Effectiveness of Monetary Policy in Pakistan: Empirical Evidences based on Bound Test Approach

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Abstract

The insights on the long run relationship amongst money, price level and the GDP are of significant importance for monetary policy formulation in a developing country like Pakistan. Taking into account the vital importance of these three variables, we empirically analyzed the long-run relationship amongst money, price level and GDP in the context of Pakistani economy. Time-series econometric techniques such as unit roots, ARDL and ECM are employed to quarterly data for the year 1972:1 to 2005: IV. ARDL has numerous advantages over the traditional approaches of causality and cointegration. Our results clearly suggest that there is a stable long run relationship amongst money supply (M1), GDP and the CPI in Pakistan. Radical changes in monetary policy in the past have significantly affected the movement of the macro economy in the country.

JEL Classification: C22, E51, E52.

Keywords: Monetary Policy; Price Level; Autoregressive Distributive Lag Model (ARDL).

1. Introduction

Monetary policy plays an important role in the economic growth of a country. The relationship among money supply, income and prices has long been a subject of controversy between the Keynesian and monetarist schools of thought. According to Keynesian, in the Hicks-Hansen, IS-LM model, money affects income through changes in the rate of interest. This is a short-run model in which the price level is assumed to be constant. As long as the investment demand curve is elastic and the demand for money is not infinitely elastic, changes in money have a positive effect on income. Changes in money stock are induced by changes in income and not *vice versa*. Monetarists, on the other hand, relied on the equation of exchange as a theoretical framework for explaining the relationship between money and income. In their framework, given that the income velocity of money is stable, money has a direct and proportional effect on income. In the long-run money has a neutral effect on income, since prices change proportionally to change in money leaving the real value of income unchanged. Friedman and Schwartz (1963), and subsequent works by Friedman (1968), attempts to provide theoretical as well as empirical support for the close relationship between money and income. Therefore money plays an active role in income generation, and changes in income are induced largely by changes in money stock.

The question whether money causes the income is important for monetary economist and has been subjected to a variety of modern econometrics techniques, producing conflicting results. One of the frequently applied method to investigate the empirical relationship between money and income in Granger Causality Analysis (Granger 1969) and Johansen Maximum Likelihood Cointegration Test (1988) for determining the long run relationship. The method used by Johansen imposes a strict restriction that the variables in system will be of equal order of integration. Furthermore it does not include the information on structural break in the time series data and also suffer from low power. In Pakistan previous studies have focused only on the Granger Causality Analysis. Recently researchers have attempted to distinguish between the short run and the long-run relationships between money and income. Tanner (1993), Davis and Tanner (1997) have shown a temporary breakdown of money-income relationship in the United States during the 1980s. However, over the period of 1874-1993, money remained the most important variable accounting for fluctuations in income.

On the other hand, Rapach (1998) showed long-run neutrality of money along the lines advocated by Lucas (1970), which is empirically supported by King *et al.* (1991) and Gali (1992). Similarly, Fung and Kasumovich (1998) have studied the relationship for six OECD countries and their findings showed that money shocks influence nominal income.This analysis presented in this paper is intended to add to the body of existing literature by examining the money, income and prices relationship in short-run as well as in long-run in the context of Pakistan economy. The analysis is not only based on new and recent data set but an alternate econometric technique, the Autoregressive Distributed Lag (ARDL) approach has also been used, which has numerous advantages. The ARDL approach can be applied irrespective of whether the variables are integrated of same order or not (Pesaran and Pesaran 1997). It takes sufficient number of lags to capture the data generation process in a general to specific modeling framework.

Moreover, a dynamic error correction model (ECM) for short run relationship, can be derived from ARDL through a simple linear transformation (Banerjee et al. 1993). The ECM integrates the short run dynamics with the long run equilibrium without loosing long run information. Furthermore, ARDL approach avoids problems resulting from non-stationary time series data (Laurenceson and Chai 2003).The purpose of this paper to fill the previous gap left by other studies in determining the lon run relationship among money supply, income and price level. The findings of the analysis of inter relationship among money, price level and GDP are expected to guide policy makers for devising economic growth and development strategies and programs in Pakistan. The remaining of this paper is organized as follows: section two presents the literature review. In Section three we discuss modeling, data and methodological framework. Section four explains the results of the study. The final section concludes and presents some policy implications.

