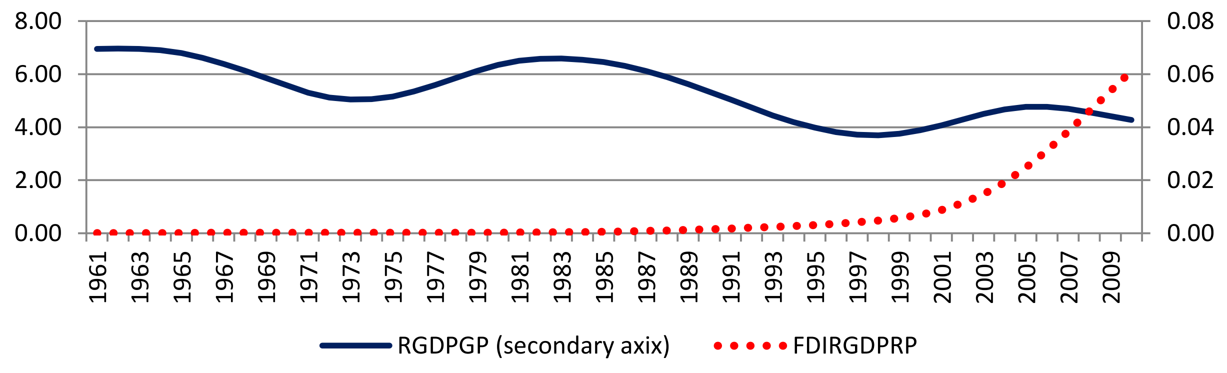


Figure 4.1D. Time plots of trends in FDIRGDP ratio and real growth



implemented using the recommended level of $\lambda = 100$ for annual data (Mise et al, 2005). RGDPGP, ICPIP, GFCFGP and POPGP are the permanent (trend) components of the growth in real GDP, inflation, investment and population, respectively. FDIGDPRP is the trend component of the ratio of foreign direct investment to real GDP.

The relationships of the trend in real GDP with the trends in inflation, investment and population depict clear patterns consistent with a wide range of theoretical and empirical research. For example, inflation and growth appear to move in opposite directions indicating an inverse relationship. Investment and population largely move in the same direction as does growth. However, the long term relationship of foreign direct investment with growth is not very clear.

This study, in order to reinforce its choice of the ARDL approach vis a vis traditional cointegration techniques, tests the stationarity properties of the underlying variables through the Augmented Dicky Fuller unit root test. The results are summarized in Table (1), which show that the indicators of investment and growth are integrated of order I(0) whereas the rest are integrated of order I(1), hence validating the preference for the ARDL.

Table -1: Unit-Root Estimation (ADF Test) – P Values

Variables	Intercept	Trend and Intercept	First Difference
ICPI	0.0279	0.0987	0.0000
POPG	0.9893	0.8358	0.0000
RGDP	0.0000	-	-
GFCF	0.0000	-	-
FDIRGDPR	0.9624	0.9388	0.0000

5. Empirical analysis and results

This section reports and analyses the long and short run results obtained by employing the ARDL cointegration approach to estimate the baseline growth model and also discusses the results obtained from the simulation.

5.1 ARDL bounds testing and estimation of the baseline growth model

The long and short run estimates are obtained from a dynamic function of the specified model through ARDL bounds testing and estimation approach of Pesaran et al (2001). Since in practice the "true" orders of the ARDL (p,m) model are rarely known a priori, the model was selected through the SBC. This is a relatively consistent model selection criterion in small samples selecting the most parsimonious model with the least number of freely estimated parameters. The order of the model specified by the SBC is ARDL(0, 2, 1, 0, 1). A maximum lag length of 3 was imposed as the data was annual and the transmission mechanism for monetary variables is deemed to vary from 2 to 3 years. The null hypothesis of no cointegration, $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ against the alternative $H_0: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$ was tested using the F-test.

