Interest Rate – Private Capital Formation Nexus in South Africa: Bounds Test Approach

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Abstract

The study uses the annual time series data for the period 1975 – 2012 to empirically examine the impact of monetary policy on private capital formation in South Africa with the view to establish any long-run relationship. The unit root test was conducted prior to regression using the Dickey-Fuller Generalised Least Squares (DF-GLS) and the Ng – Perron tests. The Granger causality test was also conducted to establish the direction of causation between variables included in the model. The unit root test results reveal that inflation, gross private capital formation and real exchange rate are stationary at first difference while real interest rate is stationary at levels.The bounds test approach asserts that variables could still drift together even when they are integrated of different orders (Pesaran, 2001). Cointegration test indicates an existence of long-run relationship among the variables included using Autoregressive Distributed Lag(ARDL)-ECM cointegration procedure advanced by Pesaran et al.(2001). The results of this study indicate that the cost of capital (interest rate) exerts a significant and negative impact on South Africa's private capital formation.

Keywords: Private capital formation, Interest rates, monetary policy, Bounds test, Cointegration,

1. Introduction

The role of macroeconomic policies on private capital formation has drawn interests amongst researchers and analysts. The private sector is seen as the main engine forengineering economic growth and development since the public institutions are considered to be inefficient, thus a need for promoting private capital formation. The financial performance of public enterprises has always been disappointing despite the huge financial resources dispersed to them. The tendency to heighten private sector participation has prominently shaped policy advice at regional and international financial institutions and policy making particularly in developing countries, giving rise to a wave of privatization programmes, liberalization policies and other policies geared towards the private sector development (Badawi, 2005).

Okoliet al (2007) in trying to find if macroeconomic policies had an impact of private capital formation did in fact find that such policies play a cruacial role. Conversely, Chhiber and Wijnbergen (1988), and Rossiter (2002) report negative effect of public investment on private investment. They argue that public investment may crowd out private investment if the additional investment is financed by a deficit, which leads to an increase in the interest rates, credit rationing and tax burden. As relates to the private capital formation impact of monetary policy, similar imprecision still holds. The advocates of the classical paradigm still argue that money supply, hence monetary policy variables have little or no influence on real economic outcomes, either in the short-run or long-run, that's monetary policy is window dressing (Tobin andBuiter, 1980).

In their paper, Slater and Anthony (2003), support the classical proposition that money is window dressing in both short run and long-run. In other words monetary policy variables were less effective determinants of private capital formation. However, their study was carried out for developed nations. In such circumstances, caution must be exercised not to generalize such conclusions for developing countries (LDCs). Contrary, to the above conclusion, Badawi (2005) argues that monetary policy through credit and interest rate channels has significant impact on private capital formation.Badawi (2005) found these variables to have had significant impact on private capital formation in Sudan over the period 1969-1998. Indeed his findings support the modern Keynesian Paradigm.

Perhaps the primary reason for the low level of private investment in Sub-Saharan Africa is the perception, held by both domestic and foreign investors, that the risk-adjusted rate of return on capital is low. In literature, three major sources of risk appear to be particularly relevant: macroeconomic instability; inadequate legal systems—in particular, the difficulty of enforcing contracts; and political risk. With particular relevance to developing countries, Barrow (1997), show

that broad number of factors determine private capital formation in developing countries, particularly the most relevant are output growth, FDI, real exchange rates, fiscal policy in the form of government spending (fiscal deficits), real interest rates and uncertainty. However, the potential impacts of fiscal and monetary austerities on the private sector's ability to commit substantial capital outlays and various institutions to mobilize required savings have not been fully ascertained. South Africa, despite its notable fiscal and monetary policy prudence and improvements in economic performance, is still confronted with a number of constraints such as low levels of savings and investment to allow for sustained growth. See figure 1 below.

Figure 1: GPCF and GGCF trends

Gross, Private and Government Fixed Capital Formation Trends over the period 1965 to 2010
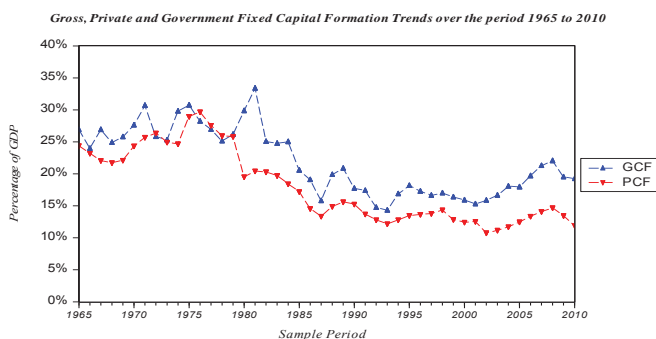
The ratio of PCF to GDP has declined from 29.7% in 1976 to 10.8% in 2002. From 2008, it showed a slight increase of about 4%, but since then it has shown some decline again. On the other hand GCF has seen the same pattern, except in 1981 where GCF increased to 33.38%. There is therefore a need to empirically test the impact of the various macroeconomic policies[1], available in South Africa on private sector development. That is on private sector capital formation in the economy.

