

Macroeconomic Variables, Investment and Economic Development in Nigeria: A Prognosis

Kizito Uyi Ehigiamusoe¹ and Hooi Hooi Lean²

The paper examines the effects of macroeconomic variables and investment rate on economic development in Nigeria for the 1980-2014 period. It also examines how the interaction between macroeconomic variables and investment affect economic development to ascertain whether the effects of investment on economic development varies with the level of macroeconomic variables. Out of the five macroeconomic variables selected based on Maastricht Criteria indicators that measure a country's macroeconomic stability, fiscal deficit relative to GDP and real exchange rate have positive impact on economic development, while inflation rate and government debt relative to GDP have negative impact on economic development. However, real interest rate has no statistically significant impact on economic development in Nigeria. Moreover, the study found overwhelming evidence that the impact of investment rate on economic development varies with the level of four macroeconomic variables except real interest rate. The implication is that macroeconomic variables help to explain variation in economic development and investment rate indicating that better performance of macroeconomic variables and more investment rate seem to be much more applicable in the process of economic development than more investment rate in the midst of poor macroeconomic environment. Based on the findings, the paper made some policy recommendations.

Keywords: Macroeconomic variables, economic development, investment rate

JEL Classification: E69, O11, E31

1. Introduction

The macroeconomic policies adopted by a country determine the predictability of the domestic macroeconomic environment in-terms of

¹ Economics Program, School of Social Sciences, Universiti Sains Malaysia (USM).
E-Mail: ehiuyikizexcel@yahoo.com

² Economics Program, School of Social Sciences, Universiti Sains Malaysia.
E-Mail: hooilean@usm.my

resource allocation decisions, investment and economic growth. A stable macroeconomic environment enhances the capacity of a country to cope with both internal and external shocks, provides opportunities for hedging risks and offers various choices of fiscal, monetary and exchange rate policies. But macroeconomic instability in the form of volatility of key macroeconomic variables or unsustainability of their behaviours is often the outcome of poor macroeconomic policies (see Serven & Montiel, 2004). Theoretical and empirical literature contend that the behaviours of macroeconomic variables such as inflation rate, real interest rate, real exchange rate, fiscal deficit relative to GDP and government debt relative to GDP are fundamental in the development process of any economy.

Hence, many developing countries strive to adopt policies (fiscal, monetary and exchange rate policies) that will guarantee favourable performances of these variables with a view to achieving macroeconomic stabilization and ultimately economic development. Todaro and Smith (2009) opine that the major goals of macroeconomic stability include; controlling inflation, restoration of fiscal balance and elimination of current accounts deficits. Thus, the International Monetary Fund and the World Bank are the two principal catalysts in the stabilization and adjustment policies of most developing countries through the provision of international private lending and multilateral development assistance.

Several developing economies traditionally experience greater macroeconomic instability than developed economies because of their inability to minimize their vulnerability to external shocks and accelerate economic development. The Maastricht Criteria³ highlighted five indicators that measure a country's macroeconomic stability to include low and stable inflation rate (within 3%), low currency fluctuation (within 3%), low long-term interest rate (within 9%), low budget deficit relative to GDP (within 3%) and low government debt relative to GDP (within 60%). Analogously, Serven and Montiel (2004) and Basci (2012) also enumerated these variables as the main indicators of macroeconomic stability.

³ The Maastricht Criteria are the five convergence criteria that the European Union members should meet before they can enter the third stage of the Economic and Monetary Union and adopt the euro as their currency. It was named after a city called 'Maastricht' in Netherlands where the Treaty on European Union was signed on 7th February, 1992.

Although Nigeria's desire to attain economic diversification and development is commendable, but its actualization would remain a mirage if the relationship between macroeconomic variables and economic development remain unclear. Infact, the capacity of a country to drive the process of economic diversification and development depends (to a large extent) on the progressive relationship between macroeconomic variables and the development process. The performances of macroeconomic variables in Nigeria in the past three decades revealed that the average inflation rate were 20.89%, 32.06, and 12.23% in the 1980s, 1990s and 2000s, respectively. These rates were far higher than the recommendation by the Maastricht Criteria and could have adverse effects on economic development in Nigeria. Theoretical and empirical evidence suggest that low and stable inflation rate are necessary to stimulate investment rate, financial development and economic growth because they create healthy demand in the marketplace, encourage long term contracts, stabilize government tax revenue and individual liabilities. Conversely, high and volatile inflation rate have adverse effects on investment rate, financial development and economic growth because they distort resource allocation (see Bruno & Easterly, 1998; Rousseau & Wachtel, 2001; Bittencourt, 2011b).

Furthermore, the real exchange rate⁴ of Nigeria depreciated greatly in the past three decades, averaging 992.03 in 2000s compared to 249.15 in 1990s and 16.89 in 1980s. Vieira et al. (2013) found that economic growth is negatively related to a high exchange rate fluctuation, but positively correlated with a moderately volatile exchange rate. Aghion et al. (2009) and Elbadawi et al. (2012) also reported a negative correlation between real exchange rate appreciation and economic growth. Albeit, Hua (2012) and Tang (2015) found no significant positive correlation between real exchange rate and economic growth, but they argued that the fluctuations in real exchange rate could result in a positive or negative impact on economic growth. Also, Serven (2003) and Bleaney and Greenaway (2001) found that real exchange rate and its volatility has negative impact on investment rate.

⁴ The real exchange rate between the Naira and the USD is the product of the nominal exchange rate of the Naira against the USD and the ratio of prices between the two countries. The core equation is $RER=eP^*/P$, where, e is the nominal Naira-Dollar exchange rate, P^* is the average price of a good in Nigeria, and P is the average price of the good in the United States.

