# The Impact of Government Spending on Economic Growth: Case South Africa

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***Abstract***

*This study investigates the validity of the Keynesian macroeconomic framework and the Classical perspective of a long run relationship and causality between government expenditure and economic growth in South Africa using the quarterly data from 1990-2010. A specific country study was used to investigate the long-run relationship between the former and the later on nation's output. Testing for unit roots and co-integration was performed first before we engage in ganger causality for testing the causality relationship between government spending and growth. Unit root tests were conducted so as to avoid the generation of the spurious regression results and co-integration determines the existence of a long run relationship among the variables. ADF(Augmented-Dickey Fuller) and the Philips-Perron tests techniques were engaged to test for stationarity. This study applies the Johansen Maximum Likelihood test techniques using both the trace technique and the more powerful eigen maximum value test. Both procedures found that certainly a long run relationship exists between government spending and growth in South Africa. Using the results obtained from the study, increased government spending in South Africa has not led to a meaningful development of the economy of the country which is inconsistent of the Keynesian stance.*

***Keywords:*** *Government expenditure, Keynesian framework, Classical perspective, Economic Growth, Inefficiency, Long-run relationship.*

## 1. Introduction

The vision of ensuring sustainable development and reduction of mass poverty at a meaningful magnitude is enshrined, in one way or another in the government's development strategy document. In this respect, economic growth measured by the rate of an annual increase in the nation's real GDP is taken as the main objective for overcoming continuing poverty and offering a hope for the possible development of society.

In emerging economies countries such as South Africa, the role of government is considerable in both scope and significance for accelerated economic growth. Notwithstanding the importance of monetary policies, the government's fiscal policy (which include taxation, expenditure, correcting market failure and providing a wide array of public goods such as state security and street lighting) have become a strong and essential instruments of economic growth of a

country. Among the fiscal policy instruments, this study focuses on government expenditures which are the crucial instruments for economic growth at the disposal of policy makers in developing and emerging economies countries. However, there is neither a general consensus nor consistent evidence regarding the significant relationship between government expenditures and economic growth.

Some economists have argued that arise in government expenditure can be an effective tool to stimulate aggregate demand for a stagnant economy and to bring about crowd-in effects on the private sector. The Keynesian argue that the government spending can positively impact growth when the government borrow from the private sector and repays back through various spending programmes such as infrastructural development. This is based on the argument that the increase in government spending will inject the new purchasing power in the pockets of the consumers and thereby stimulating aggregate demand in the periods where demand is low.

The views of the classical economists were based on the assumption that if the economy was left to itself, then it would tend towards full employment equilibrium, where everyone who wants to work is able to find work (Froyen, 2008). Therefore, the government plays no major role except to provide peace and security for investment in the country and thus, no long run relationship between government spending and economic growth.

The 2010 FIFA World cup tournament led to an increased government expenditure especially on infrastructure in South Africa, and this has been a motivation for this research to assess the impact of an increased government role in the economy. However, there is a lack of consensus on the relationship between the size of government spending and economic growth is the motivation behind this study. This study builds on the empirical theory that the long term relationship between government expenditure and economic growth but there is an attempt to eliminate cyclical from the structural factors affecting the relation between government expenditure and economic growth.

The theory of economic growth generally deals with the economy's long run trend or its potential growth path (Park, 1998). It studies the factors that leads to long run growth and analyzes which factors that leads to rapid or slow growth and even those which does not contribute to growth at all. This study is linked to the Keynesian school of thoughts since it holds the view that government expenditure has a long run positive impact on the economic growth of a country.

### *1.1 Keynesians School of thought*

According to the Keynesians, pubic spending boosts economic activities as well as act as a tool to stabilize the short run fluctuations in aggregate expenditure (Ju-Haung, 2006). This view is consistent with the evidence found in some previous empirical studies such as (Omoke, 2009) which show a positive impact of government expenditure on economic growth. The Keynesian macroeconomic model advocates an active government intervention in the economy through an increase in government spending, money supply in order to stimulate the demand for goods and services during periods where there is lack of demand (low demand) and put the unemployed back to work. This illustrates the importance of aggregate demand in the Keynesian macroeconomic framework so as to determine the level of output and income in the economy. Barro (1990) also argue over the endogenous growth theory that government expenditure directly affects the private production function. Keynes (1936) argued that market economies had no automatic capacity to generate full employment and that the economic policy is and should be inextricably linked to social policy (Connor and Simpson, 2011).

