

The Determinants of Economic Growth in the Sudan

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Abstract

The study was intended to establish the possible factors that determine economic growth in the Sudan. Using OLS, the study uses real GDP to proxy for economic growth with the regressors comprising population, foreign direct investment, government consumption expenditure, household per capita consumption expenditure, physical capital (in terms of fixed capital formation), inflation, openness of the economy, and financial sector development. Having established the existence of cointegration in the model, the study proceeded to estimate the ECM. The results have revealed that foreign direct investment and financial sector development have been significant and carry the expected signs in both the long-run and the short-run models. While inflation has been significant and carries the expected sign in the long run model, it has been insignificant in the short run. Both the government consumption expenditure and household consumption expenditure have been significant in the long run and the short run models but with unexpected signs. Additionally, while infrastructure has been insignificant in the long run, it has been significant in the short run but carries unexpected sign. The openness of the economy has been a significant factor in boosting economic growth in the short run but not in the long run. Throughout the study, population has been an insignificant determinant for economic growth in the Sudan. Although the study managed to achieve the intended objectives, the study suffers from lack of data on some variables namely natural resources, human capital, political factors, taxes, and research and development. Additionally, the study has not separated the macroeconomic determinants of economic growth from the other determinants. Given the above shortcomings, the study recommends for further investigation to be conducted by incorporating the cited variables into the model. It would equally be necessary to conduct a study that separates the macroeconomic determinants of economic growth from the other determinants to be able to gauge the effects separately.

Keywords: Sudan, Economic growth, Unit root, Cointegration, ECM, Determinants

1.0 Introduction

Economic growth can be measured either by the growth of total output or of total income (Cypher & Dietz, 2004, p. 31). The goal of economic growth is improvement in people's economic well-being: an increase in their standard of living (Diulio, 1998, Beardshaw, 1998). This is achieved by the individuals in a country when output per worker increases over time. However, the levels of growth in different countries have never been equal due to a number of factors some of which have not been made clearer. Since the availability of goods and services can lead to welfare and thereby an improvement in the standard of living, keen interest has been taken by economists, researchers and governments all over the world to understand/identify why there are differences among countries and within a country over period of time in regards to production and economic growth. Given this concern, great interest has been geared towards establishing why some economies grow faster than others, and why differences remain in terms of economic growth between the developed and the underdeveloped countries of which the Sudan is one. Different studies have been carried out to establish the factors (causes) that lead to changes in the level of economic growth with varying differences in terms of location, methods, data, and variables used. In general this study has been intended to establish the possible factors that determine the level of economic growth in a country. In particular, the study has been carried to: (i) establish the effect of, population, human capital, foreign direct investment, government expenditure, household consumption expenditure, infrastructure, inflation, openness of the economy to the outside world, and financial sector development, on economic growth, and (ii) establish long-run and Short-run relationships between the dependent and the independent variables. To be able to achieve the objectives cited, the following hypotheses were tested: the country's population, foreign direct investment, final government consumption expenditure, household consumption expenditure, the country's infrastructure, inflation rate in the country, openness of the economy to the outside world, and financial sector development, do not affect economic growth.

2.0 Literature review

2.1 The theoretical literature review

Economic growth means percentage increase in GDP on year to year basis (Dwivedi, 2008). Economic growth means a sustained increase in per capita national output or net national product over a long period of time. Economic growth is about improvement in the standard of living. The national output should comprise such goods and services which satisfy the maximum wants of the maximum number of people. For economic growth to be genuine, the increase in output must be sustained over a long period of time.

There have been different models of economic growth in the literature comprising the Harrod-Domar models, the Solow model, the Solow-Swan model of economic growth, the endogenous growth theory, and the Steady State Growth Model (Jhingan, 2010). The theoretical literature pertaining to the causes of the differences in the level of economic growth are diverse and are explained differently by different theorists. Briefly the causes/determinants of economic growth are explained below:

Natural resources (Dwivedi, 2010; Mutamba, 2009; Mankiw, 2009): Natural resources include area of usable land, resources on land surface and underground. Land surface resources include sources of natural water (rivers and lakes, forests, landscape and the like), underground resources include oil and natural gas and minerals, favourable climatic and environmental conditions added to the natural resources of a country. However, natural resources are passive factors of growth since their exploitation and use depends on the quality of manpower, availability of capital and technology.

Capital formation or capital accumulation (Dwivedi, 2010; Mutamba, 2009; Misra & Puri, 1991; Todaro, 1992; Weil, 2009; Vaish, 2011; Greenway & Shaw, 1991; Mankiw, 2009): Capital formation as a man-made means of production increases the availability of capital to every worker. In a wider sense of the term, it includes machinery, plant and building, means of transport and communication, electricity plants, and social overheads like roads, railways, schools, colleges, hospitals, and similar others. Creating or acquiring man-made means of production is known as capital formation or capital accumulation. This increase in capital per worker leads to the larger production of goods and services and hence higher economic growth for a given country.