Similar trends have also been recorded in real interest rate, fiscal deficit relative to GDP and government debt relative to GDP as these macroeconomic variables have been experiencing upward movement in Nigeria since the 1980s. Hassan et al. (2011) documented that high interest rate adversely affect the real sector of the economy, just as a very low or negative interest rate is deleterious to investment and economic growth. Ball and Mankiw (1995) argued that high budget deficit affects saving, investment, interest rate, trade balance, exchange rate and long-term economic growth. Since fiscal deficit reduces national savings, they necessarily reduce investment or/and net exports, and by reducing net exports, high fiscal deficit creates a flow of assets abroad, thereby inducing firms to invest less and foreigners to acquire less domestic products. Furthermore, high and rising fiscal deficit that is financed by domestic borrowing could crowd-out potential private investments, but if financed by external borrowing, the national debt and debt service payments increase and have adverse effects on the economy. Though Reinhart and Rogoff (2010b) found that the effects of government debt on economic growth is positive until government debt exceeds 90% of GDP, but Dritsaki (2013) opined that the impact of government debt on economic growth could be positive or negative depending on their uses. On the other hand, Karagol (2002); Panizza and Presbitero (2014); Eberhardt and Presbitero (2015) reported that government debt is negatively related to investment, economic performance and economic development. This analysis reveals that macroeconomic variables have effects on both investment rate and economic growth. Fischer (1993) argued that reduction in investment is one of the channels through which macroeconomic factors adversely affect economic growth.

In Nigeria, empirical evidence on the relationship between these macroeconomic variables and economic development remains unclear, even though macroeconomic stabilization is a sine qua non for economic diversification and development. Thus, the specific objectives of this study include: (i) to examine the effects of macroeconomic variables on economic development in Nigeria (ii) to examine the effects of investment rate on economic development in Nigeria (iii) to determine how the interaction between macroeconomic variables and investment rate affect economic development in Nigeria.

In this regards, the contributions of this study to existing literature are enormous. Firstly, it unfolds the effects of macroeconomic variables on economic development. Interestingly, the study finds that out of the five macroeconomic variables, fiscal deficit relative to GDP and real exchange rate have positive impact on economic development, while inflation rate and government debt relative to GDP have negative impact on economic development. However, real interest rate has no statistically significant impact on economic development in Nigeria. Secondly, the study uncovers the impact of investment rate on economic development. It finds evidence to conclude that investment rate help to explain variations in economic development. Finally, it unearths how the interaction between macroeconomic variables and investment rate affect economic development. This is important because it reveals whether the impact of investment rate on economic development varies with the level of macroeconomic variables. Fundamentally, the study finds that the impact of investment rate on economic development varies with the level of all the macroeconomic variable except real interest rate.

Besides this introduction, the remaining parts of the paper is divided into four sections. Section 2 examines the theoretical and empirical issues while section 3 presents the methodology employed in the study. Section 4 contains the empirical results and findings, and the last section concludes the study with some policy recommendations.

2. Theoretical and Empirical Issues

Theoretical and empirical literature suggest that a stable macroeconomic environment is a prerequisite for economic growth and development while volatility in key macroeconomic variables or unsustainability of their behaviours could result in economic retardation. Thus, the Maastricht Criteria enumerated five indicators that measure a country's macroeconomic stability to include low and stable inflation rate; low currency fluctuation; low long-term interest rate; low budget deficit relative to GDP; and low government debt relative to GDP. For instance, Fischer (1993) found that inflation rate has negative effects on economic growth through reduction in investment and productivity growth. He added that even long-term low inflation rate is unnecessary for high growth, the same way high inflation rate is inconsistent with sustained economic growth. Similarly, Barro (1996); Bruno and Easterly (1998) documented that high and volatile inflation rate has negative and

deleterious effects on the economy, while low or moderate inflation rate has mild effect on the economy. Also, Rousseau and Wachtel (2001); Boyd et al. (2001); Bittencourt (2011b) also reported the adverse effect of high and volatile inflation rate have on financial development and investment. Thus, higher inflation rate are associated with higher inflation variability, greater stock return variability, less long-run financial activity, lower long-run levels of real economic activity and slower long-run growth rates. Although, a growing empirical literature suggests that a threshold exists beyond which the effects of inflation rate on the economy are more venomous, but there are overwhelming support for a negative inflation-growth nexus.

The relationship between fiscal deficit relative to GDP and economic activity has been documented in theoretical and empirical literature. Fischer (1993) documented a negative effect of fiscal deficit on economic growth through a reduction in both capital accumulation and productivity growth. Ball and Mankiw (1995) also argued that high budget deficit affects saving, investment, interest rate, trade balance, exchange rate and long-term economic growth. Thus, fiscal deficit reduces national savings, they necessarily reduce investment or/and net exports, and by reducing net exports, high fiscal deficit creates a flow of assets abroad, thereby inducing firms to invest less and foreigners to acquire less domestic products. Furthermore, high and rising fiscal deficit that is financed by domestic borrowing could crowd-out potential private investments, but if financed by external borrowing, the national debt and debt service payments increase and have adverse effects on the economy. Conversely, Garrison and Lee (1997) found that fiscal deficit has positive impact on the real GDP per capita growth. They argued that the inclusion of investment (saving) rate in a regression could reduce the significance of the coefficient of fiscal deficit because the only role left for budget deficit is that of as a signal of poor management of the economy by the government.