The Keynesian argument for government intervention in the market is based on the argument that markets do not always clear as the Classical economists' has postulated in the 19$^{th}$ century due to price and wage rigidity in the short run. Rigid prices and wages will make firms fail to sell all the inventory of the goods they have produced leading to the accumulation unsold inventory. Thus, in times where demand is low, the government should increase its spending (injecting new purchasing power) in the economy so as to stimulate aggregate demand and thereby output through the multiplier effect. As a result, fiscal policy activities have a positive on the economic growth of a country. An increase in government expenditure will boost output and employment in the economy through the simple multiplier effect. This theory provides that there is long run causality between government spending and economic growth. Thus, the Keynesian economists argue that government spending increases the national income of a country.

The impact of government spending on the growth of the economy can also be viewed through the use of the Keynesian IS-LM model. The Keynesian IS-LM model shows how government can use its spending activities to affect the level of interest rates and output in the economy. The IS-LM model explains the existence of underemployment and equilibrium which is attributed to the existence of rigidities in the system, namely the money wage and the interest rate and it is derived from the Keynesian assumption of downward rigidity in money wages (Snowdon and Vane, 2002).

The IS represents the goods market equilibrium and the LM is the Keynesian money market equilibrium. Therefore, by combining the IS and LM schedules together we can see the equilibrium level of output and interest rates in the economy and show how a shift in government spending will impact on output and interest rates level. A rise in government spending will shift the IS schedule outward to a higher position on the right where a new equilibrium position is attained corresponding to a higher income level and interest rates. This analysis shows that an increase in government expenditure brings about an increase in income and interest rates as increased government spending will compete with the private firms for the limited loans in the money market. This is because the LM curve is fixed as it represents all combinations of interest rates (r) and income (Y) that equate the supply and demand for real money balances. An increase in government spending will discourage private investments through the process known as crowding effect. An increase in government spending of ($\Delta G$) would shift up the IS curve by less amount than the increase in the government expenditure multiplier times the change in government expenditure.

The shift is because few private investment projects will be undertaken as the costs of borrowing rises due to higher interest rates causing the efficient private investments to be substituted by inefficient public programs. The crowding out effect of an increased deficit public spending is evidenced in the IS-LM model as the effect of an initial increase in government spending will be lesser than the size of multiplier (Mankiw, 2005). This is because an increase in the government spending financed by borrowing will push interest rates high causing private firms to reduce their investment projects undertakings due to increased borrowing costs. However, although an increase in deficit government spending discourages private investment and thereby retards the growth of the nation's capital stock, an increase in government spending still results in a positive impact on economic growth (Snowdon *et al.*, 2002). The nation's output will still increase but by less than the multiplier size.

### *1.2 Classical economists' Hypothesis*

The Classical economists' view of the impact of government expenditure on economic growth is the opposite of the Keynesian hypothesis. The Classical view is based on the argument that increase in government spending will not result in an increase in the national output. Thus, government spending is seen as the destabilising force in the development of the economy of a country rather than the driving force of economic growth as the Keynesian economists has postulated. Classical economists believe in the magical powers of the invincible hand (free markets) to guarantee full employment equilibrium in the economy.

According to the Classical economists, the economy should be left to operate on its own and only prescribed a limited role for the government to play such as to promote the rule of law. This is because they saw government intervention in the economy as a serious problem which can stifle growth and therefore lead to less output. Therefore, the Classical economists argue that the state should perform the minimum number of functions essential to the existence of society such as to ensure the maintenance of internal security and to establish and maintain law courts for the settlement of disputes among citizens.

Classical economists believe that increases in government expenditure, unless financed by money creation and thus changes in the monetary policy would not affect either employment or the price level (Ju-Huang, 2006). This is because if government spending increases while money supply is fixed, the government will compete with the private firms in the money market which then push interest high. Higher interest rates discourage private investment and lead to the undertaking of public investments. This is because the costs of financing loans will be high for the private firms. Therefore, according to the Classical view an increase in government spending with money supply constant will not lead to an increase in income but will only substitute private business investments with the public programs (Froyen, 2008). This because the government has an advantage that it can borrow at any level of interest rates as they can print money or increase taxes to refinance the loan borrowing costs. Therefore, in the Classical view, increases in government spending have no effect on the long run economic growth of a country. This means that there is no causality between government spending and economic growth.