2. Review of Previous Research

National Income, prices and money supply are three key macroeconomic variables that play a crucial role in setting pace of economic growth and maintaining macroeconomic stability in a country. Various studies have analyzed the causality between money supply and income, nevertheless there is still a controversy over the consistency of the results of these studies. Some studies have established unidirectional causality running either from income to money or from money to income, some have established bi-directional causality while others have found no evidence of any causality. Many economists have worked on the topic in different countries of the world and several other variables have been included with the money income causality such as prices, interest rate, GDP and inflation etc.

Upadhyaya (1991) evaluated the effectiveness of monetary and fiscal policies for the period 1957-87 in four developing countries: India, Pakistan and India. The study employed a St. Louis type reduced form single equation model. In his analysis the original St. Louis equation has been modified by adding foreign trade variables. The author explained changes in nominal GNP through money supply (M1) and government expenditure and assumed that the effect of each of the explanatory variable on the dependent variable was completed within two years. He therefore specified two-year lags for each variable. In the case of Pakistan the impact of change in money stock (M1) was found to be significant in the first year, but this become insignificant for all the lagged periods. However, the overall cumulative impact was significant. The effect of government expenditure was significant for only the first year and then become insignificant. He found unidirectional causality from the monetary variable to nominal GNP. He confirmed the exogeoneity of the monetary variable (M1) with respect to nominal GNP. The study has concluded that monetary policy is more effective than fiscal policy in Pakistan.

In another study, Abbas (1991) examined the effectiveness of monetary policies for selected Asian developing countries for the period 1960-1988. He used Granger test for measuring causality between the monetary variables (M1 and M2) and income (GDP). The study found that M1 did not cause income (GDP), irrespective of whether the lag-length used was 1,2 or 3-years or even when the lag-length was selected using the Final Prediction Error (FPE) method. For the lag-length of one year, M2 caused income (GDP). The study further indicated that M2 and GDP show a bi-directional causality for lag-length of 2 and 3-years and also with the model based on the FPE method. Thus the effectiveness of the monetary variable in term of GDP variation was not confirmed. The validity of these results is limited due to separation of East Pakistan.

Moreover, these studies used nominal GNP rather than real GNP as a dependent variable. Hussain (1992) used Granger and Sims test to judge the relative effectiveness of monetary and fiscal policies in Pakistan. The findings of the study revealed that the monetary policy is effective for the period 1971-72 to 1989-90.
However the validity of the results are limited because of the excessive massaging of the data, the arbitrary assumption of a one year policy impact lag and the use of nominal GNP rather than real GNP as the dependent variable. Most of these have attempted to investigate the relative effectiveness of monetary policy; however these empirical studies suffer from the following methodological deficiencies:

1. These studies did not examine the time series properties of the variable (stationarity of the variables) and thus, OLS regression analysis has led to (a) non normal coefficient distribution (b) spurious regression problem (c) inconsistent and inefficient OLS estimated of parameters and (d) invalid error correction representation (Johansen and Juselios, 1991).
2. The regressions used in by these studies have been run in differenced form. This eliminates the long run information embodied in the level (without differenced) form.

In addition to the above studies, Biswas and Saunders (1988) provide further empirical evidence on the money income relationship taking the case of the United States. The study used Hsiao (1979, 1981) minimum final prediction error approach in the causality testing as well as an arbitrary lag select technique. Hussain (1982) on the other hand used the St.Louis equation to judge the relative effectiveness of monetary policy and fiscal policy for Pakistan the period (1949-1971). He used M1 and total government expenditure as proxies of monetary and fiscal policy respectively. The study reported that monetary policy is relatively less effective in term of nominal GDP determination than fiscal policy.In another study Khan and Siddique (1990) investigated the direction of causility among money, price and economic activity for Pakistan for the period 1972:I to 1981:IV to asses the effectiveness of monetary policy. The authors have used the test procedure of Sims. They found the direction of causation runs from economic activity (nominal GNP) to money (M1 and M2) without any feedback. They suggested that the expansion of money supply is determined by the change in economic activity. The study indicated a unidirectional causality running from M1 to prices and bidirectional feedback relationship between M2 and prices. It was concluded that growth in money supply and prices are exogenous.