Human capital (Dwivedi, 2010; Mutamba, 2009; Misra & Puri, 1991; Weil, 2009; Vaish, 2011; Greenway & Shaw, 1991): Human resource of a country is the most crucial factor in its economic growth. Human resource comprised the available labour force and its quality. The quality of labour force depends on the level of its education, training, skills, and its incentive and innovative abilities. Quantity and quality of manpower are both equally important. However, an excess supply of unskilled labour force, as in most of the least developed countries (LDCs) is of little consequence. Scarcity of skilled labour is a serious constraint to a country's economic growth. As regards the quality of labour, it includes not only skilled and productivity but also discipline, honest and sincere work efforts, commitment to productivity and professionalism. Without these qualities, a high skilled labour will be less productive. A society of illiterate and ignorant people living with superstitions and unscientific belief resists modern ways of life and rational organization of society which finds it very difficult to achieve a high growth rate. The form of government and its economic roles and policies matter to a great extent in determining the level and rate of the economic growth of a country.

Technological development/progress (Dwivedi, 2010; Mutamba, 2009; Misra & Puri, 1991; Todaro, 1992; Weil, 2009; Vaish, 2011; Greenway & Shaw, 1991; Mankiw, 2009; Jhingan, 1990): The technological changes are regarded as the most important factor in the process of economic growth. They are related to changes in the methods of production which are the result of some new techniques of research or innovation. Changes in technology lead to increase in the productivity of labour, capital and other factors of production. Kuznets traces a number of distinct patterns in the growth of technology in modern economic growth (Jhingan, 1990): a scientific discovery or an addition to technological knowledge, an invention, innovation, and improvement.

Political and social factors (Dwivedi, 2010; Mankiw, 2009): Social and political factors are identified to be some of the factors that determine the level of economic growth. Social and political systems, organizations, institutions, social values and the like influence economic growth. Social factors like customs, traditions, beliefs, institutions, social (communal) harmony, and attitude towards the material life and well-being determine, to a considerable extent, the pace of economic growth.

Foreign Direct Investment (Mutamba, 2009; Mankiw, 2009) is essential in economic growth. Investors increase the GDP of a country through establishment of industries, institutions, infrastructure and provision of services. Policies that are friendly to foreign investors can lead to an increase in foreign investments that leads to an increase in GDP and hence economic growth.

Taxation policy (Vaish 2011; Dwivedi, 2010): Taxes have negative effect on the equilibrium level of income. In the Keynesian approach, the introduction of taxes causes a reduction in the level of disposable income whose effect is transmitted to consumption and savings. With the fall in the level of consumption, the multiplier effect of an autonomous spending is reduced. Since what is saved is invested, the fall in the level of savings would lead to a fall in the level of private investment thereby leading to a fall in the level of equilibrium income and growth.

Population and the growth in population (Mutamba, 2009; Misra & Puri, 1991; Todaro, 1992; Weil, 2009; Mankiw, 2009) has an effect on Economic growth. Growth in population is a means of increasing labour force and hence an increase in GDP thus fostering economic growth. However, sometimes a rapid increase in population is equally detrimental to economic growth due to the fact that what should have been saved for investment is consumed leaving less or nothing for investment. Such a situation reduces the country's GDP and

hence no economic growth.

Expansion of local and foreign markets is an important factor for enhancing economic growth (Mutamba, 2009). This means when there is a demand for goods and services, businesses tend to increase their investments to be able to increase their supplies in order to increase their incomes. With the increase in domestic and foreign markets for the goods and services, investors are likely to increase their production and thus lead to economic growth.

Openness of the economy to the outside world/free trade (Weil, 2009; Mankiw, 2009): This can be understood in terms of goods and services which constitute trade and the other is the movement of factors of production across the borders of the different countries. By being opened, countries get better and wider chances of marketing their goods and services. Additionally, the mobility of factors of production reduces unemployment at home and enables the country to earned higher GNP than not.

Financial development (Mishkin, 2001): The financial systems in developing and transition countries face several difficulties that prevent them from operating efficiently. These countries usually suffer from financial crises due mainly to increases in interest rates and increases in uncertainty.

Research and development: This refers to innovation that comes to being due to research. As is known, innovation usually enhances economic growth and thereby leads to development (Mankiw, 2009; Ulku, 2004).

Health and education (Mankiw, 2009): The term human capital usually refers to education, but it can also be used to describe another type of investment in people. Expenditures that lead to a healthier population can improve productivity and hence economic growth. Other things being equal, healthier workers are more productive. The right investments in the health of the population provide one way for a nation to increase productivity and raise living standards.

2.2 Empirical literature review

In the literature, different studies have been conducted and few of them are summarized below for the empirical literature.

Petrakos & Arvanitidis (2008) conducted a study on the determinants of economic growth using survey data collected through questionnaires addressed to various experts worldwide (academics, policy makers and business people). The study revealed that alongside the conventional determinants, it is also the political and institutional aspects of an economy that play an important role in promoting the level of economic growth. Secondly, the determinants influence growth at different degrees depending on the level of the economic development achieved by a given country. The results of the study revealed that the factors that are influential for the developed countries include high technology, innovation and R&D, high quality of human capital, specialization in knowledge and capital intensive sectors, good infrastructure, high degree of openness, secured formal institutions (i.e. legal system, property rights, tax system, & financial system), capacity for adjustment, stable political environment, free market economy (i.e. low state intervention), robust macroeconomic management, low levels of public bureaucracy, capacity for collective action, significant urban agglomerations, strong informal (i.e. social and cultural) institutions, favourable demographic conditions, significant FDI, rich natural resources, favourable geography, and random factors such as unpredicted shocks.