2. Review of Literature

A number of studies have attempted to assess empirically the link between macroeconomic policies and private capital formation in both developed and developing countries. Although, the empirical results vary from one study to another, in other cases general conclusions are drawn. The relationship between monetary policy and private capital formation could be traced back to Schumpeter's theory of development in 1934, as well as Keynes (1936). Both these authors argue for the role of credit in the development process. In general, there are basically three channels through which, Monetary Policy could affect private capital formation: the credit channel, interest rate channel, and money supply channel.

Concerning the role of money in physical capital accumulation, two conflicting hypotheses have emerged in literature. The substitutability hypothesis articulated in the works of Tobin (1965) and Johnson (1967), view money as a substitute for physical assets. Thus an increase in the rate of an interest on monetary asset would result in a portfolio shift towards such assets and the result would be a reduced rate of physical capital accumulation and growth. The complimentarity hypothesis originated from the more recent works of McKinnon (1973) and Shaw (1973) and was formalized by Galbis (1979) and Fry (1980). According to McKinnon, in most developing countries, private investment relies on self-financing because of the rudimentary and fragmented nature of capital markets in these countries. Given the lumpiness of investment projects, the requirement that the investor first accumulates the money balances needed to finance or acquire physical capital is enhanced. In this context, a higher real rate of return on money balances is likely to raise investment income ratio, because it enables would-be investors to accumulate equity faster and also because this equity makes them more eligible for any limited institutional financing that may be available.

The debt-intermediation view of Shaw also focuses on this capacity of deposit accumulation to enhance the flow of deposit into banks. Thus, the emphasis in both the complimentarity and debt-intermediation hypotheses is in the use of high interest rates to enhance investment project financing either through own funds or in part through credit borrowing. Emerging, from McKinnon and Shaw hypothesis therefore, neither low interest rates nor any credit allocation policy that

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[1] *The macroeconomic policies are limited to monetary and exchange rate policies only*

is unduly influenced will enhance private capital accumulation.

In regard to private capital formation influence of monetary policy, several empirical studies as already mentioned, proxied such an influence through the credit channel and interest rate channel. For instance, Matin and Wasow (1992) conducted a study to test the impact of adjustment policies in Kenya during 1968-88, the results of this study demonstrated that restrictive monetary policy in the form of credit control to the provide sector had debilitating effect on private capital formation. The flow of credit to the private sector was found significant at 1 percent level of significance and real interest rates variable was found significant at 5 percent level with an expected negative sign. These results were reinforcing those attained by Shafik (1992) for Egypt, Ogunbenro *et al* (1996) in a study done for Nigeria between 1983-1996 and Oshikoya (1992) in a study done for Kenya. A similar conclusion that domestic credit and real interest rates matter for private capital formation was reached by Kumar and Mlambo (1995) in a study conducted for Sub-Saharan Africa, using a pooled time series and cross sectional data for the period 1970-1993. These authors experimented with both linear and log linear models and interpreted the results from log-linear, which was considered more appropriate.

In light of these problems, several authors including Belloc and Vertova (2004), Badawi (2003), Mittnik and Neumann (2001), Ligthart (2000), and Ghali (1998), recommend that such dynamic equations be specified and estimated as vector autogressive (VAR) Model, in order to account for the aforementioned problems and spurious correlations in the regression. Furthermore, to account for the delayed response with the parsimonious lag structure, due to the fact that private investment takes time to respond to changes in policy variables. Badawi (2005), in particular, utilized VAR model to investigate the impact of both fiscal and monetary policies on private capital formation in Sudan over the period 1969-98. In order to distinguish precisely between the short-run and long-run impacts, he proceeded to use the Vector Error Correction Model (VECM) embodied in the VAR technique. In his study, the VAR and VECM models employed were specified as:

$$\mathbf{Z_t} = \mathbf{A_0 D_t} + \mathbf{A_1 Z_{t-1}} + \mathbf{A_2 Z_{t-2}} + \dots\dots\dots\dots + \mathbf{A_k Z_{t-k}} + \mathbf{\varepsilon_t} \qquad (1)$$