Therefore, money supply is not a key variable in the determination of level of output. Additional studies have tested the relationship among income, money supply and the price level using time series data techniques. Stock and Watson (1989) for Canada ans US, Friedman and Kuttner (1992, 1993) and Thoma (1994) in case of the United Sates reported that changes in money do not have a statistically significant impact on output. Hafer and Kutan (2002) used a sample of 20 industrialized and developing countries to examine the long run relationship between money and income. They have estimated a significant long run relationship. Most recently Iqbal et al. (2004) studied money income link in developing countries and concluded that the causal relationship between money and two variables *viz:* income and prices appeared to be fairly heterogeneous across diverse sample of fifteen developing countries. Most of the evidence seems to favour the view that the relationship between the nominal money and real output is bi-directional. Their results are very much country specific. They found that there would be no' wholesale' acceptance of the view that 'money leads income' and there would be no 'wholesale' acceptance of the view that money follows income as well.

A study by Ramchandran and Kamaiah (1992) reexamined the relationship between money and price for India. They used seasonally adjusted quarterly data for 1961:1 to 1987:4 with four alternative measures of monetary stock (M1, M2, M3, and MB) and two price proxies (WPI and CPI with 1970 as a base year). They applied the Akaike Minimum Final Production Error (FPE) method to choose the quarterly lagged length of each variable. They applied Granger on the given lagged structure and the F test used for ascertaining joint significance. The study found that M3 and price proxies have feedback relationship. For M2 and M3 the causal direction across the price proxies seems inconsistent. However, no causation was observed between price proxies and M1 definition of money. They also examined causality through Engle-Granger (1987) method. They estimated error correction model with significant ECM term and unidirectional causality from money (M1, M2 and M3) to prices. Thus the results obtained from ECM showed that monetary policy is effective with respect to (M1, M2 and M3) as a means for controlling inflation in India.

Ibrahim (1998) studied the temporal causality between monetary aggregates (M1 and M2) and other macroeconomic variables (CPI, real industrial production index and one year treasury bill rate) for Malaysia over the period over 1976:I to 1995:IV by using unadjusted seasonal data. He used Enger-Granger causality test (1987) in two variables (money and output), three variables (money, output and price) and four variables (money, output, price and interest rate) models. The findings showed that the models for 3 and 4 variables are co-integrated with M2. Results further indicated that bidirectional causality exists between M2 and real industrial production. Biswas and Saunders (1998) examined causality between M1 and nominal national income for India over the period 1973:1 to 1995:IV. They used Engle-Granger (1987) causality test and specified two lags of each variable and lagged error term of co-integrated regression. Results revealed that nominal income and money supply have a feedback relationship. They concluded that monetary policy was ineffective. Camas and Joyce (1993) in a study for India and Mexico used Granger causality test in multivariable framework for the period 1963 -75 and 1970-82. The study followed the industrial production index approach, CPI, domestic credit, foreign exchange reserves and American money supply was used as a foreign money supply proxy. The results indicated that domestic monetary policy was not effective in either country.

They further supported their results through Variance Decomposition (VDCs) and Impulse Response (IRFs) based analysis. Looking at the validity of these studies we find that these empirical studies suffer from the invalid form of error correction models. If variables are linked by more than one co-integrating vectors, then the Engle-Granger procedure (1987) is no longer applicable (Thomas, 1997).Masih and Masih (1997) tested money-price causality in bi-variate and multivariate framework for Pakistan for the period 1971:1 to 1994:4. They used CPI, spot exchange rate, industrial production index, market interest rate and two alternative proxies of money supply (M1 and M2). They used the Johansen (1991) technique for multivariate framework. They found, through ECM, that price is leading variable. They concluded that monetary policy is ineffective in Pakistan. They further supported these results through VDs and IRF base analysis. Qiao Yu (1997) used the Johanson (1991) technique for estimating VECM for China for the period 1979-1 to 1994-12. The author used three alternative measures of money supply (M0, M1 and M2), two alternative measures of credit, five alternative measures of output, three alternative measures of sales, fixed-assets investment, merchandise imports, retail price index and exogenous dummy for tight monetary policy. He estimated several three variable systems, containing a price variable, a non-price variable and a financial variable. He found that the performance of bank credit is less impressive than that of the monetary aggregates.