In contrast the factors that are regarded to be influential for the developing countries comprise stable political environment, significant FDI, secured formal institutions (i.e. legal system, property rights), rich natural resources, high degree of openness, good infrastructure, favourable geography, robust macroeconomic management, capacity for adjustment, low levels of public bureaucracy, favourable demographic conditions, high quality of human capital, significant urban agglomerations, strong informal institutions, free market economy, high technology, innovation and R&D, capacity for collective action, specialization in knowledge and capital intensive sectors, and random factors such as unpredicted shocks.

On his part, Salahuddin (2010) carried out a study on 'the Determinants of Economic growth in Pakistan: Does Stock market Development play a role?' using time series data for the 1971 to 2006. The variables employed in the model were in the log form with real GNP per capita as a proxy for economic growth. The independent variables comprised stock market development (proxied by the amount of total capital as a share of GDP), financial development (proxied by credit availability to private sector as a share of GDP), financial stability (measured in terms of standard deviation of inflation rate), inflation rate, FDI, literacy rate (the ratio of the number of people completing primary education to total population), stock market liquidity which is taken as the value of stock traded as a share of GDP. The results both in the long run and short run models indicted that the stock market has significant positive effect on economic growth. Financial development was indentified to have significant negative effect on economic growth both in the long and the short runs. Additionally, FDI was positively and significantly related to economic growth in the long run and the short run models while literacy rate was found to be insignificant in all the two models. However, inflation has significant negative effect on economic growth both in long run as well as in the short run with financial instability having

significant negative effect on economic growth only in short run. The stock market liquidity was established to be significantly and positively related to economic growth in the long run but not in the short run.

In their study entitled 'The Impact of Human Capital on Economic Growth in Ethiopia' using time series data from 1980 to 2013, Borojo & Yushi (2015) employed Real GDP to proxy for economic growth. The regressors in the model were gross fixed capital formation, labour force, openness (measured as the ratio of the sum of exports and imports to GDP), inflation, human capital (in terms of primary and secondary enrolment rates, human capital stock from tertiary school education, public education expenditure to include investment on education, and public health expenditure to include investment in health). All the variables were in the log form with the exception of tertiary school enrollment. The results of the long-run model showed that both primary and secondary enrollment rates and public education expenditure were having positive and significant effect on economic growth while tertiary education was insignificant as it was the case with openness. In addition, while physical capital was having positive significant effect on economic growth, inflation was established to have significant negative effect on economic growth. In the short-run model, it was established that physical capital, human capital development (in terms of health expenditure), primary and secondary school enrolments were having significant positive effects on economic growth while human capital in terms of educational expenditures, tertiary enrolment rate, labour force, and openness, were found to be insignificant. On its part, inflation was found to be significant and negative throughout.

In studying the determinants of economic growth in Sub-Saharan Africa using a panel data approach, Ndambiri *et al* (2012) employed a generalized method of moment (GMM) for 19 sub Saharan countries for the period 1982 to 2000. In the study, with all the variables in the log form, a GDP per capita was used to proxy for economic growth with the right hand variables comprising the lagged per capita GDP, the ratio of gross physical capital formation to GDP, final consumption expenditure, the ratio of exports of both goods and services to GDP, nominal discount rate, literacy rate and foreign aid as the ratio to GDP. The results revealed that physical capital formation, human capital development measured in terms of improved literacy rate, and exports as a ratio of GDP, exert positive effect on economic growth. However, government expenditure, nominal discount rate, foreign aid, and the lagged value of GDP per capita, were found to have negative effects on economic growth in the concerned countries.

Using time series data for Zimbabwe for the period 1975-2012, Mbulawa (2015) carried out a VAR modeling on a number of variables: Per capita GDP a proxy for economic growth, trade openness (measured by the ratio of the sum of exports and imports to GDP), gross fixed capital formation as a percentage of GDP, FDI as a percentage of GDP, Balance of payments (BOP), and inflation. The results indicated that there were significant relationships between economic growth and inflation in a negative way, positive significant relationship between economic growth and trade openness as well as with fixed capital formation, but no significant relationship with FDI. The short run dynamics of the model showed that there were a number of relationships among the various variables in the Granger-causality test.

Kata (2009) carried out a study on the determinants of economic growth in Albania. The model estimated was the Neoclassical (Solow) model comprising labour productivity, the capital productivity, and the total factor productivity (TFP) rate. The model presented in a log form of the Cobb-Douglas production function type. The results showed TFP, the labour productivity, and capital productivity, were significantly affecting the level of economic growth.