Although Reinhart and Rogoff (2010b) found that the effects of government debt on economic growth is positive until government debt exceeds 90% of GDP, but a growing empirical literature suggests that government debt relative to GDP has negative impact on economic growth. Dritsaki (2013) opined that the impact of government debt on economic growth could be positive or negative depending on their uses. While Spilioti and Vamvoukas (2015); Egert (2015) found that

government debt has positive effects on economic growth, Karagol (2002); Panizza and Presbitero (2014); Eberhardt and Presbitero (2015) reported that government debt is negatively correlated with investment and economic growth. On the relationship between real interest rate and economic growth, Hassan et al. (2011) found that both high and very low or negative interest rate are deleterious to investment, economic growth and adversely affect the real sector of the economy.

The literature on the link between real exchange rate/volatility and economic performance are mixed. Hua (2012) and Tang (2015) found no significant positive correlation between real exchange rate and economic growth, but argued that the fluctuations in real exchange rate could result in a positive or negative impact on economic growth. Vieira et al. (2013) found that high exchange rate fluctuation is negatively related to economic growth while a moderately volatile exchange rate is positively correlated with economic growth. Aghion et al. (2009) and Elbadawi et al. (2012) also found negative correlation between real exchange rate appreciation and economic growth.

This analysis shows that the effects of each macroeconomic variable on the economy depends on the level (high or low) of each variable. It also shows the absence of previous empirical studies that have extensively examined the effects of five macroeconomic variables such as inflation rate, real interest rate, real exchange rate, fiscal deficit relative to GDP and government debt relative to GDP on economic development in Nigeria. It also revealed the absence of previous studies that show how the interaction between these five macroeconomic variables and investment rate affect the economy. These are some of the gaps this present study intends to fill.

3. Data and Method

3.1 Data

All the annual data for the period 1980-2014 used in this paper are sourced from the World Development Indicators of the World Bank (2016) except fiscal deficit relative to GDP that were obtained from the Central Bank of Nigeria Statistical Bulletin (2014). Economic development is proxied by real GDP per capita (see Menyah et al., 2014; Chortareas et al., 2015), investment rate is proxied by gross fixed capital

formation as a ratio of GDP (see Demetriades & Law, 2006); human capital is proxied by average years of schooling (see Beck & Levine, 2004). Based on Maastricht Criteria, the macroeconomic variables selected in this study include; inflation rate, real exchange rate, real interest rate, fiscal deficit as a ratio of GDP and government debt as a ratio of GDP (also see Fischer, 1993; Garrison & Lee, 1995; Vieira et al., 2013; Egert, 2015).

3.2 Empirical Strategy

The study uses the standard baseline growth regression and introduced macroeconomic variables as additional explanatory variables. Thus, the specification shows that variation in a country's real GDP per capita can be explained by the level of investment, human capital growth and augmented with macroeconomic variables which is consistent with Solow (1956). This model is an empirical representation of the Solow's growth model (also see Rousseau & Wachtel, 2002; Rousseau & Yilmazkuday, 2009). Hence, the baseline model is specified as follows:

$$Y_t = \beta_0 + \beta_1 INV_t + \beta_2 HCA + \beta_3 DEF + \delta' MCV_t + \varepsilon_t \quad (1)$$

where: Y = real GDP per capita; INV = investment as a ratio of GDP; HCA = human capital growth; DEF = fiscal deficit relative to GDP⁵; MCA = macroeconomic variables such as inflation rate, real exchange rate, real interest rate and government debt as a ratio of GDP; ε = error term; $\beta_0, \beta_1, \beta_2, \beta_3, \delta$ = coefficients. All the variables except inflation rate, real interest rate and fiscal deficit are in natural logarithm.

In order to determine the effects of the interaction terms of macroeconomic variables and investment rate, each of the macroeconomic variables is interacted with investment rate in the following models:

⁵ Fisher (1993) argued that budget deficit/surplus relative to GDP captures government influence on the economy because it is a signal of good or poor management of the economy. According to Barro (1991), an alternative measure of government influence on the economy is government consumption expenditure as a ratio of GDP. But Rousseau and Yilmazkuday (2009) argued that government consumption expenditure as a ratio of GDP is inefficient in many developing countries.

$$Y_t = \varpi_0 + \varpi_1 INV_t + \varpi_2 HCA_t + \varpi_3 DEF_t + \varpi_4 INV_t * INF_t + \mu_t \quad (2)$$

$$Y_t = \theta_0 + \theta_1 INV_t + \theta_2 HCA_t + \theta_3 DEF_t + \theta_4 INV_t * INT_t + \mu_t \quad (3)$$

$$Y_t = \lambda_0 + \lambda_1 INV_t + \lambda_2 HCA_t + \lambda_3 DEF_t + \lambda_4 INV_t * RER_t + \mu_t \quad (4)$$

$$Y_t = \psi_0 + \psi_1 INV_t + \psi_2 HCA_t + \psi_3 DEF_t + \psi_4 INV_t * DEF_t + \mu_t \quad (5)$$

$$Y_t = \delta_0 + \delta_1 INV_t + \delta_2 HCA_t + \delta_3 DEF_t + \delta_4 INV_t * DEB_t + \mu_t \quad (6)$$

where: INF= inflation rate; INT= interest rate, RER= real exchange rate; DEF= fiscal deficit as a ratio of GDP and DEB= government debt as a ratio of GDP.

