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Population growth, income growth and savings in Ghana

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Abstract

Purpose – The study explores the relationship among economic growth, population growth, gross savings and energy consumption over the period 1987– 2017.

Design/methodology/approach – The autoregressive distributed lag (ARDL) bounds test approach by Pesaran *et al.* (2001) was employed to investigate variables for the study.

Findings – In the key findings, both gross savings and population growth negatively affect economic growth. However, energy consumption has positive impact on economic growth.

Practical implications – These findings call for policy portfolios to address the impacts of gross savings and population growth on economic development. In particular, the financial sector needs to be revamped to be more efficient in channeling funds from the surplus units to the deficit units. It is recommended that investment be made in financial and technological innovation to provide efficient access to credits and other financial products even though individual savings may not move with economic growth.

Originality/value – Many studies have explored the nexus between savings and economic growth without considering population growth and energy consumption. In this study, the relationship among savings, economic growth, population growth and energy consumption provide additional knowledge in policy formulation.

Keywords Economic growth, Gini index of Ghana, Energy consumption, Gross savings

Paper type Research paper

1. Introduction

National savings are critical to the development of every nation. It is so important that when less developed capital markets channel funds inefficiently from surplus units to deficit units for various productive activities, economic development is negatively affected (Krieckhaus, 2002). According to Nurkse (1953), increased national savings have high tendency to spur national investment which in turn will serve as a premise for more rapid economic growth. The flip-side of the argument is that high savings rate has its own implications. It is argued that less developed financial markets constrain the investment demand but *in lieu* promotes savings growth. "Due to the relatively smaller scale *per se,* comparatively less sophisticated and complex money market investments and operations with lesser variety of financial instruments, options and mechanisms in the market, banks in China have ways to utilize their large amount of savings besides providing traditional loans. It is harder for them to transfer or convert savings into investments efficiently and effectively as compared to the far more developed countries with highly developed markets" (Lean and Song, 2009).

It is argued that economic growth is essentially one of the main policy objectives of every country. Thus, achieving this objective is predicated on a number of factors including but not limited to the following factors, savings rate, energy consumption, population growth, capital

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formation and political freedom. However, the contributions of these factors, economic growth or development are not straightforward. Moreover, Kitov (2008) argued that an increase in economic growth is reliant solely on the changes in specific age group in population and the attained level of real GDP per capita. In reference to the above, GDP has a steady growth increment and any fluctuations can be explained by changes in composition of the population structure.

Moreover, Kitov (2008) argued that an increase in economic growth is reliant solely on the changes in specific age group in population and the attained level of real GDP per capita. In reference to the above, GDP has a steady growth increment and any fluctuations can be explained by changes in composition of the population structure.

Furthermore, academic and policy evidence show that population growth, income growth and savings yield outcomes that impact on economic growth differently. These mixed conclusions are a result of different methodologies employed in the various studies, varying characteristics of economic fundamentals of the different countries, different sample sizes and omitted variable bias. The motivation for this work stems from the disagreement among researchers on the effects of these factors on economic growth. Moreover, the few studies conducted on Ghana are quite old and essentially explored only the relations between savings and economic growth. Thus, the relations among population, savings and economic growth have not been thoroughly examined in the Ghanaian context. In this study, we examine how population growth affects income growth per capita. Further, the effect of savings on economic growth as well as the interactions between population growth and economic growth are explored. Moreover, this study employed a more robust econometric technique and recent data. In effect, findings from this study have contributed to scholarship, and policy makers have the research output of this study to shape policies toward economic growth.

The rest of the paper has been organized as follows: the remaining part of Section 2 expatiates on some stylized facts on Ghana, while Section 3 is on literature review, Section 4 is on methodology, Section 5 is on empirical results and Section 6 is on conclusion and policy implications.

2. Literature review

In this section, both theoretical and empirical review of the relevant literature is conducted. This is important to underscore various arguments underpinning previous studies as there were mixed conclusions on the nexus between income growth levels, population and savings. Some scholars have argued that growth in income levels has a positive impact on population growth while others argue for the opposite. Other scholars have also looked at the impact of domestic savings on the income levels of countries and its association with the rate of growth in their population.