In gauging the effects of infrastructure Determinants on Economic growth: European Union Sample, Sahin *et al* (2014) employed a panel data approach for the period 1980 to 2011 covering the European Union member countries. In the study, GDP per capita growth rate was used to proxy for economic growth with the independent variables consisting of the lagged dependent variable, telephone lines, air transport, rail lines, roads, and energy production, urban population, and inflation. In the study, all the independent variables were in log form. The findings showed that the lagged dependent variable in one model has a positive significant effect on economic growth while in the other model; it was found to have a negative significant effect on economic growth just as is the case of roads. The telephone lines, rail lines, and energy production, were found to be positive and significant in affecting economic growth. Contrary, air transport was found to be having significant negative influence on economic growth in the Union.

Mbulawa (2015) did a study on the 'Determinants of Economic Growth in Southern Africa Development Community: The Role of Institutions' by using GMM estimator in the panel annual data setting for the period 1996 – 2010 in the SADC region. The GDP growth rate was used to proxy for economic growth. The independent variables comprised the lagged GDP growth rate, trade openness (the ratio of the sum of exports and imports to GDP), inflation, credit to private sector, gross fixed capital formation, financial openness (in terms of FDI), domestic credit by the banking sector, saving ratio, remittances, human capital Measured by the ratio of total enrollment to the population of age group that officially corresponds to the level of education, and quality of institutions. The results showed that openness was having a significant positive effect on economic

growth before the inclusion of quality of institutions. FDI and human capital were found to have significant negative effect on economic growth. Additionally, the saving ratio initially was insignificant but with the inclusion of the quality of institutions, it turned out to be negative.

Iqbal (1998) carried out a study on macroeconomic Determinants of Economic Growth in Pakistan by employing two separate models of time series nature for the period 1959/60 – 1996/7. In one model, per capita real income annual growth was used to proxy for economic growth and in the other annual growth real GDP was used. In all the two models, the independent variables were the same: primary schools enrollment as a ratio of total employed labour force, secondary schools enrollment as a ratio of total employed labour force, enrollments in other educational institutions such as colleges and universities as a ratio of total employed labour force, physical capital stock as a ratio of GDP, overall budget deficit as a ratio of GDP, exports of goods as a ratio of GDP, imports of goods as a ratio of GDP, external debt as a ratio of GDP, Per capita and per capita squared. In the two models, primary school enrollment as a proxy of human capital was positive. The enrollments in the upper levels remain insignificant with wrong signs. It was also established that physical capital, exports, and imports have significant positive effects on economic growth while budget deficit, foreign debt, and per capita real income, have been found significant and exerted negative effects on economic growth.

Havi et al (2013) conducted a study on the ‘Macroeconomic Determinants of Economic Growth in Ghana: Cointegration Approach’ using annual data for the period 1970 – 2011. The real GDP was used to proxy for economic growth in Ghana for the period covered in the study. The explanatory variables in the study consisted of physical capital (fixed capital formation), labour force, FDI, foreign aid, inflation, government expenditure, and military rule. The results revealed that in the long run the physical capital, labour force, FDI, foreign aid, inflation, government expenditure, and military rule were the significant factors in determining economic growth in Ghana. In the short run, it was found that the drivers of economic growth in Ghana were the FDI and government expenditure. There were equally a number of unilateral causalities among the different variables in the model with an exception of single bidirectional causality between CPI (inflation) and FDI in Ghana.

In investigating the Macroeconomic determinants of economic growth in Nigeria: A Cointegration Approach, Ismaila & Imoughele (2015) used time series data for the period 1986 – 2012 in the log form. The real GDP was used to represent economic growth in Nigeria. The right hand variables consisted of physical capital (measured in terms of fixed capital formation), total labour force, FDI, Openness (in terms of the ratio of the sum of exports and imports to GDP), inflation, and government expenditure. The findings in the short run model showed that all the variables with the exception of labour force, trade openness, and inflation, were significantly and positively related to economic growth.

3.0 The methodology of the study

3.1 The data

In this study annual time series data collected from two different sources covering the period 1980 to 2011 were used. The data for real GDP (to proxy for economic growth), population, government consumption expenditure, household consumption expenditure, fixed capital formation (a proxy for infrastructure), inflation (to proxy for macroeconomic instability), openness (measured by ratio of exports to GDP), and financial sector development (measured in terms of broad money supply as a percentage of the GDP), were collected from the World Bank database. The data for FDI were collected from the United Nations Conference on Trade and Development (UNCTAD) database.

3.2 The model and the method of estimation

In this study, Ordinary Least Squares (OLS) estimation method was employed. As in the literature, different variables (factors) have been identified being the determinants of economic growth. However, because of lack of data for some of the variables, the model was formulated to include only those variables whose data were available for the Sudan. Therefore, the functional form of the model became:

$$RGDP = f(POP, FDI, GEXP, HCPC, INFRA, INF, Open, FSD) \quad (1)$$

Given the above functional form, the model estimated was:

$$RGDP_t = \beta_0 + \beta_1 POP_t + \beta_2 FDI_t + \beta_3 GEXP_t + \beta_4 HCPC_t + \beta_5 INFRA_t + \beta_6 INF_t + \beta_7 Open_t + \beta_8 FSD_t + \varepsilon_t \quad (2)$$

Where:

RGDP = Real GDP as a proxy for economic growth.

POP = Population in the country.