Through the interaction between investment rate and each of the macroeconomic variables, the marginal effects of changes in the two variables can be captured through the partial derivatives of the real GDP per capita equation with respect to investment rate given as follows:

$$\frac{\partial Y_t}{\partial INV_t} = \varpi_1 + \varpi_4 INF_t \quad (7)$$

$$\frac{\partial Y_t}{\partial INV_t} = \theta_1 + \theta_4 INT_t \quad (8)$$

$$\frac{\partial Y_t}{\partial INV_t} = \lambda_1 + \lambda_4 RER_t \quad (9)$$

$$\frac{\partial Y_t}{\partial INV_t} = \psi_1 + \psi_4 DEF_t \quad (10)$$

$$\frac{\partial Y_t}{\partial INV_t} = \delta_1 + \delta_4 DEB_t \quad (11)$$

Thus, when the two coefficients (ϖ_1, ϖ_4) in the partial derivatives in Equation 7 are positive, it implies that more of investment rate and inflation rate would increase real GDP per capita. But when one of the estimated coefficients is negative while the other is positive, it means that the growth effect of investment rate vary with the rate of inflation. Hence, it would be necessary to evaluate the derivative within the

sample. The partial derivative is calculated at the minimum, mean and maximum rate of inflation within the sample of the study. If the marginal effect turns out positive, it implies that inflation rate is not detrimental to investment rate, but if the marginal effect turns out negative or zero, it implies that inflation rate is venomous to investment rate. Similar procedure would be applied to other macroeconomic variables in Equations 8-11 with a view to ascertaining whether the rate of investment varies with each of the variables.

4. Empirical Results

4.1 Descriptive Statistics and Correlation Analysis

The summary of descriptive statistics reported in Table 1 reveal that the average real GDP per capita in Nigeria for the 1980-2014 period was USD699.19 while the average investment rate was 12.96% of GDP. The average human capital growth was 5.15 and fiscal deficit averaged -2.95 of GDP during the period. The average inflation rate and government debt as a ratio of GDP were 19.74% and 54.05%, respectively. This analysis revealed that fiscal deficit as a ratio of GDP, interest rate and government debt relative to GDP fall within the Maastricht Criteria recommendations while inflation rate and real exchange rate were higher during the period. Furthermore, the correlation analysis presented in the lower Panel of Table 1 reveals that investment rate, fiscal deficit, interest rate and real exchange rate are positively correlated with real GDP per capita while inflation rate and government debt are negatively related to real GDP per capita in Nigeria.

Table 1: Descriptive statistics and correlation analysis

	Y	INV	HCA	DEF	INF	INT	RER	DEB
Mean	699.185	12.959	5.148	-2.948	19.741	-0.790	485.549	54.051
Maximum	1098.04	35.221	5.200	0.790	72.835	25.282	4831.94	228.37
Minimum	494.239	5.459	5.000	-6.730	5.382	-43.57	0.403	7.450
Standard Dev.	188.664	6.650	0.077	2.074	17.919	16.626	835.788	57.792
Y	1.000							
INV	0.168 (0.335)	1.000						
HCA	-0.072 (0.679)	-0.370 (0.029)	1.000					
DEF	0.394 (0.019)	-0.384 (0.023)	0.229 (0.187)	1.000				
INF	-0.406 (0.015)	-0.098 (0.574)	0.106 (0.543)	-0.101 (0.565)	1.000			
INT	0.219 (0.204)	-0.080 (0.646)	-0.029 (0.867)	-0.059 (0.737)	-0.471 (0.004)	1.000		
RER	0.427 0.010	-0.155 (0.375)	0.239 (0.166)	0.121 (0.489)	-0.073 (0.675)	0.209 (0.227)	1.000	
DEB	-0.503 (0.002)	-0.122 (0.486)	-0.147 (0.398)	-0.375 (0.026)	0.520 (0.001)	-0.053 (0.001)	-0.158 (0.363)	1.000

Notes: Probability values in parenthesis. Y =real GDP per capita, INV= investment rate as a ratio of GDP; HCA= human capital growth; DEF= fiscal deficit as a ratio of GDP; INF= inflation rate; INT= real interest rate; RER= real exchange rate; DEB= government debt as a ratio of GDP

4.2 Unit Root Test

To ascertain the order of integration of the variables, the study conducted unit root test using both the Augmented Dickey Fuller (ADF) and Philip-Perron (PP) tests. The results reported in Table 2 indicate that all the variables are integrated at order zero [I(0)] at 1%, 5% or 10% significant levels. Thus, we cannot reject the null hypotheses of no unit root in the series implying that the variables are stationary.

Table 2: Unit root test results

Variables	Augmented Dickey Fuller (ADF)		Philip-Perron (PP)	
	Level [I(0)]	1st Difference [I(1)]	Level [I(0)]	1 st Difference [I(1)]
Y	-2.960**	-4.744***	-2.943**	-4.741**
INV	-2.932**	-5.526***	-2.853**	-5.401***
HCA	-2.991**	-5.656***	-3.047**	-5.656***
DEF	-3.168**	-6.933***	-3.159***	-17.228***
INF	-3.202**	-5.992***	-3.108**	-12.874***
INT	-5.951***	-7.069***	-5.973***	-32.626***
RER	-2.972**	-5.657***	-2.906**	-7.061***
DEB	-3.461**	-4.880***	-3.517**	-4.880***

Notes: ***, ** and * indicate statistically significant at 1%, 5% and 10% levels, respectively, and a rejection of the null hypothesis of no unit root. Y =real GDP per capita, INV= investment rate as a ratio of GDP; HCA= human capital growth; DEF= fiscal surplus/deficit as a ratio of GDP; INF= inflation rate; INT= real interest rate; RER= real exchange rate; DEB= government debt as a ratio of GDP