where Z_t = nx1 vector containing n endogenous variables in the system, which were Private Investment (I), real output (Y), public sector investment (PSI), real exchange rate (RE), and real credit to the private firms (CR); (all variables in natural logarithm). D = a vector holding deterministic terms, and ε_t = nxn dimensional vector of multivariate random error terms with mean and covariance matrix given by Σ. The Error Correction representation of the above VAR took the following form:

$$\mathbf{\Delta Z_t} = \mathbf{\psi D_t} + \mathbf{\Pi Z_{t-1}} + \mathbf{\Gamma_1 \Delta Z_{t-1}} + \mathbf{\Gamma_2 \Delta Z_{t-2}} + \dots\dots\dots + \mathbf{\Gamma_{k-1} \Delta Z_{t-k+1}} + \mathbf{V_t} \qquad (2)$$

where $\mathbf{\Pi}$ = long-run matrix containing two matrices, $\mathbf{\alpha}$ and $\mathbf{\beta}$ holding long-run adjustment coefficients and long-run elasticities respectively. Accordingly, the current study employs the Bounds test approach to study the impact of monetary policies on private capital formation in South Africa.

3. Econometric Specification of the Model and Results

The abovementioned model specification has been extended and modified in order to derive a model that is deemed appropriate for evaluating the impact of fiscal and monetary policies on private capital formation in South Africa. The general dynamic form of the econometric model used in this study is:

$$GPCF_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i} GPCF_{t-i} + \sum_{i=0}^{k} \beta_{ti} Y_{t-i} + \delta_0 D_t + v_t \qquad (3)$$

where, $GPCF_t$= gross private investment, Y_{t-i} represents a set of all explanatory variables to be included in the model and their lags, D_t represents a set of deterministic terms (dummies, trends and others). V_t is a well behaved error term. Therefore, specifying equation (3) as a VAR system of equations gives equation (4), which is compactly written as equation (5):

$$Y_t = \delta_0 D_t + \delta_1 Y_{t-1} + \delta_2 Y_{t-2} + \dots\dots\dots\dots + \delta_k Y_{t-k} + \pi_t \qquad (4)$$

$$Y_t = \delta_0 D_t + \sum_{i=1}^{k} \delta_i Y_{t-i} + \pi_t \qquad (5)$$

4. Research Findings

4.1 Granger causality analysis

The results of causality test are reported in table 1 below. We conclude that there is unidirectional causality with causality running from consumer confidence to consumer spending. The study excluded other explanatory variables such as personal tax, inflation and unemployment after the preliminary tests showed that these variables were not statistically significant in explaining consumer spending. As much as other studies could come to a different conclusion about the dropping of these variables, they are found to be insignificant for South Africa.

Table 1: VAR Granger Causality/Block Exogeneity Test results

Dependent variable: GPCF			
Excluded	Chi-sq	df	Prob.
INF	5.705723	2	0.0577
REER	2.231937	2	0.3276
RIR	6.924950	2	0.0314
All	10.33345	6	0.1113

*, **, *** represent 1%, 5% and 10% respectively

The results of exogeneity test indicate that not all variables can be treated as endogenous. The variables can be treated as endogenous individually but not always jointly. The pairwise Granger causality shows that there is unidirectional causation from interest rates to private capital formation and from inflation to PCF.

4.2 Stationarity Analysis

A stochastic process, correspondingly a time series, is stationary if the means and variances of such series are constant overtime and the covariances between the two time periods "t" and "t + k", depend only on the distance (lag) k between these two time periods and not on the actual time period "t" at which these covariances are considered (Katos*et al.*, 2000). Technically, non-stationarity implies that the moments (mean, variance and other higher moments) of the distribution from which the series of observations were generated/drawn is not constant/ time invariant, depending rather on the point in time at which the observations were made (Harvey, 1990).

Various solutions are proposed to deal with non-stationary time series, these include differencing of the series to reach stationarity or combining different sets of time series together at level form provided they are cointegrated[2]. Preferably, any non-stationary series should be preceded by identifying the order of integration of each series by running the stationarity tests to decide the number of times a series should be differenced to achieve stationarity. A series that is to be differenced d times to achieve stationarity is said to be integrated of order d, thus ~I (d). In literature, several tests have been proposed to tests for stationarity of time series data, however this study employs the modified DF test (DF-GLS) as well as the Ng-Perron test due to their superiority over the standard Dickey-Fuller (DF, ADF)and the Phillips-Perron (PP) tests.In empirical research, regressing of one non-stationary series on the other may lead to spurious regression, which adversely affects the validity of the standard statistical tests (t and F-tests). Various solutions are proposed to deal with non-stationary time series; these include differencing of the series to reach stationarity. The most notable tests include the ADF proposed by Dickey and Fuller (1979) as well as the PP by Phillips andPerron (1988), which were found to lack power and hence a development of other tests.