FDI = Foreign direct investment as a proxy for financial openness.

GEXP = Final government consumption expenditure.

HCEXP = Household per capita consumption expenditure (as a proxy for private consumption).

INFRA = Physical capital (measured in terms of fixed capital formation as a share of GDP).

INF = Inflation rate a proxy for macroeconomic instability.

OPEN = Openness of the economy to the external trade links (to measure the degree of country's openness to the rest of the world).

FSD = Financial sector development in the concerned economy (proxied by broad money supply as percentage of GDP).

ε = error term.

t = Represents the time series dimension in the data.

To test the reliability of the model (2) above and to validate the results of the said model, different diagnostic tests were conducted and it was established that the model did not violate any of the classical OLS assumptions and as such the study proceeded to conduct unit root tests of the various variables in the model.

3.3 Unit root test

Time series data for most developing countries such as the Sudan are non-stationary. Estimation within such an environment not only violates most classical econometric assumptions, but also renders policy making from such econometric results less accurate. In cases where the data series exhibit unit roots, the short-run dynamic properties of the model can only be captured in an error correction model, when the existence of cointegration has been established (Engle & Granger, 1987). That is, to avoid spurious regression, variables that are at the same order of integration were to enter the regression equation. Therefore, in this study a test for a unit root was conducted.

To carry out the test of unit root, the study applied the test method developed by Dickey and Fuller (1979) popularly known as Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) test. To illustrate the use of DF test, consider first a general form of an AR(1) process:

$$y_t = \mu + \rho y_{t-1} + \varepsilon_t \quad (3)$$

where μ and ρ are parameters and ε_t is assumed to be white noise. y is stationary if $-1 < \rho < 1$.

If $\rho = 1$, y is a nonstationary series (i.e. a random walk with drift). If the absolute value of ρ is greater than 1, the series is explosive. Therefore, the hypothesis of nonstationary series can be evaluated by testing whether the absolute value of ρ is strictly less than 1. The DF test method takes the unit root as the null hypothesis $H_0 : \rho = 1$. Since explosive series do not make much economic sense, this null hypothesis is tested against the one-sided alternative $H_1 : \rho < 1$. The test is carried out by estimating an equation with y_{t-1} subtracted from both sides of the equation:

$$\Delta y_t = \mu + \delta y_{t-1} + \varepsilon_t \quad (4)$$

where $\delta = \rho - 1$ and the null and alternative hypotheses are:

$H_0 : \delta = 0, H_1 : \delta < 0$. The test is based on the critical values simulated by Mackinnon (1991). The simple unit root test described above is valid only if the series AR(1) process is uncorrelated. If the series is correlated at higher order lags, the assumption is violated. The ADF test use different method to control for higher order serial correlation in the series. The ADF test makes a parametric correction for higher order correlation by assuming that the y series follows an AR(p) process and adjusting the test methodology. The approach controls for higher order correlation by adding lagged differenced terms of the dependent variable y to the right hand side of the regression:

$$\Delta y_t = \mu + \lambda y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \dots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \quad (5)$$

This augmented specification is then used to test $H_0 : \lambda = 0$ against the alternative $H_0 : \lambda < 0$ in the test regression. In carrying out the above test, one has to specify the number of lagged first difference terms to add to the test regression (selecting zero lag yields the DF test; choosing lags greater than zero generate ADF tests).

The decision to whether to include a constant, a constant and a linear trend, or neither in the test

regression, was taken on the basis of the following: each of the series was graphed and observed, if the series did not exhibit any trend and has a nonzero mean, a constant was included in the test regression, if the series exhibited a trend and a constant, then a constant and a trend was included, while if the series seems to be fluctuating around a zero mean, neither a constant nor a trend was included into the test.

In this study, the lag length (i.e. p) was chosen as follows:

Firstly, a DF test was carried out on a given variable and secondly, each of the variables - $RGDP$, POP , FDI , $GEXP$, $HCEXP$, $INFRA$, INF , $OPEN$, FSD - was regressed on its first lag. Thirdly, statistics (i.e. the coefficients, the t-statistic, the standard errors, and the p-values) of the first lag in the DF and estimated equation results were compared to ensure that indeed the variable was regressed on its own first lag (which normally indicated by the equality of the statistics). Then a test of autocorrelation conducted by the Breach-Godfrey method with lags zero up to the lag where there were no serial correlations. This procedure was carried out on each of the variables in levels and first differences. In levels, the variable $RGDP$ and $HCEXP$ were found to have serially correlated errors from lag zero to lag four and lag five, respectively, and as such ADF test was employed in unit root test for each of these two variables. The variables, POP , FDI , $GEXP$, $INFRA$, INF , $OPEN$, FSD , were having no serially correlated errors and as such DF was used to test for stationarity.

In first differences, the same procedure was followed as above to establish the lag length in testing for a unit root. It was found that the first differences were not serially correlated and as such DF was used in every case. The result of the unit root test showed that all the variables in the regression were nonstationary in levels. That is, in levels, every variable in the regression model was $I(1)$. In first differences, all the variables were found to be stationary. This means that in first differences, all the variables were $I(0)$. The results of unit root tests in levels and in first differences are presented in tables 1 and 2 below, respectively.