4.3 The Effects of Macroeconomic Variables on Economic Development

Starting with the baseline model, the regression results presented in Table 3 (Column 1) reveal that investment rate and fiscal deficit enter with positive and statistically significant coefficients at 5% level implying that investment rate and fiscal deficit enhance real GDP per capita in Nigeria. Thus, a percentage increase in investment rate would increase real GDP per capita by 0.26 percent, while a unit increase in fiscal deficit would also increase real GDP per capita by 0.07 percent in Nigeria. However, the coefficient of human capital growth was not statistically significant at 5% level suggesting that human capital growth does not explain variation in real GDP in Nigeria. These results are not due to the presence of heteroscedasticity, autocorrelation or multicollinearity because the standard errors are heteroscedasticity-corrected using Newey-West. Also, the study used Variance Inflation Factor (VIF) and correlation analysis to check for multicollinearity and the mean VIF of 1.21 suggests absence of multicollinearity. The correlation analysis reveals that the highest correlation among the explanatory variables is 0.38 (see Table 1). Multicollinearity cannot be said to exist in a model when the mean VIF is less than 5 or the correlation among the independent variables is less than 0.90.

Table 3: Estimation results the effects of macroeconomic variables on economic development

Dependent Variable: Real GDP per capita (Y)

Variables	(1)	(2)	(3)	(4)	(5)
Constant	9.774** (4.356)	8.915** (4.197)	8.922** (4.278)	11.861*** (2.616)	13.447*** (2.437)
INV	0.256** (0.122)	0.232** (0.111)	0.255** (0.113)	0.465*** (0.075)	0.398*** (0.067)
HCA	-2.238 (2.577)	-1.636 (2.499)	-1.680 (2.548)	-4.104** (1.618)	-4.776*** (1.469)
DEF	0.074*** (0.024)	0.067*** (0.019)	0.072*** (0.021)	0.059*** (0.013)	0.045*** (0.012)
INF		-0.005*** (0.013)	-0.003* (0.018)	-0.049*** (0.011)	-0.004** (0.001)
INT			-0.003 (0.002)	0.013 (0.015)	0.018 (0.014)
RER				0.077*** (0.016)	0.073*** (0.011)
DEB					-0.114*** (0.052)
R^2	0.354	0.455	0.483	0.779	0.828
\bar{R}^2	0.292	0.383	0.394	0.732	0.784

Notes: ***, ** and * indicates statistically significant at 1%, 5% and 10%, respectively. Heteroscedasticity-corrected and robust standard errors in parenthesis. INV= investment rate as a ratio of GDP; HCA= human capital growth; DEF= fiscal surplus/deficit as a ratio of GDP; INF= inflation rate; RER= real exchange rate; INT= real interest rate; DEB= government debt as a ratio of GDP

In Column 2, inflation rate was included in the regression as additional explanatory variable. The sign and significance of the coefficients of investment rate and fiscal deficit remain unchanged (though the size of the coefficients somewhat decrease) which implies that investment rate and fiscal deficit continue to have positive impact on real GDP per capita despite the inclusion of inflation rate in the model. But it reveals that inflation rate enters with a negative and statistically significant coefficient at 1% level connoting that inflation rate is deleterious to real GDP per capita in Nigeria. The standard errors of this model are robust and heteroscedasticity-corrected using Newey-West while the mean VIF of 1.18 suggests absence of multicollinearity in the model.

In Column 3, additional explanatory variable namely real interest rate was included in the regression and the results reveal that the coefficient of real interest rate is not statistically significant at 5% level which means that real interest rate cannot explain variation in real GDP per capita in Nigeria. The coefficients of investment rate and fiscal deficit continue to be positive and statistically significant at 5% level (the size of the coefficients increase) while the coefficient of inflation rate remains negative and statistically significant at 10% level. It is important to note that the addition of real interest rate in the regression increases the size of the coefficients of investment rate and fiscal deficit and decreases the statistical significance of inflation rate. The standard errors of this model are robust and heteroscedasticity-corrected using Newey-West while the mean VIF of 1.31 suggests absence of multicollinearity in the model.

In Column 4, real exchange rate was included in the model as additional explanatory variable and the results show that real exchange rate enters with a positive and statistically significant coefficient at 1% level implying that real exchange rate enhance real GDP per capita in Nigeria. The coefficients of investment rate and fiscal deficit continue to be positive and statistically significant at 5% level while the coefficient of inflation rate remains negative and statistically significant at 1% level. Though the inclusion of real exchange rate in the regression increases the size of the coefficients of investment rate, but it increases the size and statistical significance of the coefficient of inflation rate, and the coefficient of human capital growth turns negative and statistically significant at 5% level. These results are robust to heteroscedasticity, autocorrelation or multicollinearity because the standard errors are heteroscedasticity-corrected using Newey-West, while the mean VIF is 1.52.

Finally, Column 5 has all the five Maastricht criteria variables in the model with the inclusion of government debt relative to GDP as additional explanatory variable. It is shown that the coefficient of government debt is negative and statistically significant at 5% level suggesting that government debt reduces real GDP per capita in Nigeria. The sign and significance of other variables remain unchanged (only the size of the coefficients change), with investment rate, fiscal deficit and real exchange rate positively related to real GDP per capita while inflation rate and human capital growth are negatively related. These

results are not due to the presence of heteroscedasticity, autocorrelation or multicollinearity because the standard errors are robust and heteroscedasticity-corrected using Newey-West. Also, the study used Variance Inflation Factor (VIF) and correlation analysis to check for multicollinearity and the mean VIF of 1.66 suggests absence of multicollinearity. The correlation analysis reveals that the correlation between inflation rate and government debt of 0.52 seem the highest among the explanatory variables (see Table 1). Since the VIF is less than 5 and the correlation among the independent variables is less than 0.90 multicollinearity cannot be said to exist in a model.