4.2.1 The DF-Generalized Least Squares (DF-GLS) test

This detrending test was suggested by Elliott, Rothenberg & Stock in 1996[3]. These authors optimized the power of the

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[2] *Formally, time series Xt and Ytare said to be cointegrated of order (d, b,) that is Yt~CI (d, b), where d≥b ≥0, if both series are I (d) and there exists a linear combination of the series such that [$\beta_1 x_t + \beta_2 y_t$] is I(d,b) and the vector $\beta_1 x_t + \beta_2 y_t$ is called the cointegrating vector . For the case of n series where n >2, an nx1 vector β exist such that $x_t \beta$ ~I (d-b) where xt denotes an nx1 vector of series x1t, x2t, ...xnt, (Engle and Granger, 1987, p253; Charemza and Deadman, 1997, p.125).*

[3] *See details of the test in G. Elliott, T.J.Rothenberg, and J.H.Stock, "Efficient Tests for an Autoregressive Unit Root," Econometrica, Vol.64, 1996,pp813-836.*

ADF test by detrending. The test is based on testing the null hypothesis that ϕ_0 = 0 given the following regression:

$$\Delta Z_t^d = \varphi_0 Z_t^d + \varphi_1 \Delta Z_{t-1}^d + \ldots\ldots\ldots\ldots\ldots + \varphi_p Z_{t-p}^d + \varepsilon \qquad (6)$$

where Z_t^d is the de-trended series Z_t. The null hypothesis of the test is that Z_t^d has a random walk trend, possibly with a drift as follows:

$$Z_t^d = Z_t - \hat{\delta}_0 - \hat{\delta}_1 t \qquad (7)$$

Two possible alternative hypotheses accrue to this test:

(a) Z_t is stationary about a linear trend

(b) Z_t is stationary with a non-zero mean, but with no linear time trend.

Under the first alternative hypothesis, the DFGLS test is performed by first estimating the intercept and the trend using the generalized least squares technique. This estimation is performed by generating the following variables:

$$\bar{Z} = [Z_1, (1-\bar{\alpha}L)Z_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots, (1-\bar{\alpha}L)Z_T]$$
$$\bar{W} = [Z_1, (1-\bar{\alpha}L)W_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots, (1-\bar{\alpha}L)W_T] \qquad (8)$$

And $W_t = (1,t)$ $\bar{\alpha} = 1 + \frac{C}{T}$ (9)

where T represents the number of observations for Z_t and $\bar{C}$ is fixed at -13.7^a. Then an OLS regression is performed on the following equation: $Z = \delta_0 W + \bar{\delta}_1 W_t + \varepsilon_t$ (10)

and the OLS estimators $\hat{\delta}_0$ *and* $\hat{\delta}_1$ are then used to remove the trend from Z_t above. Finally, the ADF is performed on the transformed variable by fitting the OLS regression given by equation (11) below:

$$\Delta Z_t^d = \varphi_0 + \rho Z_{t-1}^d + \sum_{j=1}^{k} \beta_j \Delta Z_{t-j}^d + \mu_t \qquad (11)$$

From equation (9), the null hypothesis that ρ = 0 is tested using the tabulated critical values provided by Elliot *et al* (1996). Under the second alternative hypothesis, the DFGLS test is implemented as before but this time $\bar{C}$ is fixed at -7 in the equation of $\bar{\alpha}$, above. Then $Z_t^d = Z_t - \hat{\delta}_0$ is computed and the ADF is fitted on the newly transformed variable and the null hypothesis of ρ = 0 is evaluated using the tabulated critical values. The results pertaining to the most parameterized model are presented in Table 2 below.

4.2.2 Ng-Perron unit root test

Ng and Perron (2001) show that DGGLS exhibits size distortions and hence propose a test for unit root that has good size and power properties. These tests have similar size and power properties and simulations show that they perform better than the DF-GLS test (Ng and Perron 2001). Ng and Perron also address the problem of sensitivity of unit root testing to the choice of lag length. They propose the new information criteria, the Modified Information Criteria (MIC). The distinction between the standard information criteria such as the Akaike and the Schwartz Bayesian is that the former takes into account the fact that the bias in the sum of the autoregressive coefficients is highly dependent on the number of lags.