Table 1. The results of unit root tests in levels

Variable	DF/ADF	T-Statistic	Order of integration
$RGDP$	ADF	0.020667**	$I(1)$
POP	DF	-3.320314**	$I(1)$
FDI	DF	-1.344485**	$I(1)$
$GEXP$	DF	0.133995**	$I(1)$
$HCEXP$	ADF	-1.087706**	$I(1)$
$INFRA$	DF	-1.981919**	$I(1)$
INF	DF	-2.185784**	$I(1)$
$OPEN$	DF	-1.937868**	$I(1)$
FSD	DF	-0.676284**	$I(1)$

** All values insignificant at 1%, 5%, and 10%.

Table 2. The results of unit root tests in first differences

Variable	DF/ADF	T-Statistic	Order of integration
$\Delta RGDP$	DF	-4.904849*	$I(0)$
ΔPOP	DF	-3.063999*	$I(0)$
ΔFDI	DF	-3.718201*	$I(0)$
$\Delta GEXP$	DF	-6.095009*	$I(0)$
$\Delta HCEXP$	DF	-3.481850*	$I(0)$
$\Delta INFRA$	DF	-6.325786*	$I(0)$
ΔINF	DF	-7.718885*	$I(0)$
$\Delta OPEN$	DF	-7.923182*	$I(0)$
ΔFSD	DF	-4.880841*	$I(0)$

* All values significant at 1% level

3.4 The Cointegration test

A number of methods to test for cointegration have been analyzed in the econometric literature among which is the Engle-Granger two-stage procedure (EG) or the Augmented Engle-Granger two stage procedure (AEG). The

test for cointegration in this study was carried out by the EG/AEG test procedure. The EG test procedure goes as follows:

Let us suppose a general case where y_t is regressed on x_t both being time series. Subjecting each of these time series to unit root test, it is found that these variables are $I(1)$; that is, they contain unit roots. Supposed then that y_t is regressed on x_t as follows.

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t \quad (6)$$

The above equation can be rewritten as:

$$\varepsilon_t = y_t - \beta_0 - \beta_1 x_t \quad (7)$$

where the dependent variable is regressed on several explanatory variables. If the linear combination of two or more series is stationary, that is; $I(0)$, it can be said that the variables are cointegrated. Economically speaking, two or more variables are said to be cointegrated if they have a long term, or equilibrium, relationship between or among them. A test Supposed ε_t is subjected to a unit root test and is found that it is stationary; that is, it is $I(0)$. This means that, although y_t and x_t are individually $I(1)$, that is, they have stochastic trend, their linear combination in (6) above is $I(0)$. That means the linear combination cancels out the stochastic trends in the two series. This concept can be extended to a regression of cointegration as Granger noted can be thought of as a pre-test to avoid ‘spurious regression’ situation. In this case, a regression such as (6) above is known as a cointegrating regression and the slope parameter β_1 is known as the cointegrating parameter. In the case of regression model containing k regressors, we are to have k cointegrating parameters. This procedure subjects the errors from the cointegrating equation, say in (6) to a unit root test by DF or ADF test depending on whether there are no lagged terms of the AR (1) process or there are lagged terms of the AR(p) process. However, the critical values from DF or ADF are not valid in this case. The value of the test statistic from the DF or ADF is to be compared with the critical values simulated by Engle and Granger that are found in the EG critical values table(s) on which basis a judgment can be carried out whether given variables are indeed cointegrated or not.

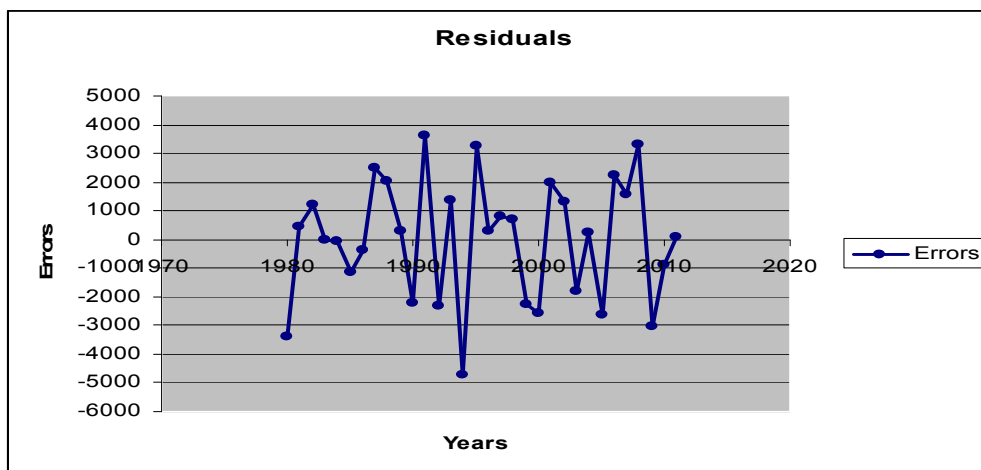


Figure 1. Errors from the long run regression model

In this study, the errors from equation (2) estimated were subjected to a unit root test. The procedure of conducting the unit root test was the same as outlined in the section on the ‘unit root test’ above. The result of the test indicates that the variables are cointegrated given the rejection of the null hypothesis of a unit root.

