KEY DETERMINANTS OF INVESTMENT IN GHANA: COINTEGRATION AND CAUSALITY ANALYSIS

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ABSTRACT

This paper examines the relationship between Investment, Income, Interest Rate and Inflation in Ghana from 1990 to 2014 (data period of 25 years) using Unit roots test, co-integration analysis and causality tests. The findings of the study suggest that there has been a significant and positive bidirectional Granger-causal relationship between level of investment and level of income in Ghana over the period. The study also finds a unidirectional causal relationship running from level of income to inflation and from level of income to interest rate at significant levels. The study however finds no significant causal relationship in any direction among the other variables. The findings of the study make relevant contribution to especially policy makers and stakeholders involved in the management of Ghana's macro economy, in particular, where the primary objective is to increase investment level.

Keywords: Investment, Interest rate, inflation, Causality, Ghana.

INTRODUCTION

The role of investment in economic growth can hardly be overemphasized in an economy. Both economic theories as well as empirical work have concluded that there is a positive relationship between investment and economic growth[1]–[7]. As a result, policy makers and economists are often concerned with the factors that determine the level of investment in an economy. Two of such factors that exert greater influence on investment is the real interest rate and level of income[8]–[17].

According to the neoclassical theory of investment, there is a negative relationship between investment and the real interest rate[18][19]–[21][16]. Thus, a rise in the real interest rate raises the real cost of capital and as a result reduces investment level and vice versa. There is however positive relation between investment and income[22][19]–[21], [23][24].

The negative relationship between investment and the real interest rate has generated interesting discussions in economic theory[10], [25], [26]. As much as real interest rate plays a crucial role in the monetary policy transmission mechanism, the relationship between the real interest rate and investment is of great importance to policy makers[10], [25], [26][8], [9]. Other studies have also considered factors such as macroeconomic stability, structural reforms, external stability, macroeconomic volatility, physical infrastructure and trade

openness as having significant influence on investment, especially private investment[27][28].

In the case of Ghana, investment growth has often been linked with the real rate of interest. Similar to the trend in other countries[16], [24], the Central Bank (i.e. Bank of Ghana) charges the prime rate and the commercial banks compete with each other in determining the level of interest rate[17].

The purpose of this paper is therefore to examine the key determinants of investment in Ghana and to assess the nature of the relationship among the variables. The findings of this study is expected to provide invaluable reference to academia and potential investors in Ghana. It is also expected to provide useful insight to investment decisions policy direction in Ghana.

LITERATURE REVIEW

Economist and policy makers alike agree that Investment (either private or public) plays a crucial role in the economic growth of every nation[1]. In fact, some economists (Neo-classical and Marxist) emphasize investment (capital accumulation) as the engine of economic growth[1].

Extant literature and theories on investment identifies real interest rate as one of the key influencers of investment[1][20].The relationship between investment and real interest rate has generated interesting discussions in economic theory[10], [25], [26][20]. According to the neoclassical theory of investment, there is a negative relationship between investment and the real interest rate[18][19]–[21][16]. Thus, a rise in the real interest rate raises the real cost of capital and as a result reduces investment level and vice versa.

Consistent with economic theory, a study on the impact of real interest rate on investment level in Jordan over the period (1990- 2005) found a negative relationship between real interest rates and investment[16]. A similar study evaluating the determinants of unsatisfying private investment growth in the Middle East and North Africa (MENA) throughout the 1980s and 1990 also identified real interest rate (one of the traditional determinants of level of investment) as an explanatory factor to MENA's low investment rate[27].

Another study on the Investment Decisions and Financial Standing of Portuguese Firms evaluated the extent to which the financial pressure of a firm, as assessed by the level of interest payments (as a percentage of operating income), affects its investment[29]. The findings of the study indicated a negative relationship among the variables that measured the financial pressure of firms (such as real interest rates) and firm's investment. In particular, firms spent larger percentage of their operating income in debt servicing (as a result of among other factors, high interest rates) showed lower investment rates[29].

In the case of a study involving Polish companies in 2009, interest rate was ranked among the least of important elements that determine investment decisions process. Interest rates were however, among the key factors for financial services. Whiles at the same time remained less important to small and medium sized companies[15].