Table 2: Unit Root Test Results

Name	DF-GLS	MZ_α^{GLS}	MZ_t^{GLS}	Inference
GPCF	-0.8309	-0.3459	-0.2241	I(1)
REER	-1.3273	-4.9398	-1.4906	I(1)
RIR	-3.0437*	-11.9453**	-2.4434**	I(0)
INF	-1.4917	-4.4565	-1.3811	I(1)

Note: the Ng-Perron critical values for MZa&MZt at 1 %, 5 % & 10 % are [-13.8000, -8.1000, -5.7000;-2.5800, -1.1980, -1.6200 respectively]. *, **, *** represent level of rejection at 1%, 5% and 10% respectively

The unit root test results show that GPCF, INF and REER are integrated of order one, while RIR is integrated of order zero. From an application of Ng-Perron test show that the unit root hypothesis is rejected at 5 percent level of significance in the case of RIR. Therefore, Ng-Perron test also confirms that variables is I(0).

4.2.3 Cointegration Analysis: Bounds Test

The bounds test approach requires that we perform the coefficient diagnostic test in order to find if the estimated coefficients are statistically equal to zero using the Wald test. The results of the Wald test are presented in table5 below.

Table 3 : Wald test Results

Test Statistic	Value	df	Probability
F-statistic	4.288147	(2, 21)	0.0274
Chi-square	8.576294	2	0.0137

The wald test in table 5 above indicates that the explanatory variables are statistically significant. The F-statistic on the other hand appears to be greater than the upper bound (4.06)against the lower bound 3.03 at k = 3, suggesting the presence of long-run relationship amongst the variables in question. This shows that gross private capital formation and interest rates drift together and thus may drift apart should there be a monetary policy shock. The establishment of the long-run amongst the variables compelled us to perform the vector error correction (VECM), which is represented by equation below:

$$\Delta GPCF_t = \beta_1 + \sum_{i=0}^{n}\beta_2\Delta RIR_{t-i} + \sum_{i=0}^{n}\beta_3\Delta INF_{t-i} + \sum_{i=0}^{n}\beta_4 REER_{t-i} + \sum_{i=1}^{n}\beta_5\Delta GPCF_{t-i} + \beta_8 EC_{t-1} + \pi_t \qquad (12)$$

Where the respective variables are of the same order of integration but those with order zero will cointegrate with high power, while those integrated with order one will cointegrate with low power. The value of *n* is chosen using the AIC and the SIC. *EC* is the error correction component and π is the random error term. The error correction term (*EC)* is the lagged values of the error term that has been derived from the regression model. The results are presented in table 6 below.

Table 4: VECM Results

Error Correction:	D(GPCF)	D(INF)	D(REER)	D(RIR)
CointEq1	-0.005178	-0.026261	1.075069	-0.223985
	(0.04216)	(0.06099)	(0.25388)	(0.11052)
	[-0.12284]	[-0.43056]	[4.23463]	[-2.02659]

The VECM results reveal that about 0.5 percent of the disequilibrium is corrected each year by changes in gross private capital formation in South Africa. This is justified by the coefficient -0.005178. This coefficient bears the expected sign (negative) as expected, because the negativity implies that the model is stable. Gross private capital formation responds slowly when there is a shock. In addition to the VECM, the impulse response functions (shown in appendix A) also justify the negative relationship between real rate of interest and private capital formation.

5. Conclusions

Although, the role of Private Capital Formation (PCF) in engineering growth and development is highly appreciated, PCF is inclined to changes in Government Policy (GP). This study set out to empirically investigate the impact of monetary policy on private capital formation in South Africa, following the IMF-World Bank policy recommendation that for her to achieve favourable growth rate and reduce poverty, she must develop the private sector and use it an engine of growth while also pursuing stringent fiscal policy and prudential monetary policy.

The results from this study indicated the impact of interest rates on PCF in the long-run is negative. This supports the Investment-Interest rates nexus in South Africa and therefore discerned that indeed, in the long-run, the costs of funds do matter to private investors when making decisions regarding expansion in fixed assets. Several principal

conclusions therefore, emerge from this study. First, interest rates have implications on long-run private capital accumulation in South Africa, which might or might not be the case for other countries participating in the Southern African Development Community (SADC). The cost of capital has a bearing on long-run private capital accumulation in South Africa. Therefore, on aggregate basis, those countries experiencing low levels of bank lending rates and unrationed credit, *ceteries' paribus,* are likely to accumulate more capital and grow faster than those experiencing high levels of interest rates. The falling trends in private investment in South Africa (see figure 1) is a clear indication that, although SADC has served South Africa well in terms of low inflation and conduct of monetary policy, the country might be beginning to suffocate as its dominant partners prosper.

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