3.5. The Error Correction Mechanism (ECM)

Having established the existence of cointegration in the series of nonstationary variables, there was a need to proceed to estimate an error correction model. The error term in the long run equation could be treated as the “equilibrium error”. That is, the error term was used to tie the short run behaviour of real GDP in this study to its long run value. The error correction mechanism (ECM) first used by Sargan and later popularized by Engle and Granger (1987) corrects for disequilibrium. Granger representation theorem states that if two variables Y and X

are cointegrated, the relationship between the two can be expressed as ECM which can be expressed as:

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta x_t + \alpha_2 u_{t-1} + \varepsilon_t \quad (8)$$

where Δ denotes the first difference operator, ε_t is a random error term, x_t represents every independent variable in the model, and

$$u_{t-1} = y_{t-1} - \beta_1 - \beta_2 x_{t-1} \quad (9)$$

That is, the one-period lagged value of the error term was from the cointegrating equation (i.e. the original equation). The ECM equation (8) states that Δy_t depends on Δx_t and also on the equilibrium error term. If the error term is nonzero, then the model is out of equilibrium. Supposed Δx_t is zero and u_{t-1} is positive. This means that y_{t-1} is too high to be in equilibrium, that is, y_{t-1} is above its equilibrium value of $(\alpha_0 + \alpha_1 x_{t-1})$. Since α_2 is expected to be negative, the term $\alpha_2 u_{t-1}$ is negative and therefore, Δy_t will be negative to restore the equilibrium. That is, if y_t is above its equilibrium value, it will start falling in the next period to correct the equilibrium error, hence the name ECM. By the same token, if u_{t-1} is negative (y is below its equilibrium value), $\alpha_2 u_{t-1}$ will be positive, which causes Δy_t to be positive, leading y_t to rise in period t. Thus the absolute value of α_2 decides how quickly the equilibrium is restored. The results of the ECM for real GDP in the Sudan are availed in section four. The ECM model was estimated with variables in their first differences since every one of them was differenced stationary with the cointegrating error term entered in its first lag (as usual) as shown in the model below.

$$\begin{aligned} \Delta RGDP_t = & \alpha_0 + \alpha_1 \Delta POP_t + \alpha_2 \Delta FDI_t + \alpha_3 \Delta GEXP_t + \alpha_4 \Delta HCEXP_t + \alpha_5 \Delta INFRA_t \\ & + \alpha_6 \Delta INF_t + \alpha_7 \Delta OPEN_t + \alpha_8 \Delta FSD_t + \alpha_9 U_{t-1} + \varepsilon_t \end{aligned} \quad (10)$$

4.0 Results and discussion

The present section is devoted to the results as shown in tables 3 and 4 respectively followed by discussion in each case below.

Table 3. Results of the long-run model

Variable	Coefficient	T-statistic	P-value
C	33426.51	2.431849	0.0232
POP	0.000623	1.669858	0.1085
FDI	3.539926	7.677295	0.0000
GCEXP	-0.00000672	-2.813614	0.0099
HCPC	-71.37760	-4.256815	0.0003
INFRA	-398.1453	-1.110914	0.2781
INF	-39.81374	-2.042728	0.0527
OPEN	461.5257	1.228717	0.2316
FSD	372.6955	2.241938	0.0349
$R^2 = 98\%$, $DW=2.5$, F -Statistic 193.3051 Prob(F-statistic) 0.000000			

The population as a measure of labour force has been insignificant in both the long-run and the short-run models although having the expected sign in the long-run model but carries unexpected sign in the short-run model. Given the insignificance of this variable, then it is not different from zero in terms of influence on economic growth in the Sudan. These results are inconsistent with the findings of a study carried out by Petrakos & Arvanitidis (2008).

Foreign direct investment (FDI) has been significant and carries the expected sign in both the long-run and the short-run models. This means the flow of FDI to the country is highly beneficial to economic growth and eventually development. These results are in agreement with the findings of studies conducted by Petrakos & Arvanitidis (2008), Salahuddin (2010), Havi et al (2013). However, in terms of the sign, the results do not agree with the findings of a study by Mbulawa (2015, 2015).

The final government consumption expenditure has been significant but carries unexpected sign in all the two models. This means that increase in government expenditure is detrimental to economic growth in the Sudan and this could be due to the fact that the major share of government spending is on military armament from outside the country and does not help in the growth of the country or could be that the government consumption has been on commodities that are not from the local suppliers. These results are not consistent with

the study carried by Ndambiri et al (2012). However, different studies have indicated that government consumption expenditure is likely to be counterproductive to economic growth for a country (Gali et al, 2003).