Table-2. : Estimated long run coefficients using the ARDL approach
ARDL(0,2,1,0,1) Based on Schwarz Bayesian Criterion
Dependent Variable: (RGDPG)

Variables	Coefficient	Standard Error	P-Values
$ICPI$	-0.24	0.08	(.005)
$POPG$	0.95	0.74	(.207)
$GFCFG$	0.16	0.04	(.000)
$FDIRGDPR$	23.78	27.07	(.385)
$CONST$	4.2	2.11	(.054)
R-Square =0.46		F-Statistics = 4.03 (.002)	
Adjusted R-Square=0.34		Durbin-Watson Statistic= 2.01	

P-Values, Langrange Multiplier Test of Residual Serial Correlation (.956)
P-Values, Ramsey's RESET Test using the Square of the Fitted Values (.223)
P-Values, Normality- Based on a test of Skewness and Kurtosis (.161)
P-Values, Heteroscedasticity-Based on the Regression of Squared residuals on Squared Fitted Values (.849)

The F-Statistic (7.41) is greater than the asymptotic critical value bounds (3.74, 5.06) at 1 % level,[9] which confirms the existence of the long term cointegrating relationship. In the long term inflation and investment bear statistically significant effects on real growth; this is consistent with a wide range of empirical literature (long term parameter estimates are presented in Table 2). Inflation dampens real growth whereas investment boosts it. Although the long run effects of population and foreign direct investment on real growth are statistically insignificant they are statistically significant in the short run (short run parameter estimates are presented in Table 3).

It is worth mentioning that the deletion of the population and foreign direct investment indicators on the basis of their long run insignificance are not supported by the joint test of zero restrictions on the coefficients of the deleted variables. For example, the P- values of the Langrange Multiplier Statistics, Likelihood Ratio Statistics and F-Statistics for the deletion of population are 0.016, 0.013 and 0.027, respectively and those for population and foreign direct investment jointly the respective p-values are 0.055, 0.050 and 0.080, respectively. The error correction representation ECT_{t-1} shows that the speed of adjustment to the long run equilibrium level takes place in the same period[10].

Table-3 : Error Correction Representation for the selected ARDL model ARDL(0,2,1,0,1) Based on Schwarz Bayesian Criterion Dependent Variable: $\Delta RGDPG$

Variables	Coefficient	Standard Error	P-Values
$\Delta ICPI_{t-1}$	-0.03	0.07	(.720)
$\Delta ICPI_{t-2}$	0.21	0.07	(.007)
$\Delta POPG_{t-1}$	8.97	3.89	(.026)
$\Delta GFCFG_{t-1}$	0.16	0.04	(.000)
$\Delta FDIRGDPR_{t-1}$	-89.16	49.64	(.080)
$\Delta CONS_{t-1}$	4.20	2.11	(.053)
ECT_{t-1}	-1.00	0	-None-
R-Square =0.67		F-Statistics=12.95(.000)	
Adjusted R-Square=0.60		Durbin-Watson Statistic= 2.01	

[9] The F-stat is also greater than the upper bound at 1 % for the critical bound values (4.306, 5.874) computed by Narayan (2005) for the small sample sizes. The values reported in Pesaran and Pesaran (1997) and Pesaran *et al*. (2001) are generated using relatively larger samples.

[10] Technically, this is the case with ARDL models to reduce to Dynamic Distributed Lag models if the model selection criterion does not identify any lag of the regressand as optimal. In such cases the coefficient of the error term ECT_{t-1} in the error correction representation is -1.

5.2 Simulation results

The baseline growth model was estimated without the variable $D_t.(\pi o_t - \pi a)$. Since the prime objective of this research was to identify the effects of the range of observed inflation rates on real growth, the expression $D_t.(\pi o_t - \pi a)$ was simulated through the baseline growth model for varying values of πa from 1% to 26%. The choice of this range of values of πa was motivated by the fact that the observed inflation during the 50 years sample period of the study remained between this band.[11]

When $D_t.(\pi o_t - \pi a)$ was simulated for $\pi a = 1\%$, the results show that ignoring the existence of the structural break makes a huge difference to the long run estimated effects of overall inflation on growth. In the baseline growth model, the estimated effect of inflation on growth was -0.23 whereas after the simulation it increased to -4.63 (complete simulation results and diagnostics are presented in appendix). This implies that if the break is ignored, the effects of inflation on growth are underestimated. Technically, this downward bias is due to the fact that the baseline growth model estimates the effect of inflation on growth conditional on this effect being the same throughout the inflation spectrum (see Sarel, 1996 for this interpretation).

Overall, the simulation results show that lower inflation is associated with higher growth unless it crosses the 5% inflation rate, and high inflation rates beyond that of 5% rate are associated with low growth (see figure 1). The break occurs at 6% inflation rate beyond which moderate increases in inflation affect growth with moderately increasing intensity till 17% rate. Beyond 17% the intensity of the negative effect increases exponentially. Since the objective of this study was to locate the optimal, desirable and threshold rates of inflation to be used as benchmarks for assessment purposes, a clear picture is presented in Table (4).