## 2. Statement of the Problem

Economists identify several factors that contribute to the growth of a nation's output such as the growth in the number of the workforce, increase in the number of plants and equipment and economic productivity. To ensure well functioning markets and stimulate economic growth, the government must expand its resources to enforce contracts, maintain national security, protect against criminals and provide valuable public goods.

Theoretically, there are two competing schools of thought defining this causal relationship between government spending and economic growth. Firstly, Keynes (1936) regards government expenditure as an exogenous variable which can be used to generate national income and this will make public expenditure a cause rather than an effect of national income. Then (Tang, 2009) concluded that causal relationship should run from public expenditure to national income. Contrary to the Keynesians view, the Classical economists such as Adam Smith (1990) introduced the notion of the invincible hand and argue for the limitation of government spending in the economy. In this view, there is no causality between government spending and economic growth which postulate that the government's fiscal policy does not have any effect on the growth of national output. Therefore, if the country wishes to see economic growth, the Classical view requires the government to avoid the risk of distorting the resource allocation through government intervention and allow the free markets to rein.

## 3. Research Methodology

The Granger causality test technique was utilised in this study in order to examine the causality relationship between government expenditure, money supply, investment and economic growth in South Africa. The quarterly time series data of total economic growth, government spending, money supply by broad definition ($M_2$) and investment, all in real terms from 1990 to 2010 was analysed using data from the International Monetary Fund's International Financial Statistics, South African Reserve Bank (SARB) and the National Treasury.

### *3.1 Measurements*

Economic growth refers to the changes in the real (Mankiw, 2005). Real GDP is in turn obtained by dividing GDP at current market price by the consumer price index (CPI). Government spending is taken as the real government spending and this is obtained by dividing the total government spending between the first quarters of 1990 to the second quarter of 2011 by the consumer price index at year 2005 as the base year. Also, money supply is deflated for the effect of inflation using the consumer price index at year 2005 as the base year so as to get the real money supply. Investment level is taken at the 2005 constant prices so as to obtain the real investment level.

We employed vector autogressive (VAR)/Granger causality in this study; this was developed by Sims (1980) and Granger (1969) respectively. We also have four macro-economic endogenous variables namely, economic growth, government expenditure, money supply and investments in our estimated model. Unlike convectional simultaneous equations techniques which are regarded to be too restrictive and far arbitrary, (Ju-Haung, 2006) all variables on VAR are endogenous which can be written in a linear function of its own lagged values. A multivariate VAR model produces reliable results compared to a typical causality test because the model avoids biased causality inferences due to omission of the relevant variables (Lutkepohl, 2004).

However, before investigating the direction of causality relationship between government spending and economic growth, the Phillips-Perron unit root test technique was employed to test the data for stationarity so as to avoid the generation of spurious regression results. Also, the Johansen cointegration technique and the error correction methods to analyse the long run relationship between government spending, money supply, investment and economic growth.

The notion that increased government spending has a positive impact on the nation's output has been an issue in macroeconomics that is rarely questioned. This study is a contribution to the previous studies on this subject matter in the case that it considers other variables into the model such as the real money supply and real investment. From the foregoing discussion, increased government expenditure is an important determinant of the growth of the nation's output. The choice of the variables was influenced by the economic literature on the positive influence of money supply and investment on the economic growth of a country. Thus, our model expresses economic growth (GDP) as an independent variable which is a function of government spending (G). In addition, we include money supply (Ms), and Investment since they can have an impact on economic growth. This is written as follows;

GDP = (G, M, I)..... (1)

Where;

GDP = real economic growth, G = real government spending, M = real money supply, andI = real investment level in the economy.

### *3.2 Empirical Model Specification.*

In examining the impact of government spending, money supply and investment on economic growth, this study adopt the above theoretical model and modify it by employing the Granger causality test. Here, the real GDP (economic growth) is the dependent variable. The explanatory variables in this study are real government spending (G), real stock of money in the economy (Ms) and the investment component (I). To estimate the causality relationship between economic growth and the variables listed above, Granger causality test was used.

The model to be estimated will be written as follows;

$RGDP_t = \beta_0 + \beta_1 RGOV_t + \beta_2 RMS_t + B_3 RI_t + \varepsilon_t$ ..... (2)

Where $\beta_0$,$\beta_1$ and $\beta_3$ are the coefficients to be estimated and $\varepsilon_t$ is the usual error term. According to the economic theory, there is either a positive or negative relationship government spending or economic growth while some empirical studies which have included money supply provide a negative relationship between money supply and economic growth.