The findings of this study reveal that out of the five Maastricht criteria variables, fiscal deficit relative to GDP and real exchange rate have positive impact on economic development while inflation rate and government debt relative to GDP have negative impact on economic development. But real interest rate has no significant impact on economic development. Of the set of conditioning variables, investment rate has positive impact on economic development, while human capital growth has negative impact on economic development. The finding on investment rate in this study is consistent with theory and empirical studies such as Harris (1997) and Demetriades and Law (2006) that documented a positive impact of investment rate on GDP per capita growth rate. Growth theory suggests that increase in capital accumulation or investment rate is a major factor in explaining growth as well as accounting for differences in the standard of living among countries. The findings on the relationship between fiscal deficit relative to GDP and economic development confirmed Garrison and Lee (1995) who also found that both investment and fiscal deficit have positive impact on per capital GDP growth. Analogously, Karagol (2002); Panizza and Presbitero (2014); Eberhardt and Presbitero (2015) also found that government debt is negatively related to investment, economic performance and economic development. This study sheds new light on the relationship between real exchange rate and economic development. Although Hua (2012) and Tang (2015) found no significant positive correlation between real exchange rate and economic growth but they argued that the fluctuations in real exchange rate could result in a positive or negative impact on economic growth.

4.4 The Effects of Interaction of Macroeconomic Variables and Investment Rate on Economic Development

Table 4 reports the regression results of the interaction terms between each of the macroeconomic variables and investment rate. Starting from Column 1, fiscal deficit is interacted with investment rate to ascertain whether the impact of investment rate on real GDP per capita varies with the level of fiscal deficit. The coefficient of the interaction term is not statistically significant at 5% level suggesting that the impact of investment rate on real GDP does not vary with the level of fiscal deficit. In Column 2, inflation rate is interacted with investment rate to ascertain whether the impact of investment rate on real GDP per capita varies with the rate of inflation. It is shown that the coefficient of the interaction term enters with a negative and statistically significant coefficient at 1% level implying that the impact of investment rate on real GDP per capita varies with the rate of inflation. The economic implication of this result is that investment rate increases real GDP per capita more at lower rate of inflation than at higher rate of inflation in Nigeria. In Column 3, real interest rate is interacted with investment rate to ascertain whether the impact of investment rate on real GDP per capita varies with the level of real interest rate. The coefficient of the interaction term enters with a positive and statistically significant coefficient at 10% suggesting that the impact of investment rate on real GDP per capita varies with the level of real interest rate.

Table 4: Estimation results of the effects of interaction of macroeconomic variables and investment rate on economic development

Dependent Variable: Real GDP per capita (Y)

Variables	(1)	(2)	(3)	(4)	(5)
Constant	13.388*** (4.184)	8.292** (4.220)	9.312** (4.243)	14.027*** (3.114)	12.836*** (3.061)
INV	0.616** (0.315)	0.261** (0.115)	0.285** (0.122)	0.356*** (0.082)	0.286** (0.113)
HCA	-4.935* (2.689)	-1.689 (2.503)	-1.989 (2.501)	-5.167** (1.914)	-4.001** (1.840)
DEF	-0.188 (0.167)	0.066*** (0.020)	0.078*** (0.023)	0.067*** (0.017)	0.048* (0.025)
INV*DEF	0.112 (0.074)				
INV*INF		-0.019*** (0.006)			
INV*INT			0.019* (0.001)		
INV*RER				0.026*** (0.007)	
INV*DEB					-0.089** (0.043)

Notes: ***, ** and * indicates statistically significant at 1%, 5% and 10%, respectively. Heteroscedasticity-corrected and robust standard errors in parenthesis. INV= investment rate as a ratio of GDP; HCA= human capital growth; DEF= fiscal surplus/deficit as a ratio of GDP; INV*DEF= interaction of investment rate as a ratio of GDP and fiscal surplus/deficit as a ratio of GDP; INV*INF= interaction of investment rate as a ratio of GDP and inflation rate; INV*RER= interaction of investment rate as a ratio of GDP and real exchange rate; INV*INT= interaction of investment rate as a ratio of GDP and real interest rate; INV*INT= interaction of investment rate as a ratio of GDP and government debt as a ratio of GDP.

Furthermore, real exchange rate is interacted with investment rate in Column 4 to ascertain whether the impact of investment rate on real GDP per capita varies with the level of real exchange rate. The results reveal that the interaction term enters with a positive and statistically significant coefficient at 1% level suggesting that the impact of investment rate on real GDP per capita varies with the level of real exchange rate. Finally, the regression in Column 5 interacted government debt as ratio of GDP with investment rate to ascertain whether the impact of investment rate on real GDP per capita varies with the level of government debt. The results show that the interaction term enters with a negative and statistically significant coefficient at 1%

level implying that the impact of investment rate on real GDP per capita varies with the level of government debt. The economic implication of this result is that investment rate increases real GDP per capita more at lower level of government debt than at higher level of government debt in Nigeria. These results are robust to heteroscedasticity, autocorrelation or multicollinearity because the standard errors are heteroscedasticity-corrected using Newey-West. The findings seem to indicate that macroeconomic variables do not only explain variations in economic development, but they also matter in as much as they improve or reduce the rate of investment. Thus, better macroeconomic variables and more investment rate will contribute to the process of economic development than more investment rate in the midst of poor macroeconomic environment.