After the 2008 global financial crisis, interest rates regulation has received even greater priorities in the economic policies of governments[30]. For instance, in a bid to improve the

volume and conditions of bank loans in the economy, the Brazilian government adopted measures, including reduction of interest rates, not only in order to reduce the banking spread in Brazil, but also to encourage investment and productive activity in the country[30].

A study on the key determinants on investment in Ethiopia using co-integration tests, and Engle and Granger Two Step Error Correction Model(ECM) found that public investment, real GDP per-capital, and external debt had significant positive long run effect on private investment, while lagged private investment(proxy for investment climate) had significant negative long run effect. Again, real GDP per-capita and external debt were found to have significant positive impact on private investment in the short run while inflation had significant short run negative effect on private investment[31].

In the case of Ghana, the determinant of investment (largely Private investment) has been varying across the few studies[22], [28], [32]. For instance, a study on private investment behavior, using both time series and cross sectional analysis concluded that trade regime, growth of real credit to the private sector, macroeconomic instability and political instability were the four most important variables (in terms of the magnitude of their influence on private investment)[32]. Another study assessed, empirically, the factors that have either stimulated or dampened private sector investment in Ghana from 1970 to 2002[28]. Using the unit root tests, cointegration and error correction techniques within an ARDL framework, the results of the study suggested that in the short-run, private investment is determined by public investment, inflation, real interest rate, openness, real exchange rate and a regime of constitutional rule. However, in the long-run, real output, inflation, external debt, real interest rate, openness and real exchange rate had significant impact on private investment response[28].

Empirical Strategy

Data sources

The study used annual time series data for the period 1990 – 2014(data period of 25 years) on all the variables. All data used in this study were from secondary sources. Data on GFCF and GDP were extracted from World Bank database[33]. Data on real interest rates were extracted from the Bank of Ghana (BoG) Monetary Policy time series databank[34], [35] whiles CPI data were also extracted from the Ghana Statistical Services(GSS) database [36].

Method of estimation

Granger Causality and Cointegration

The test of causality direction in time series data is suggested by Engle and Granger[37], [38]. If X_t and Y_t are two stationary time series with zero means, then the series X_t is said to Granger-cause Y_t if current Y_t can be predicted better by using past values of X_t than by not doing so, having used all other past information in the dataset. Thus, the variable X_t improves the prediction of the variable Y_t .The simple causal model for series X_t and Y_t can then be written as

$$X_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{n} b_j Y_{t-j} + \varepsilon_t \quad \ldots (1)$$

$$Y_t = \sum_{j=1}^{m} c_j Y_{t-j} + \sum_{j=1}^{n} d_j X_{t-j} + \gamma_t \quad \ldots (2)$$

Where ε_t and γ_t are taken to be two uncorrelated white-noise series.
The null hypotheses to be tested are:
$(i)\ H_o: b_j = 0, j = 1 \ldots \ldots m$, implying that X_t does not Granger-cause Y_t
$(ii)\ H_o: d_j = 0, j = 1 \ldots \ldots m$, implying that Y_t does not Granger-cause X_t

The two series are independent of each other if none of the hypotheses is rejected. Bidirectional causality occurs if both hypotheses are rejected (i.e. (i) and (ii)). However, unidirectional causality occurs if one is rejected and the other is not rejected[37], [38].

In general, this study adopts three steps in the causality testing procedure: (1) test the order of integration (stationarity) of the levels of the variables (in logs). To specify the integration order of the variables, the study adopts the Augmented Dickey-Fuller (ADF) test[39]. The ADF test tests the null hypothesis that the series is non-stationary or the series contains a unit root (i.e. $H_0: \beta_1 = 0$) against the alternate hypothesis that the series is stationary or not integrated of order zero ($H_0: \beta_1 < 0$);(2) test for Cointegration (depending on results from step 1) using Johansen's (1991) multivariate procedure to check for a common trend. if Cointegration exists, then either unidirectional or bidirectional Granger causality must exist in at least the stationary variables.(3) perform a standard Granger causality test on the stationary series including, in the model, an appropriate error-correction term to cater for the short-run dynamics and the likelihood of 'spurious causality'[37], [38].