Although statistically insignificant, 5 % inflation is the threshold inflation rate beyond which the break occurs and inflation starts affecting growth adversely. Inflation from 1% to 3% is desirable because its effect on growth is positive and statistically significant, and among the desirable range, 1% inflation is optimal with the maximum boosting effect on growth.

[11] Negative inflation was recorded in 1962. It may be noted that only round numbers rather than fractions have been simulated due to their direct policy relevance.

Figure 1. Long run effects of inflation rates on real growth

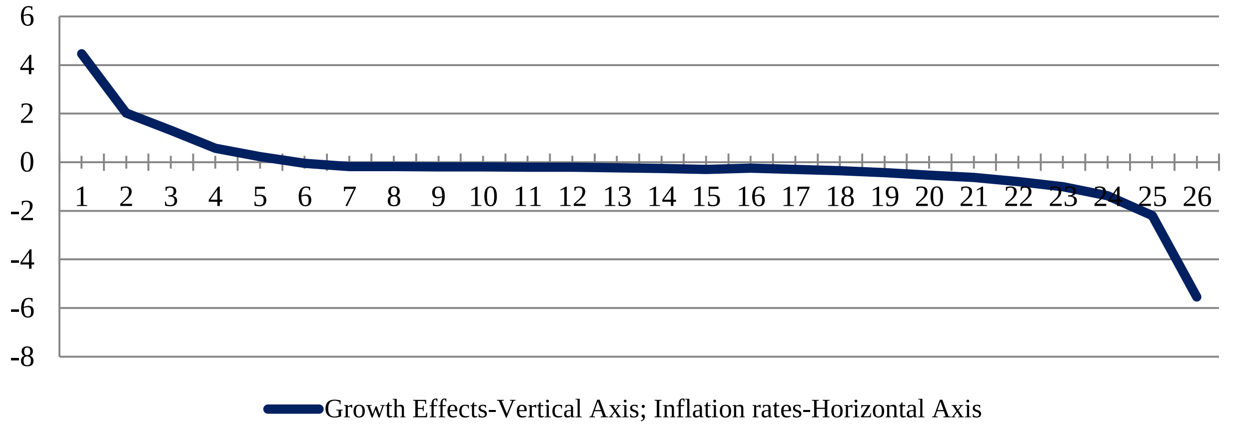


Table-4: Estimated long run coefficients for πa =1-26 using the ARDL approach
Dependent Variable: (RGDPG)

Dummy Variables	Coefficient	Standard Error	P-Values
πa =1	4.46	2.61	(.097)
πa =2	2.02	1.19	(.097)
πa =3	1.31	0.77	(.097)
πa =4	0.58	0.55	(.304)
πa =5	0.23	0.41	(.582)
πa =6	-0.05	0.32	(.871)
πa =7	-0.18	0.27	(.495)
πa =8	-0.18	0.22	(.414)
πa =9	-0.19	0.20	(.345)
πa =10	-0.19	0.19	(.342)
πa =11	-0.20	0.19	(.305)
πa =12	-0.21	0.18	(.257)
πa =13	-0.23	0.20	(.250)
πa =14	-0.26	0.22	(.234)
πa =15	-0.30	0.24	(.225)
πa =16	-0.24	0.29	(.398)
πa =17	-0.29	0.31	(.363)
πa =18	-0.35	0.35	(.325)
πa =19	-0.43	0.40	(.287)
πa =20	-0.53	0.46	(.251)
πa =21	-0.63	0.51	(.226)
πa =22	-0.80	0.62	(.203)
πa =23	-1.01	0.75	(.190)
πa =24	-1.38	1.03	(.190)
πa =25	-2.20	1.65	(.190)
πa =26	-5.54	4.15	(.190)

The purpose of granting discretion to the monetary policy maker is to allow sufficient flexibility to adjust the monetary policy as and when and as frequently as desired to ensure optimal gains to the society in terms of favorable inflation growth-nexus in the long term. Its performance can fairly be assessed on the basis of the three estimated benchmarks in this research. Firstly, the monetary policy maker with sufficient discretion would be expected to maintain inflation around the optimal rate. This would mean an optimal state in the economy and can be regarded as the best performance if the observed inflation rate mostly remains close to this optimal rate of 1% in 50 years. The second best performance a discretionary monetary policy maker may exhibit is by retaining inflation in the desirable range from 1% to 3% as this range ensures statistically significant gains in terms of real growth. The third yardstick for the performance evaluation of the discretionary monetary policy maker is to at-least ensure zero welfare losses with no gains in terms of real growth by not allowing inflation beyond the 5 % threshold level. This third yardstick, however, may be the minimum a monetary policy maker would be expected to retain with insignificant gain but no loss state in terms of inflation-growth nexus in the economy.