Table 4. Results of the short-run model

<i>Variable</i>	<i>Coefficient</i>	<i>T-statistic</i>	<i>P-value</i>
<i>C</i>	851.7881	1.163389	0.2577
ΔPOP	-0.000317	-0.456772	0.6525
ΔFDI	3.316275	6.284913	0.000
$\Delta GCEXP$	-0.00000672	-3.326572	0.0032
$\Delta HCPC$	-55.21240	-2.941962	0.0078
$\Delta INFRA$	-555.1505	-2.795160	0.0108
ΔINF	-26.65311	-1.583688	0.1282
$\Delta OPEN$	513.3301	3.073006	0.0058
ΔFSD	330.7218	1.793258	0.0873
<i>UR(-1)</i>	-1.300078	-6.504107	0.0000
<i>R² = 80%, DW=2.1, F-Statistic 14.74423 Prob(F-statistic) 0.000000</i>			

Household per capita consumption expenditure has been equally significant and carries wrong signs in both the long-run and the short-run models. These results are contrary to the theoretical literature and in particular to the Keynesian model of income determination. Perhaps, it could be that most of the household consumption expenditure has been greatly on goods that have been imported to the country by foreign firms whose profits normally get out of the Sudan.

The infrastructure has been insignificant in the long run but significant in short run with unexpected sign. These findings are not in line with the studies conducted by Borojo & Yushi (2015), Ndambiri et al (2012), Mbulawa (2015), Kata (2009), Iqbal (1998), Havi et al (2013). In the short run, the sign is negative possibly because of the fact that the lack of development of the infrastructure in the country affects economic growth negatively.

Inflation has been found significant and carries the correct sign in the long-run. The results are consistent with the studies carried out by Salahuddin (2010), Borojo & Yushi (2015). However, in the short-run, inflation has been insignificant although it carries the expected sign. The result is consistent with the results of the study conducted by Ismaila & Imoughele (2015). The insignificance of inflation in the short run is inconsistent with the studies conducted by Salahuddin (2010), Borojo & Yushi (2015), Mbulawa (2015), Havi et al (2013). This means that in the long run, as the rate of inflation increases, the rate of economic growth is affected adversely.

The openness of the economy to the outside world has been insignificant in the long-run but carries the expected sign. The insignificance of openness to the outside world has equally been confirmed in the study by Ismaila & Imoughele (2015). In the short-run, the openness of the economy to the outside world has been found significant and positively influences the rate of economic growth in the Sudan. These results are in line with the findings of studies carried out by Petrakos & Arvanitidis (2008), Iqbal (1998), and, Ismaila & Imoughele (2015) and not compatible with the results of studies carried out by Borojo & Yushi (2015), and, Mbulawa (2015, 2015) .

The financial sector development in the Sudan has been found significant and carries the expected positive sign both in the long-run and the short-run models. This means that the development of financial sector in the country is so beneficial to economic growth throughout the period starting from the short run and continues to impact the growth of the economy in the long-run. These findings are consistent with the results of Petrakos & Arvanitidis (2008), and in terms of the sign, the results are inconsistent with the study carried out by Salahuddin (2010). The significant positive effect of financial development on economic growth indicates that financial credit to the private sector in the Sudan promotes economic growth. This significant positive impact of financial development on economic growth conforms to the theoretical explanation offered by Mishkin (2001).

The error correction mechanism (ECM) term in the short run model is negative and significant. This means that at equilibrium, economic growth can be slightly above its equilibrium value and would adjust downwards towards its equilibrium value. The coefficient of the ECM is high meaning the speed of adjustment of the dependent variable to its equilibrium value is so high.

5.0 Conclusions and recommendations

The study was meant to investigate the determinants of economic growth in the country. In the study, real GDP was used to proxy for economic growth while the regressors comprised population, foreign direct investment, final government consumption expenditure, household per capita consumption expenditure, infrastructure,

inflation, openness of the country to the outside world, and financial development. The results show that population has been an insignificant determinant of economic growth in the country both in long run and in the short run. FDI has been significant and carries the expected sign throughout. To the contrary, final government consumption expenditure and household per capita consumption expenditure have the unexpected signs and significant. While openness has been significantly and positively influencing economic growth in the short run, financial sector development has been significant and positively affecting economic growth in the country both in the long run and in the short run. Inflation on its part has the expected sign and equally significant in the long run but insignificant in the short run although with the correct sign. Infrastructure has been insignificant in the long run but significant in the short run although it carries the unexpected sign. It can be concluded that for the Sudan to foster economic growth, there is a need for the authorities to enhance FDI flow into the country, continue to have an open economy, and continue to develop the financial sector in the country. Additionally, the authorities in the Sudan have to design both monetary and fiscal policies to control inflation in order to stimulate economic growth while at the same try to develop the infrastructure in the country. In regards to government expenditure and household consumption expenditure, there is a need to redirect the government consumption expenditure to local resources so as to pave way for fostering growth in the country. Although the study managed to achieve its objectives, there have been some weaknesses in the study that would call for further enquiry. Firstly, the study has not broken down the independent variables into macroeconomic and non-macroeconomic determinants of economic growth to be able to gauge the effect of each group of the said variables on economic growth in the Sudan. Secondly, there are variables that have not been taken into consideration due to lack of availability of data for the concerned variables such as natural resources, human capital, political factors, taxes, and research and development. Therefore, the study recommends for further enquiry into the case in point to improve on the results of the study.

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