4.5 Robustness Checks

For robustness checks of the regression results of the interaction terms of each of the macroeconomic variables with investment rate, each of the macroeconomic variables is lagged by one period and then interacted with investment rate and the results are reported in Table 5. It is shown that the coefficient of the interaction term of lagged fiscal deficit and investment rate is positive and statistically significant at 1% level. The interaction term of lagged inflation rate and investment enters with a negative and statistically significant coefficient at 5% level. While the interaction term of lagged real interest rate and investment is not statistically significant at 5% level, but the interaction term of lagged real exchange rate and investment enters with a positive and statistically significant coefficient at 1% level. Finally, interaction term of lagged government debt relative to GDP and investment rate enters with a negative and statistically significant coefficient at 5% level. The results are similar to the results obtained with the interaction between current macroeconomic variables and investment rate, except that the interaction term of fiscal deficit is now statistically significant at 1% level. These results are robust to heteroscedasticity, autocorrelation or multicollinearity because the standard errors are heteroscedasticity-corrected using Newey-West. The findings suggest that one period lagged of macroeconomic variables matter in the process of economic development in as much as they improve or reduce the rate of investment.

Table 5: Estimation results of the effects of interaction of lagged values of macroeconomic variables and investment rate on economic development

Dependent Variable: Real GDP per capita (Y)

Variables	(1)	(2)	(3)	(4)	(5)
Constant	10.798** (3.684)	9.645** (4.298)	9.264** (4.139)	12.334** (3.012)	11.897*** (3.098)
INV	0.355*** (0.127)	0.248** (0.123)	0.285** (0.128)	0.345*** (0.073)	0.303*** (0.104)
HCA	-2.949 (2.202)	-2.105 (2.575)	-1.959 (2.474)	-4.137** (1.805)	-3.416* (1.845)
DEF	0.049*** (0.018)	0.069*** (0.020)	0.078*** (0.021)	0.056** (0.022)	0.057** (0.023)
INV*laggedDEF	0.023*** (0.008)				
INV*laggedINF		-0.017** (0.008)			
INV*laggedINT			0.017 (0.001)		
INV*laggedRER				0.026*** (0.005)	
INV*laggedDEB					-0.099** (0.039)

Notes: ***, ** and * indicates statistically significant at 1%, 5% and 10%, respectively. Heteroscedasticity-corrected and robust standard errors in parenthesis. INV= investment rate as a ratio of GDP; HCA= human capital growth; DEF= fiscal surplus/deficit as a ratio of GDP; INV*laggedDEF= interaction of investment rate as a ratio of GDP and lagged fiscal surplus/deficit as a ratio of GDP; INV*laggedINF= interaction of investment rate as a ratio of GDP and lagged inflation rate; INV*laggedRER= interaction of investment rate as a ratio of GDP and lagged real exchange rate; INV*lagged INT= interaction of investment rate as a ratio of GDP and lagged real interest rate; INV*laggedDEB= interaction of investment rate as a ratio of GDP and lagged government debt as a ratio of GDP.

5. Conclusion and Policy Options

The paper sought to provide answer to three basic questions: What are the effects of macroeconomic variables on economic development? What is the impact of investment rate on economic development? How do macroeconomic variables affect the impact of investment rate on economic development? The study used baseline growth regression for 1980-2014 data of Nigeria. The five macroeconomic variables were

selected based on Maastricht Criteria indicators that measure a country's macroeconomic stability. Out of the five macroeconomic variables, fiscal deficit relative to GDP and real exchange rate have positive impact on economic development, while inflation rate and government debt relative to GDP have negative impact on economic development. However, real interest rate has no statistically significant impact on economic development in Nigeria. It was also found that investment rate has positive and significant impact on economic development. Finally, with the exception of real interest rate, the study found overwhelming evidence that the impact of investment rate on economic development varies with the level of macroeconomic variables in Nigeria. The results of this study are robust and not due to heteroscedasticity, autocorrelation or multicollinearity because the standard errors are heteroscedasticity-corrected using Newey-West while the Variance Inflation Factor (VIF) and correlation matrix depict absence of multicollinearity.

The findings of this study seem to indicate that macroeconomic variables do not only explain variations in economic development, but they also matter in as much as they improve or reduce the rate of investment. It does appear that the interaction between macroeconomic variables and investment rate has been neglected by previous studies even though it is important in the process of economic development. Thus, "better macroeconomic variables, more investment rate" seem to be much more applicable proposition to the process of economic development than "more investment rate in the midst of poor macroeconomic variables environment". The implication of this study is that macroeconomic variables help to explain variation in economic development and investment rate, hence government should embark on macroeconomic policies that can promote a better performance of these variables with a view to achieving sustainable economic development.

Acknowledgement: The author wishes to appreciate the support from Universiti Sains Malaysia (USM) through USM Fellowship Award 2/15.