When the actual performance of the monetary policy maker with discretion over the 50 years' time period is evaluated against the three proposed and estimated benchmarks the outcome seems discouraging. The observed inflation remained close to the optimal, desirable and threshold levels only 4, 9 and 19 years respectively (see Table 5) indicating that discretion has harmed (31 years of non-performance) rather than aided the economy in terms of welfare gains/losses associated with inflation-growth nexus.

Table 5. Inflation rate hit close to estimated benchmarks in 50 years' time period

	Optimal criterion πo **<2%**	**Desirable Criterion** πo **<4%**	**Threshold Criterion** πo **<6%**
Best Performance	4 (8% of 50 years)	-	-
Second best performance	-	9 (18% of 50 years)	-
Threshold performance	-	-	19 (38% of the 50 years)
Non performance	46(92% of 50 years)	41(82% of 50 years)	31 (62% of the 50 years)

6. Conclusion

This study proposed a benchmark discretion-assessment approach instead of relative assessment in the conduct of monetary policy. Optimal, desirable and threshold inflation rates were estimated through a baseline growth model in a framework adopted from Sarel (1996). The baseline growth model was estimated through the ARDL bounds testing and estimation approach of Pesaran et al. (2001) to avoid spurious regression and endogeneity problems. The results suggest that the actual performance of the discretionary monetary policy maker of Pakistan when assessed against the estimated benchmarks has brought in welfare losses compared to the expected welfare gains for most of the time.

The methodology is straightforward and can be replicated for the cases of typical discretionary monetary policy strategies. Discretionary monetary policy strategies are the hallmarks of developing and emerging market economies owing to their ambition for growth and the assignment of explicit growth objective to the central monetary authority. In these countries more temptation is likely on the part of the central monetary authorities to boost the growth beyond its potential. In doing so, they might be harming rather than aiding their economies in terms of inflation-output growth nexus. The proposed assessment approach of the study provides objective benchmark criteria for the evaluation of a discretionary monetary policy strategy. It is pertinent to mention as a word of caution that although the results of this study are largely consistent with the conventional wisdom they may not be generalized as such because the benchmarks for other countries may vary depending on their macroeconomic conditions.

Nevertheless, for Pakistan, the findings of the study suggest that discretion in the conduct of monetary policy is not an economically justifiable choice. Consideration of institutional change is warranted not only to minimize the welfare losses but to optimize on the monetary policy welfare gains. Moreover, the estimated benchmarks can be used as inflation targets preferably a rate of 2% with 1% plus/minus margin to stay within the desirable range just in case transformation to the inflation targeting regime is considered. The inflation rate of 2% is the target in most of the central banks of advanced countries (Romer ad Romer, 2002) providing sufficient cushion for small shocks thereby trivializing the ZLB (Blanchard et al. 2010).

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Appendix: Baseline Growth Model and Simulation Results

Models /Variables	Variables					Model Fit	Diagnostic Tests			
	ICPI	POPG	GFCF	FDIRGDPR	Dummy	R-Square	Serail Correlation	Functional Form	Normality	Heteroscedasticity
Baseline Growth Model	-0.24	0.95	0.16	23.78	-	0.46	-	-	-	-
P-Values	0.01	0.21	0.00	0.39	-	-	0.96	0.22	0.16	0.85
Model 1	-4.63	1.32	0.17	28.08	4.45	0.44	-	-	-	-
P-Values	0.08	0.07	0.00	0.31	0.09	-	0.81	0.01	0.95	0.34
Model 2	-2.19	1.32	0.17	28.08	2.02	0.44	-	-	-	-
P-Values	0.07	0.07	0.00	0.31	0.09	-	0.81	0.01	0.95	0.34
Model 3	-1.48	1.33	0.17	28.31	1.31	0.44	-	-	-	-
P-Values	0.06	0.07	0.00	0.31	0.09	-	0.83	0.01	0.96	0.34
Model 4	-0.79	1.10	0.17	28.47	0.58	0.47	-	-	-	-
P-Values	0.14	0.15	0.00	0.31	0.30	-	0.83	0.09	0.34	0.56
Model 5	-0.45	1.05	0.16	26.70	0.23	0.46	-	-	-	-
P-Values	0.25	0.18	0.00	0.34	0.58	-	0.89	0.16	0.26	0.73
Model 6	-0.19	0.92	0.15	22.98	-0.05	0.46	-	-	-	-
P-Values	0.50	0.23	0.00	0.41	0.87	-	0.96	0.24	0.15	0.86
Model 7	-0.10	0.88	0.15	21.68	-0.18	0.47	-	-	-	-
P-Values	0.66	0.24	0.00	0.43	0.49	-	0.94	0.22	0.14	0.88