### *3.3 Estimation Techniques*

#### *3.3.1 Stationarity*

A time series process is a sequence of random variables indexed by time. Therefore a time series is said to be stationary if its mean, variance and the autocovariances do not vary systematically over time that is, do not depend on time (Gujarati, 2010). Given the time series nature of the data, the first step is to test for unit roots and the common trends. The unit root tests were conducted using the Phillips-Perron test. The reason for testing the time series for stationarity is that in time series analysis, non stationary data may lead to spurious regression unless at least one cointegrating relationship exists. Therefore, the unit root tests are done to avoid the generation of spurious regression results which obtains biased results.

#### *3.3.2 Unit Root Test*

Many macroeconomic time series contain unit roots dominated by stochastic trends as developed by Nelson and Plosser (1982). Unit roots are important in examining the stationarity of a time series, because a non-stationary regressor invalidates many empirical results. Magazzino (2012) states that the effects of non stationarity include spurious regression results, high $R^2$ and low Durbin Watson (*dw*) statistic. High $R^2$ may only indicate correlated trends and not true economic relationships while low D-W statistics may reflect non stationarity residuals. In this study, the Phillips-Perron (1988) tests were used to determine the presence of unit roots in the data sets.

#### *3.3.3 Error Correction Model*

The Error Correction Model (ECM) represents the speed of adjustment to restore equilibrium in the model. The ECM coefficient shows how slowly or quickly a variable returns to equilibrium and it should be negative, less than 1 and highly significant. Bannerjee, Dolado and Mestre (1998) argue that a highly significant error correction term is further proof of the existence of a stable long term relationship. The most recent studies have used the error correction model so as to capture the dynamics between government expenditures and economic growth.

The VECM model will take the form of:

$\Delta Y_t = \beta_0 + \sum \beta_1 \Delta Y_{t-1} + \sum \beta_2 \Delta X_{t-1} + \beta_3 Y_{t-1} + \beta_4 X_{t-1} + \varepsilon_t$ .....(5)

## 4. Empirical Findings

### *4.1 Unit root test results*

Results from both the Augmented Dickey Fuller and the Phillips-Perron stationary techniques are presented below. Unit root tests are conducted to determine the order of integration of the data series for each of the variables. As noted above, unit root tests are very important in order to avoid the generation of spurious regression results. Table 1 below illustrates unit root tests in levels the Phillips-Perron tests.

*4.1.1 Phillips-Perron tests*

**Table 1:** Phillips-Perron stationarity tests

| Variable | $(\tau)$ |
|---|---|
| RGDP | |
| Trend and intercept | -3.121 |
| Intercept | 1.120 |
| None | 4.356 |
| DRGDP | |
| Trend and intercept | -16.875*** |
| Intercept | -14.135*** |
| None | -11.705*** |
| RTGOV | |
| Trend and intercept | -5.475*** |
| Intercept | -0.882 |
| None | 2.390** |
| DRTGOV | |
| Trend and intercept | -53.282*** |
| Intercept | -32.294*** |
| None | -19.267*** |
| RMI | |
| Trend and intercept | -2.093 |
| Intercept | 0.467 |
| None | 3.235 |
| DRMI | |
| Trend and intercept | -6.378*** |
| Intercept | -6.348*** |
| None | -5.456*** |
| RI | |
| Trend and intercept | -2.068 |
| Intercept | 0.722 |
| None | 2.632 |
| DRI | |
| Trend and intercept | -7.110*** |
| Intercept | -6.964*** |
| None | -6.354*** |

*** stationarity at 1 % significance level
**stationarity at 5 % significance level
*stationarity at 10 % significance level

For getting more robust result, the Phillips-Perron test has been conducted and obtained the uniform results for the variables (Table 1 above). In this unit root test, RGDP, RI and MI are found to be non stationary at level. The null hypothesis which states the existence of unit root cannot be rejected. This shows that the variables are non stationary at level. Government spending is found to be stationary at level at the time trend, intercept and none at the 1 percent significance level. Here, we reject the null hypothesis which states the existence of unit root.

When all the variables are differenced at first difference, interesting results are seen as they all become stationary at the 1 percent significance level. This provide the evidence that the variables are integrated at the first difference, I(1). That is, they are integrated at the order of one.