3. Methodology and Data

The traditional practice in determining long run and short run relationship among variables in the literature has been the standard Johansen Cointegration and VECM (Vector Error Correction Model) framework, but this approach suffers from several serious flaws. The results related to long term as well as short term relationship often depends upon the observation period and the econometric techniques employed. In this regard, when time series data are used for analysis in econometrics, several statistical steps must be undertaken. First of all, unit root test has been applied to each series individually in order to provide information about the stationarity of the data because non-stationary data contains unit roots. To check the existence of unit roots and to determine the degree of differenced in order to obtain statistically stationary series of variables, that are money supply M1, GDP and Prices, Augmented Dickey-Fuller Test (1979, 1981) and Philips-Perron (1988) have been applied. The tests are based upon estimating the following equations.

$$\Delta GDP_t = \alpha_0 + \alpha_1 t + \alpha_2 GDP_{t-1} + \sum_{i=1}^{n} \gamma_i \Delta GDP_{t-i} + \varepsilon_{t1} \quad (1)$$

$$\Delta M1_t = \beta_0 + \beta_1 t + \beta_2 M1_{t-1} + \sum_{i=1}^{n} \delta_i \Delta M1_{t-i} + \varepsilon_{t2} \quad (2)$$

$$\Delta P_t = \lambda_0 + \lambda_1 t + \lambda_2 P_{t-1} + \sum_{i=1}^{n} \psi_i \Delta P_{t-i} + \varepsilon_{t3} \quad (3)$$

If the time series data of a variable is found to be non-stationary, there may exist a long run relationship among these variables, M1, GDP, and P. In order to obtain robust results for the long run relationship, we applied the ARDL approach to know the existence of long run relationship and short run.

ARDL is a powerful concept that allowed us to describe the existence of an equilibrium/relationship in long run and short run dynamics without losing long run information. ARDL approach consists of estimating the following equation.

$$\Delta GDP_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{n} \beta_i \Delta GDP_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta M1_{t-i} + \sum_{i=0}^{n} \delta_i \Delta P_{t-i} + \lambda_1 GDP_{t-1} + \lambda_2 M1_{t-1} + \lambda_3 P_{t-1} + \varepsilon_t \text{..........} \quad (4)$$

The first part of the equation 4 with β_i , γ_i and δ_i , represents the short run dynamics of the model whereas the parameters λ_1, λ_2 and λ_3, represents the long run relationship. The null hypothesis of the model is;

H_0: $\lambda_1 = \lambda_2 = \lambda_3 = 0$ (There exist no long run relationship)

H_1: $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq 0$ (There exists a long run relationship)

The ARDL model testing procedure starts with conducting the bound test for the null hypothesis of no cointegration. The calculated F-statistic is compared with the critical value tabulated by Pesaran et al. (2001). If the test statistics exceeds the upper critical value, the null hypothesis of no long-run relationship can be rejected regardless of whether the underplaying order of integration of the variables is zero or one. Similarly, if the test statistic falls below a lower critical value, the null hypothesis is not rejected. However, if the test statistic falls between the two bounds, the result is inconclusive. When the order of integration of the variables is known and all the variables are I (1), the decision is made on the upper bound. Similarly, if all the variables are I (0), then the decision is made on the lower bound. The ARDL methods estimates $(p+1)^k$ number of regression in order to obtain optimal lag length for each variable, where 'p' is the maximum number of lag to be used and 'k' is the number of regressors in equation.

In the second step, when the long run relationship is estimated using the selected ARDL model and long run relationship among variables is found, there exists an error correction relationship. Therefore, in the third step, the error correction model is estimated. The error correction model result indicates the speed of adjustment back to the long run equilibrium after a short run disturbance. The standard error correction model (ECM) involves estimation of the following equation:

$$\Delta GDP_t = \gamma_1 + \delta_1 CE_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta GDP_{t-i} + \sum_{i=0}^{n} \beta_i \Delta M1_{t-i} + \sum_{i=0}^{n} \mu_i \Delta P_{t-i} + \varepsilon_t \text{................................} \quad (5)$$

To ascertain the goodness of fit the ARDL model, the diagnostic test and the stability test are conducted. The diagnostic test examines the serial correlation, functional form, normality and heteroscedasticity associated with the model. The structural stability test is conducted by employing the cumulative residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ). Examining the prediction error is another way of ascertaining the reliability of the ARDL model. If the error or the difference between the real observation and the forecast is infinitesimal, then the model can be regarded as best fitting. We use quarterly data from 1972-I–2005-IV to investigate the existence of short-run dynamics as well as long-run equilibrium relationship among money supply, income and prices in Pakistan. Gross Domestic Product (GDP), money (M1), and Consumer Price Index (P), are used as Income, Money and Prices, respectively. Table 1 presents summery statistic of the data.