This study adopt the Johansen procedure[40] to test any Cointegration relationship among the variables If the variables are found to have unit roots (nonstationarity), and are of the same order of integration. The vector error correction model (VECM) is then used to estimate long-run causality and short-term dynamics if there is an evidence of Cointegration relationship among the variables.

Model Specification

According to neoclassical economic theory, the level of Investment depends mainly on Interest Rate. Other key determinants (variables) include the level of Income and Inflation.
Consequently, this study tests the causality relationship among these four (4) variables: Investment (I_t) Real Interest Rate (R_t), Inflation ($INFL_t$) and Level of Income (Y_t). Gross Domestic Fixed Investment (GDFI) is used as proxy for level of Investment. GDFI refers to real capital calculated using 2000 constant prices. Interest rate here refers to the real interest rate and measures the annual percentage increase in the real value of a financial asset. It is calculated by making adjustments for increase in price (or inflation). For the purposes of this study, the Bank of Ghana's Monetary Policy Rate (MPR) is used as a proxy for Interest Rate (R_t). Inflation ($INFL_t$) as measured by the Consumer Price Index (CPI) reflects the annual percentage change in the cost to the average consumer of acquiring a fixed basket of goods and services that may be fixed or changed at specified intervals(e.g. yearly). Gross Domestic Product (GDP) is used as proxy for level of Income (Y_t). GDP is the total value of goods and services produced within the borders of an economy or a country during a given period of time and measured in market prices.
The general models using the aforementioned variables are:

$$I_t = f(R_t, INFL_t, Y_t) \ldots \ldots \ldots \ldots (3)$$
$$R_t = f(I_t, INFL_t, Y_t) \ldots \ldots \ldots \ldots (4)$$
$$INFL_t = f(R_t, I_t, Y_t) \ldots \ldots \ldots \ldots (5)$$
$$Y_t = f(R_t, INFL_t, I_t) \ldots \ldots \ldots \ldots (6)$$

$where\ I_t = the\ level\ of\ investment, R_t = rate\ of\ interest\ and\ t = time(from\ 1990\ to\ 2014)$
$INFL_t = Inflation, Y_t = level\ of\ Income$

Empirical Results and Discussion

Unit Root Test

The results of the ADF test for unit root are presented in Table 1. The results compares the test statistics on Investment (I_t) Real Interest Rate (R_t), Inflation ($INFL_t$) and Level of Income (Y_t) at common significant levels (1%, 5% and 10%) with their respective critical values. The test regression included both an intercept and a linear trend for the log levels as well as intercept with no linear trend for the first differences of the variables.

Table 1: ADF Unit Root Test Results

Variable	Test Value	Critical Value		
		1%	*5%*	*10%*
$\ln I_t$	-3.475	-2.508	-1.717	-1.321
$\Delta \ln I_t$	-6.172	-2.518	-1.323	-3.24
$\ln R_t$	-1.007	-2.508	-1.717	-1.321
$\Delta \ln R_t$	-4.821	-2.518	-1.721	-1.323
$\ln Y_t$	-1.617	-4.380	-3.600	-3.24
$\Delta \ln Y_t$	-3.454	-2.518	-1.721	-1.323
$\ln INFL_t$	-1.495	-2.508	-1.717	-1.321
$\Delta \ln INFL_t$	-4.833	-2.518	-1.721	-1.323

Δ indicates first difference

From the results in Table 1, the null hypothesis that the levels of the series contain unit roots cannot be rejected except for lnIt. However, on first-differenced data, the results reject the hypothesis of a unit root in all the variables (i.e. in level form the series are I (1) but in first difference form they are I (0)).

The Johansen Cointegration Test

The results of the Johansen test of Cointegration are shown in Table 3a and Table 3b. Both the trace statistics (Table 3a) and the maximum eigenvalues reject the null hypothesis of no Cointegrating equation among the variables at 1% significance level. The results however fail to reject the null hypothesis of at most one (1) cointegrating equation. Hence, we accept the null hypothesis that there is one cointegrating equation in the multivariate model. The results imply that the four (4) variables are cointegrated (i.e. have long run association) and causally related.