*4.2 Cointegration tests results*

The null hypothesis is rejected only when the trace test statistics is greater than the critical value. At none, the trace test indicates one cointegrating equation at the 0.05 level. The trace statistics is larger than the critical value. However, at most 1, 2 and 3 hypothesized number of cointegrating equations, we fail to reject the null hypothesis that states that there is no cointegration among the variables. Since the trace test is considered to be more powerful than the max

eigenvalue test, it is concluded that there is one cointegrating vector. Therefore, the VECM model will be estimated.

**Table 2:** Co integration analysis 1990- 2010

Unrestricted Co integration Rank Test (Trace)

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.279713 | 49.75800 | 47.85613 | 0.0328 |
| At most 1 | 0.133393 | 22.52555 | 29.79707 | 0.2702 |
| At most 2 | 0.103381 | 10.64218 | 15.49471 | 0.2345 |
| At most 3 | 0.18914 | 1.584911 | 3.841466 | 0.2081 |

Trace test indicates 1 co integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
** MacKinnon-Haug-Michelis (1999) p-values

**Table 3:** Unrestricted Co integration Rank Test (Maximum Eigenvalue)

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None | 0.279713 | 27.23278 | 27.58434 | 0.0554 |
| At most 1 | 0.133393 | 11.88304 | 21.13162 | 0.5593 |
| At most 2 | 0.103381 | 9.057269 | 14.26460 | 0.2814 |
| At most 3 | 0.018914 | 1.584911 | 3.841466 | 0.2081 |

Max-eigenvalue test indicates 0 cointegratingeqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

**Source:** Authors' Own Computation using Eviews 7

*4.3 VECM*

The study proceeds to estimate a VECM model where economic growth in the VECM is a function of the remaining variables. The long run regression results are provided below:

$RGDP_t$= 1.38228- 6.5465$RTGOV_t$- 0.2377 $RMI_t$ + 2.5964 $RI_t$
(SE 1.2730) (SE 0.04570) (SE 1.2730)
(t = -5.14271) (t = -5.20127) (t = 3.90960)

The empirical results indicate that government expenditure is significant and there is a negative relationship between government spending and economic growth. A 1 percent increase in RTGOV (the government expenditures) led to a 6.54 percent decrease in the RGDP. The sign was not as expected. From the Keynesian view, an increase in government spending is expected to a have a positive impact on the country's output through the multiplier effect. The reason of a negative relationship between government spending and economic growth could be due to the inefficiency of public programs which leads to wastages and losses.

The t statistics show that RMI is significant. A long run relationship is shown between RMI and RGDP. A 1 percent increase in the money supply leads to a 0.23 percent decrease in RGDP which is prior to expectations. This is consistent with the monetary economists' economic theory. An increase in the money supply has an inflationary pressure on the economy which has a displacing effect on the nation's output and therefore economic growth.

There is a long run relationship RGDP and investment. The evidence in the study is prior to expectations. A one percent increase in investment leads to a 2.59 percent increase in the nation's output. The t statics also show that the RMI is statistical significant.

The fact that the variables are cointegrated justifies the use of VECM. The VECM allows the long term behaviour of the endogeneous variables to converge to long term equilibrium while allowing a wide range of short dynamics. The table below shows the speed of adjustment indicated by the coefficients of the error correction terms in the cointegrating equation above.

The coefficients of the error correction terms are interpreted as speed of adjustment to long run equilibrium. In

table above, the speed of adjustment is indicated by the coefficients of the error correction terms. Government spending (RTGOV) and money supply (RMI) have negative coefficients indicating that these variables converge to their long run equilibrium. However, economic growth (RGDP) and RI (Investment) has a positive coefficient indicating that any disequilibrium in RGDP and RI continues to grow. That is to say, if there is any shock to the RGDP or Investment, it takes longer to adjust, it does not adjust immediately.

The adjusted R-squared looks at goodness of fit, therefore as presented in table 5.4 below, the model explains a significant proportion of the variability of the series, principally for RGDP, RTGOV, RMI and RI. The low value of the $R^2$ for government spending reflects that only about 58 % of the variations in economic growth is explained by government spending in South Africa.