References

- Aghion, P., Bacchetta, P., Ranciere, R. and Rogoff, K. (2009), "Exchange Rate Volatility and Productivity Growth: The Role of Financial Development," *Journal of Monetary Economics*, 56(4), 494-513.
- Ball, L. and Mankiw, N. G. (1995), "What do Budget Deficits do?" National Bureau of Economic Research, Working Paper (No. w5263), 1-35.
- Barro, R. J. (1991), "A Cross-country study of Growth, Saving, and Government" In *National saving and economic performance* (pp. 271-304). University of Chicago Press.
- Barro, R. J. (1996), "Inflation and Growth," Federal Reserve Bank of St Louis, *Review*, 78, 1-17.
- Basci, E. (2012), "Financial and Macroeconomic Stability," Paper presented by the Central Bank Governor of Turkey in the Financial and Macroeconomic Stability Conference held in Istanbul 4 June. 1-2.
- Beck, T., and Levine, R. (2004) "Stock Markets, Banks, and Growth: Panel Evidence," *Journal of Banking and Finance*, 28(3), 423-442.
- Bittencourt, M. (2011b), "Inflation and Financial Development: Evidence from Brazil" *Economic Modelling*, 28(1), 91-99.
- Bleaney, M., and Greenaway, D. (2001), "The Impact of Terms of Trade and Real Exchange Rate Volatility on Investment and Growth in Sub-Saharan Africa," *Journal of Development Economics*, 65(2), 491-500.
- Bruno, M and Easterly, W. (1998), "Inflation Crises and Long-run Growth," *Journal of Monetary Economics*, 41(1), 3-26.
- Chortareas, G., Magkonis, G., Moschos, D. and Panagiotidis, T. (2015), "Financial Development and Economic Activity in Advanced and Developing open Economies: Evidence from Panel Cointegration," *Review of Development Economics*, 19(1), 163-177.

Demetriades, P. and Hook Law, S. (2006), "Finance, Institutions and Economic Development," *International Journal of Finance and Economics*, 11(3), 245-260.

Dritsaki, C. (2013), "Causal Nexus between Economic Growth, Exports and Government Debt: the case of Greece," *Procedia Economics and Finance*, 5(2013), 251-259.

Eberhardt, M. and Presbitero, A. F. (2015), Public Debt and Growth: Heterogeneity and non-linearity," *Journal of International Economics*, 97(1), 45-58.

Egert, B. (2015), "Public Debt, Economic Growth and Nonlinear effects: myth or reality?" *Journal of Macroeconomics*, 43, 226-238.

Elbadawi, I. A., Kaltani, L. and Soto, R. (2012) "Aid, Real Exchange Rate Misalignment, and Economic Growth in Sub-Saharan Africa" *World Development*, 40(4), 681-700.

Fischer, S. (1993), "The Role of Macroeconomic Factors in Growth," *Journal of Monetary Economics*, 32(3), 485-512.

Garrison, C. B. and Lee, F. Y. (1995), "The Effect of Macroeconomic Variables on economic Growth Rates: A cross-country study," *Journal of Macroeconomics*, 17(2), 303-317.

Harris, R. D. (1997), "Stock Markets and Development: A re-assessment," *European Economic Review*, 41(1), 139-146.

Hassan, M.K., Sanchez, B. and Yu, J. (2011), "Financial Development and Economic Growth: New Evidence from Panel Data," *The Quarterly Review of Economics and Finance*, 51(1), 88-104.

Hua, P. (2012), "Real Exchange Rate and Economic Growth in China" *Journal of Reviews on Global Economics*, 1(2012), 89-105.

Karagol, E. (2012), "The Causality Analysis of External Debt Service and GNP: The case of Turkey," *Central Bank Review*, 2(1), 39-64.

Menyah, K., Nazlioglu, S., and Wolde-Rufael, Y. (2014), “Financial Development, Trade Openness and Economic Growth in African countries: New insights from a panel causality approach,” *Economic Modelling*, 37, 386-394.

Panizza, U. and Presbitero, A. F. (2014), “Public Debt and Economic Growth: is there a causal effect?” *Journal of Macroeconomics*, 41(2014), 21-41.

Reinhart, C. M., and Rogoff, K. S. (2010b), “Growth in a Time of Debt,” *American Economic Review*, 100(2), 573-578.

Rousseau, P. L. and Wachtel, P. (2001), “Inflation, Financial Development and Growth” in Negishi, T., Ramachandran, R.V & Mino, K. (Eds) *Economic Theory, Dynamics and Markets*. Springer, United States.

Rousseau, P. L. and Wachtel, P. (2002), “Inflation Thresholds and the Finance–Growth Nexus,” *Journal of International Money and Finance*, 21(6), 777-793.

Rousseau, P. and Yilmazkuday, H. (2009), “Inflation, Financial Development and Growth: A Trilateral Analysis,” *Economic Systems* 33(4), 310-324.

Serven, L. (2003), “Real-Exchange-rate uncertainty and Private Investment in LDCs” *Review of Economics and Statistics*, 85(1), 212-218.

Serven, L. and Montiel, P. (2004), “Macroeconomic Stability: the more the better? Economic Growth in the 1990s: Learning from a Decade of Reforms,” Available on: <http://www1.worldbank.org/prem/lessons1990s/Chap%204%20macroecon%20092104%20rw.pdf>.

Solow, R. (1956), “A Contribution to the Theory of Economic Growth” *Quarterly Journal of Economics*, 70(1), 65-94.

Spilioti, S. and Vamvoukas, G. (2015), “The Impact of Government Debt on Economic Growth: An Empirical investigation of the Greek market,” *The Journal of Economic Asymmetries*, 12(1), 34-40.

Tang, B. (2015), "Real Exchange Rate and Economic Growth in China: A Cointegrated VAR Approach," *China Economic Review*, 34(2015), 293-310.

Todaro, M.P and Smith. C. S (2009), "Economic Development" 10th Edition. United Kingdom. Addison-Wesley Pearson Education Limited.

Vieira, F. V., Holland, M., da Silva, C. G., and Bottecchia, L. C. (2013), "Growth and Exchange Rate Volatility: a Panel Data Analysis," *Applied Economics*, 45(26), 3733-3741.