Model 8	-0.11	0.88	0.15	21.47	-0.18	0.47	-	-	-	-
P-Values	0.56	0.24	0.00	0.43	0.41	-	0.91	0.20	0.13	0.90
Model 9	-0.11	0.88	0.15	21.15	-0.19	0.47	-	-	-	-
P-Values	0.45	0.24	0.00	0.44	0.34	-	0.91	0.17	0.13	0.87
Model 10	-0.13	0.88	0.15	20.98	-0.19	0.47	-	-	-	-
P-Values	0.32	0.24	0.00	0.44	0.34	-	0.92	0.16	0.13	0.83
Model 11	-0.14	0.87	0.15	19.82	-0.19	0.47	-	-	-	-
P-Values	0.26	0.24	0.00	0.47	0.30	-	0.95	0.15	0.13	0.78
Model 12	-0.14	0.85	0.15	18.06	-0.21	0.48	-	-	-	-
P-Values	0.21	0.25	0.00	0.51	0.25	-	0.97	0.14	0.13	0.75
Model 13	-0.15	0.85	0.15	15.63	-0.23	0.48	-	-	-	-
P-Values	0.20	0.25	0.00	0.57	0.25	-	0.98	0.15	0.13	0.75
Model 14	-0.14	0.83	0.15	12.74	-0.26	0.48	-	-	-	-
P-Values	0.20	0.26	0.00	0.65	0.23	-	0.99	0.15	0.12	0.75
Model 15	-0.14	0.83	0.15	12.23	-0.30	0.48	-	-	-	-
P-Values	0.20	0.26	0.00	0.67	0.22	-	0.99	0.16	0.11	0.76
Model 16	-0.18	0.83	0.15	11.59	-0.24	0.47	-	-	-	-
P-Values	0.12	0.27	0.00	0.70	0.39	-	0.87	0.18	0.12	0.79
Model 17	-0.17	0.82	0.15	11.05	-0.29	0.47	-	-	-	-
P-Values	0.11	0.28	0.00	0.71	0.36	-	0.88	0.18	0.11	0.80
Model 18	-	0.82	0.15	10.63	-0.35	0.47	-	-	-	-

	0.17									
P-Values	0.11	0.27	0.00	0.72	0.32	-	0.90	0.18	0.09	0.80
Model 19	0.17	0.83	0.15	10.58	-0.43	0.48	-	-	-	-
P-Values	0.09	0.27	0.00	0.72	0.28	-	0.93	0.19	0.08	0.82
Model 20	-0.18	0.84	0.15	11.35	-0.53	0.48	-	-	-	-
P-Values	0.07	0.26	0.00	0.69	0.25	-	0.96	0.20	0.06	0.83
Model 21	-0.19	0.86	0.15	13.19	-0.62	0.48	-	-	-	-
P-Values	0.04	0.24	0.00	0.64	0.22	-	0.99	0.22	0.05	0.86
Model 22	-0.19	0.86	0.15	13.16	-0.80	0.48	-	-	-	-
P-Values	0.03	0.24	0.00	0.64	0.20	-	0.94	0.21	0.05	0.87
Model 23	-0.19	0.87	0.15	14.10	-1.01	0.48	-	-	-	-
P-Values	0.02	0.24	0.00	0.61	0.19	-	0.85	0.22	0.04	90.00
Model 24	-0.19	0.87	0.15	14.23	-1.38	0.48	-	-	-	-
P-Values	0.02	0.24	0.00	0.61	0.19	-	0.84	0.22	0.04	0.90
Model 25	-0.19	0.87	0.14	14.23	-2.20	0.48	-	-	-	-
P-Values	0.02	0.24	0.00	0.61	0.19	-	0.84	0.22	0.04	0.90
Model 26	-0.19	0.87	0.15	14.23	-5.54	0.48	-	-	-	-
P-Values	0.02	0.24	0.00	0.61	0.19	-	0.84	0.22	0.04	0.90