Insert Table (1) about here

4. Empirical Results

Prior to determining whether all the series are integrated, this study examines the integration order of all the variables by applying unit-root test i.e. Dickey and Fuller (1981) and Phillips-Perron (1988). Unit-root test are classified into series with and without unit roots, according to their null hypothesis. The purpose is to conclude whether each variable is stationary or not. All the variables are first tested for stationarity with intercept and trend using the Augmented Dickey- Fuller (ADF) and Phillips-Perron. The results in Table 2 and 3 show that GDP is I(0) and the remaining variables M1 and P are I(1).

Insert Table (2) and (3) about here

The test results (ADF and Phillips Perron) presented in tables 2 and 3 indicate that the Gross Domestic Product (GDP) is stationary at level and is integrated of order zero I(0), while the remaining two variables Money supply (M1) and Prices (P) are not stationary at level but at first difference. They are integrated of order one I(1).

It is possible to deploy the ARDL to determine whether there exists a stable long run relationship among these variables GDP, M1 and P in Pakistan. Now we turned to ARDL for long run relationships as mentioned in Table 4. The main assumption of ARDL is that included variables in model are I(0), I(1) or mutually conintegrated. This tends to support for the implementation of bounds testing, which is a three steps procedure; in the first step we selected lag order on the basis of SBC because computation of F-statistics for cointegration is very much sensitive to lag length, therefore, lag order 5 is selected on lowest value of SBC[1].The total number of regressions estimated following the ARDL method in the equation 4 is $(5+1)^2 = 36$. Owing to the existence of a long run relationship, in the next step we used the ARDL cointegration method to estimate the parameters of equation (4) with a maximum lag set to 5. The results of bounds testing approach for cointegration relationship represents that the calculated F-statistic is 18.85, which is higher than the upper level of bounds critical value of 7.52 and lower bounds value of 6.34 for k=2. This result implies that the null hypothesis of no cointegration cannot be accepted, which indicates that there is indeed a cointegration relationship among the variables. Having found a long run relationship, we applied the ARDL method to investigate the long run and short run parameters.

Insert Table (4) about here

The results presented in Table 4 indicate the existence of a stable long run relationship among income, money supply and price level in Pakistan. We conclude that change in money supply positively affects the income growth, while the price level has a significant negative impact. An important feature of cointegrated variables is that their time paths are influenced by the extent of deviation from the long run equilibrium. If the model is out of equilibrium at any point in time and returns to the long run equilibrium, the movements of at least one of the variables must respond to the magnitude of the disequilibrium. If the gap between the money supply and the GDP is large relative to the long run relationship, the GDP must ultimately rise relative to money supply. This gap can be closed in one of the three following ways:

1. The gap may be narrow down by increasing the income level in the economy. The nominal income can increase as a result of an increase in the price level, or an increase in real output, or some combination of increases in both of these variables.
2. The adjustment can take place through an increase in the money supply and a related large increase in income.
3. This gap can be closed by a fall in money supply accompanied by a smaller fall in the nominal income.

It is not possible to determine which of these possibilities will occur without a full dynamic specification of a model. However, it is possible to investigate the short run dynamics of the present model with the Error Correction Model (ECM). The short-run coefficients estimates obtained from the ECM version of ARDL model are given in Table 5. The ECM coefficient shows how quickly/slowly variables return to equilibrium. The error correction term CE_{t-1}, which measures the speed of adjustment to restore equilibrium in the dynamic model, appear with negative sign and is statistically significant at 5 percent level, indicating that long run equilibrium can be attained. Our results are consistent with Bannerjee et al. (1998), who argue that a highly significant error correction term is further a proof of the existence of stable long run relationship. The coefficient of CE_{t-1} is equal to -0.434, which implies that the deviation from the long-term equilibrium is corrected by 43.4 percent over each quarter of the year at 5 percent level of significance. The lag length of short run model is selected on the basis of Schwartz Bayesian Criteria (SBC). In short run dynamics, income is influenced positively by its lagged period at 1 percent level of significance by 0.84 percent. Our results reveal that income level in the short-run analysis is positively affected by the money supply and negatively by the price level.