Table 3a: Johansen Cointegration Test Results - Trace Statistics

Number of Cointegration Equations(CEs)	Trace Statistics(TS)	Critical Values(CV)	
		1%	*5%*
None	61.2666	54.46	47.21
At most 1	27.193*	35.65	29.68
At most 2	8.9282	20.04	15.41
At most 3	0.345	6.65	3.76

The * indicates that this estimator has selected the number of cointegrating equations corresponding to this row of the table.

Table 2b: Johansen Cointegration Test Results - Maximum Eigenvalues

Number of Cointegration Equations(CEs)	Max-Eigenvalues(ME)	Critical Values(CV)	
		1%	*5%*
None	34.0736	32.24	27.07
At most 1	18.2648*	25.52	20.97
At most 2	8.5832	18.63	14.07
At most 3	0.345	6.65	3.76

The * indicates that this estimator has selected the number of cointegrating equations corresponding to this row of the table

Granger Causality Test

The causality test results are shown in Table 4. The *F*-statistics from the Granger-causality test suggest a bidirectional causality between Level of Investment (lnI_t) and Level of Income (lnY_t).However, a unidirectional causality running from Level of Income (lnY_t) to Inflation ($lnINFL_t$) (F-value 403.4, significant at the 1% level) and from Level of Income to Interest Rate (lnR_t) (F-value 170.02, significant at the 1% level) is also reported. Furthermore, the result show no causality relationship between lnI_t and $lnINFL_t$ and vice versa, lnI_t and lnR_t and vice versa, $lnINFL_t$ and lnY_t, lnR_t and lnY_t, $lnINFL_t$ and lnR_t and vice versa. These results are significant at 5% level.

Table 3: Results from Granger Causality Test

Causality Direction		*Lags*	*F-Statistics*	*P-values*	*Remarks*	*Conclusion*
lnI_t	lnY_t	4	9.4123	0.0479**	Reject Null	lnI_t Granger Cause lnY_t
lnY_t	lnI_t	4	249.11	0.0004***	Reject Null	lnY_t Granger Cause lnI_t
lnI_t	$lnINFL_t$	4	7.3754	0.0662*	Fail to reject Null	lnI_t does not Granger Cause $lnINFL_t$
$lnINFL_t$	lnI_t	4	4.695	0.1172	Fail to reject Null	$lnINFL_t$ does not Granger Cause lnI_t
lnI_t	lnR_t	4	1.6625	0.3525	Fail to reject Null	lnI_t does not Granger Cause lnR_t
lnR_t	lnI_t	4	7.311	0.0670*	Fail to reject Null	lnR_t does not Granger Cause lnI_t
lnY_t	$lnINFL_t$	4	403.4	0.0002***	Reject Null	lnY_t Granger Cause $lnINFL_t$
$lnINFL_t$	lnY_t	4	5.1644	0.1043	Fail to reject Null	$lnINFL_t$ does not Granger Cause lnY_t
lnY_t	lnR_t	4	170.02	0.0007***	Reject Null	lnY_t Granger Cause lnR_t
lnR_t	lnY_t	4	1.8108	0.3266	Fail to reject Null	lnR_t does not Granger Cause lnY_t
$lnINFL_t$	lnR_t	4	5.2356	0.1025	Fail to reject Null	$lnINFL_t$ does not Granger Cause lnR_t
lnR_t	$lnINFL_t$	4	1.3498	0.4193	Fail to reject Null	lnR_t does not Granger Cause $lnINFL_t$

*, **, *** denotes significance at 10%, 5% and 1% level respectively

CONCLUSION

This paper tested the causal relationship among level of Investment, Interest Rate, level of Income and Inflation in Ghana over the period 1990-2014(data period of 25 years). The study used tests of Cointegration as a pre-test strategy for Granger tests of causality between the two variables. The results of the tests suggest that there has been a significant and positive bidirectional Granger-causal relationship between level of Investment and level of Income in Ghana over the period. The study also finds a unidirectional causal relationship running from level of Income to Inflation and from level of Income to Interest Rate at significant levels. The study however finds no significant causal relationship in any direction among the other variables.

The findings of the study makes relevant contribution to especially policy makers and stakeholders involved in the management of Ghana's macro economy. In particular, where the primary objective is to increase investment level.

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