**Table 4:** Vector Error Correction Model

| Error Correction: | D(RGDP(-1)) | D(RGDP(-2)) | D(RTGOV(-1)) | D(RTGOV(-2)) | D(RM(-1)) | D(RMI(-2)) |
|---|---|---|---|---|---|---|
| CointEq1 | 0.077958 | -0.270935 | 0.212533 | -0.487976 | -0.122555 | -0.095047 |
| | (0.10415) | (0.11290) | (0.55372) | (0.48079) | (0.04797) | (0.04957) |
| | [ 0.74853] | [-2. 39980] | [0.38383] | [ -1.01494] | [ -2.55494] | [1.91728] |

Notes:
( ) Standard errors
[ ] t-statistic

**Source:** Authors' Own Computation using Eviews 7

## 5. Summary and Conclusion

The study focused on the impact of government spending on economic growth using the Granger causality econometric model and the Johansen cointegration test techniques. Money supply and investment were also included in the model to avoid the mis-specification of the model and also these variables seem to work together with government spending to influence the economic activity of the country.

Economic theory provides ambiguous predictions about the relationship between liquidity and economic growth. The study presents country specific evidence on the causality relationship between government spending and economic growth over the period 1990-2010 using quarterly data. Based on the results obtained in the study, a negative causal relationship between government spending and economic growth is evidenced. This is inconsistent with the Keynesian macroeconomic framework which states that government spending has a positive impact on the nation's output. In the study, it has been evidenced that an increase in government spending in South Africa by 1 percent leads to the reduction in economic growth by 6.5 percent.

### *5.1 Recommendations*

Government spending has been seen to having a negative relationship on the economic growth of South Africa. This could be attributed to the inefficiencies of the government programs. Therefore, it is recommended that the South African government needs to restructure its spending to make it in line with its economic growth macroeconomic objectives. Therefore, it is recommended for the government to improve the efficiencies of its public programs and the provision of services so as to eliminate the wastage of the scarce economic resources.

The research recommends that there is need to address the issue of causality at the disaggregate level of government spending. This will help to reduce the aggregation problem which arises when the aggregate data is employed. Also, a disaggregate approach to examine the impact of government spending on the economic growth of the country will also help to identify those government departments which contributes to the nation's output so as to improve the allocation of the government spending among the different levels.

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## Appendix 1

(accessed November 5, 2009).

VAR Lag Order Selection Criteria
Endogenous variables: RGDP RTGOV RMI RI
Exogenous variables: C
Date: 10/27/11 Time: 11:31
Sample: 1990Q1 2011Q2
Included observations: 74

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -3223.383 | NA | 8.96e+32 | 87.22656 | 87.35111 | 87.27624 |
| 1 | -2907.429 | 589.2108 | 2.70e+29 | 79.11971 | 79.74243 | 79.36812 |
| 2 | -2865.685 | 73.33503 | 1.35e+29 | 78.42391 | 79.54480 | 78.87105 |
| 3 | -2838.161 | 45.37697 | 1.00e+29 | 78.11246 | 79.73153 | 78.75832 |
| 4 | -2782.497 | 85.75198 | 3.49e+28 | 77.04047 | 79.15772 | 77.88506 |
| 5 | -2738.652 | 62.80602 | 1.70e+28* | 76.28788 | 78.90331* | 77.33121* |
| 6 | -2724.125 | 19.23752 | 1.85e+28 | 76.32771 | 79.44131 | 77.56976 |
| 7 | -2709.619 | 17.64323 | 2.06e+28 | 76.36807 | 79.97985 | 77.80885 |
| 8 | -2690.802 | 20.85087 | 2.09e+28 | 76.29195 | 80.40190 | 77.93146 |
| 9 | -2675.116 | 15.68560 | 2.39e+28 | 76.30044 | 80.90857 | 78.13868 |
| 10 | -2642.879 | 28.75229* | 1.82e+28 | 75.86159 | 80.96790 | 77.89856 |
| 11 | -2620.078 | 17.87067 | 1.89e+28 | 75.67780 | 81.28228 | 77.91349 |
| 12 | -2595.461 | 16.63368 | 2.01e+28 | 75.44488* | 81.54754 | 77.87931 |

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error

AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Roots of Characteristic Polynomial
Endogenous variables: RGDP RTGOV RMI RI
Exogenous variables: C
Lag specification: 1 2
Date: 10/27/11 Time: 11:35

| Root | Modulus |
|---|---|
| 0.999988 | 0.999988 |
| 0.888647 - 0.071275i | 0.891501 |
| 0.888647 + 0.071275i | 0.891501 |
| -0.767542 | 0.767542 |
| 0.202203 - 0.498973i | 0.538387 |
| 0.202203 + 0.498973i | 0.538387 |
| 0.173241 - 0.064510i | 0.184862 |
| 0.173241 + 0.064510i | 0.184862 |

No root lies outside the unit circle.
VAR satisfies the stability condition.