Insert Table (5) about here

The ECM model passes all short run diagnostic tests for no serial correlation, no conditional autoregressive serial correlation, no heteroskedasticity and no specification in functional form and the error term is normally distributed. The regression for the underlying ARDL equation fits very well at $R^2 = 0.975$ and also passes the diagnostic tests.

[1] At lower value of SBC, value of AIC is also low.

The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMsq) plots from recursive estimation of the model also indicate stability of long run coefficients (Figures 1 and 2) over the sample period because graphs of cumulative sum of squares (CUSUM) and (CUSUMsq) do not exceeds the critical boundaries of both the figures at 5% level of significance.

Insert figures (1) and (2) about here

5. Conclusion

This paper has examined the long run and short run causal relationship among income, money supply and price level in Pakistan, a subject which has been widely investigated in the past in both developed and developing countries, including Pakistan, through recently developed econometric technique --- ARDL (Auto Regressive Distributed Lagged Model). Our results suggest that there is a stable long run relationship among the three variables, on which our analysis is based. As a policy guide line we suggest that monetary authority in Pakistan should devise strategies to ensure long run price stability through balanced expansion in the money supply. As this type of monitory policy would help to provide a stable economic environment (Eichenbaum, 1997). This stability in the economic environment will aid economic agents in their decision making. Therefore, it is fair to conclude that monetary policy, as approximated by changes in the M1, will have important implications for changes in Pakistan's nominal income in the long run. Based on our results we further conclude that in the short run the monetary policy is relatively effective and that the money supply is exogenous and cause a significant movement in the price level and hence GDP. The policy implications stemming from the analysis clearly suggest that monetary policy plays an active role in influencing the level of economic activity in Pakistan. In a nutshell, an increase in money supply increases economic activity in Pakistan, which in turn increases money demand to finance a higher level of economic activity.

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Table 1: Descriptive Statistics and Correlation Matrix

Variables	GDP (unit)	M1	CPI
Mean	108087.7	314330.8	46.878
Median	101643.4	175145.0	33.330
Maximum	207343.1	1387600.	112.550
Minimum	36103.08	16850.30	7.230
Std. Dev.	48521.14	331454.0	32.599
Skewness	0.259	1.227	0.673
Kurtosis	1.825	3.609	2.026
Jeraq-Bera	8.789	34.124	14.719
Probability	0.012	0.000	0.000
Observations	128	128	128
Correlation Matrix	GDP	M1	P
GDP	1.000	0.914	0.955
M1	0.914	1.000	0.451
P	0.955	0.451	1.000

Sources: CPI and M1 data is based on International Financial Statistics (IFS) database, while GDP data is based on Kemal and Muhammad Farooq Arby (2004).

Table 2: Unit-Root Estimation (ADF Test)

Variables	Lag 1	Lag 2	Lag 3
GDP	-6.536*	-6.659*	-2.659
ΔGDP	-11.937*	-63.028*	-7.874*
M1	5.244	5.244	6.658
Δ M1	-6.991*	-6.619*	0.293
P	-0.632	-0.632	-0.708
ΔP	-6.473*	-4.162*	-2.843

Notes: * Represents significance at 1% , ** represents significance at 5%

Table 3: Unit-Root Estimation (Phillips Perron Test)

Variables	Lag 1	Lag 2	Lag 3
GDP	-13.686*	-13.547*	-13.512*
Δ GDP	-29.045*	-42.044*	-114.373*
M1	4.674	4.620	6.173
ΔM1	-16.659*	-16.565*	-16.424*
P	-0.749	-0.762	-0.777
ΔP	-6.566*	-6.359*	-6.262*

Notes: * represents significant at 1%.

Table 4. Estimated long run coefficients using the ARDL approach (dependent variable:GDP) (3,4,1)

Variables	Coefficient	Prob-values
Constant	5.513 (1.474)	0.042
GDP_{t-1}	0.074 (4.390)	0.002
$M1_t$	0.026 (3.639)	0.002
P_t	-8.602 (-2.390)	0.006
R^2 = 0.927	F-Statistics =317.930 (0.000)	
Adjusted-R^2= 0.913	Durbin-Watson stat =2.006	

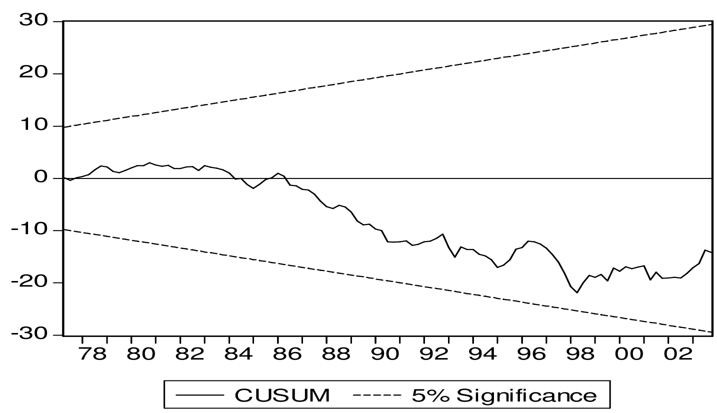
Note: Figures in parenthesis are t-values

Table 5. Error correction representation for the selected ARDL-model (3,4 ,1) **(dependent variable: ΔGDP)**

Variables	Coefficients	Prob-values
Constant	16.060 (1.831)	0.0699
ΔGDP(-1)	0.352 (1.982)	0.0459
ΔGDP(-2)	0.321 (2.642)	0.0134
ΔGDP(-3)	0.319 (2.675)	0.0069
ΔM1	0.014 (2.742)	0.0455
ΔM1(-1)	0.007 (2.500)	0.0397
ΔM1(-2)	0.024 (1.424)	0.0474
ΔM1(-3)	0.006 (0.338)	0.5361
ΔM1(-4)	0.009 (0.455)	0.6498
ΔP	-09.284 (-2.378)	0.0071
ΔP(-1)	-2.322 (-2.519)	0.0082
CE(-1)	-0.434 (-1.998)	0.0316
R-squared = 0.975 Akaike info criterion = 18.794 Adjusted R^2 = 0.969 Schwarz criterion = 19.094 Durbin-Watson stat = 1.983 F-statistic = 361.5 (0.000)		
Short run Diagnostic Tests: Serial Correlation LM Test 6.162 (0.858) ARCH Test = 0.196 (0.823) W-Heteroskedasticity Test =2.224 (0.274) Ramsey RESET Test = 2.109(0.126) Jarque-Bera Test = 0.140 (0.937)		

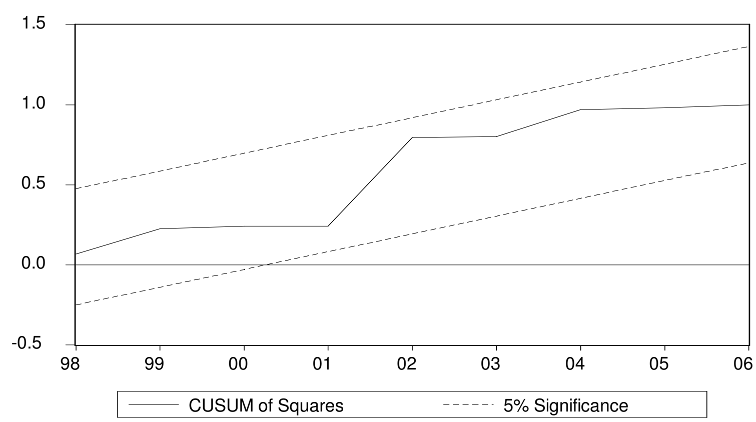
Note: Figures in parentheses are t-values

Figure 1 : Plot of Cumulative Sum of Recursive Residuals



The straight lines represent critical bounds at 5% significance level.

Figure 2: Plot of Cumulative Sum of Squares of Recursive



The straight lines represent critical bounds at 5% significance level.