First, the theoretical underpinning of the relationship among income growth, population and savings stems from the standard Solow-Swan model. The standard Solow–Swan model is the neoclassical economic theory propounded by concurrently by Solow (1956) and Swan (1956). The theory argues that economic growth drives from capital, labor, new technology and ideas. The theory posits that in the long run, sustained economic growth is achievable only by technological advancement (Solow, 1956). In addition, Modigliani and Brumberg (1954) propounded the life cycle theory which explores the consumption and savings pattern of individuals over their lifetimes. The theory explains that people tend to save more in times of higher income and during their prime working days to cater for future consumption in their old age. This may imply that a population with majority falling within the working-age bracket can accumulate more private savings to provide capital for productive activities.

Equally a lot of empirically studies have been conducted on this topic. Thus, Narayan and Narayan (2006) employed the autoregressive distributed lag (ARDL) approach to cointegration to examine both the long-run and short-run relationships among savings, real interest rate, income, current account deficits and age dependency ratio in Fiji from 1968 to 2000. The study concluded that when growth rate increases by 1% , savings will rise by 0.07% in the short run and 0.5% in the long run. Again, the Johansen and Juselius cointegration and Granger causality tests were utilized by Lean and Song (2009) to analyze the domestic savings and economic growth relationship in China over the period 1955– 2004. The results of the study also confirmed that China's economic growth have a positive long-run relationship with household savings and enterprise savings. In addition, a mutual causality runs from domestic savings growth to economic growth in the short run. On the contrary, causality solely runs from domestic savings growth to the economic growth in the long run.

In addition, with data from 1990 to 2014, Duran *et al.* (2017) used grey relational analysis to study the relationship between domestic savings and macroeconomic indicators in Turkey. The study postulated that unemployment rate and gross domestic product per capita growth were highly related prior to 2001. However, current balance ratio and GDP ratio also proved to be the variables with high level of relationship with domestic savings. In a similar vein, three models such as dynamic ordinary least square, fully modified ordinary least squares and the vector error correction model were employed by Uddin *et al.* (2016) to explore the impact of population age structure and savings rate on economic growth in Australia from 1971 to 2014. All the three models utilized affirms a long-run relationship between the dependency ratio, savings rate and real GDP. Furthermore, Jouini (2016) employed ARDL bounds test approach to examine economic growth and savings nexus in Saudi Arabia from 1980 to 2012. It was concluded from the study that economic growth and savings are cointegrated and have a positive mutual granger causality in both the short and long run.

Also, Sekantsi and Kalebe (2015) applied ARDL bounds testing approach to cointegration and vector error correction model test to investigate the causal linkage between savings, investment and economic growth in Lesotho with data from 1970 to 2012. Their outcome suggests the existence of cointegration among the variables and a unidirectional causality running from economic growth to savings in the short run. On the contrary, causality runs from savings to economic growth in the long run. Moreover, a trivariate causality framework and error correction technique were employed by Odhiambo (2008) to the data from 1969 to 2005 to evaluate the causal interaction among financial depth, savings and economic growth in Kenya. The findings of this study indicate that a unidirectional causality flows from economic growth to financial development. Also, Odhiambo (2009) applied a multivariate causality test to data from 1950 to 2005 to investigate the causal relationship between savings and economic growth in South Africa. The outcome from the studies reveals a short-run bidirectional causality between savings and economic growth but a unidirectional causal flow from economic growth to savings in the long run.

Furthermore, utilizing time series data, with a varying data period, Adam *et al.* (2017) employed the Granger causality, Toda–Yamamoto approach and instantaneous causality test to investigate the causal relationship between domestic savings and economic growth in selected sub-Saharan African countries. The outcome of the studies proves that domestic savings and economic growth are completely independent in the three countries, a unidirectional causality running from saving to economic growth. The evidence from the other five countries yield mixed results from the different methods making it inconclusive. Again, the relationship between savings and investment in China for the period 1952–1998 was studied by Narayan (2005). The study applied a cointegration test and the result proved that saving and investment are correlated for the entire period. In addition, Larbi (2013) used a cointegration analysis and data covering the period 1970–2010 to explore the factors that influence domestic savings in the long run in Ghana. The studies established that financial liberalization, per capita income and inflation have a positive and significant relationship with private savings.

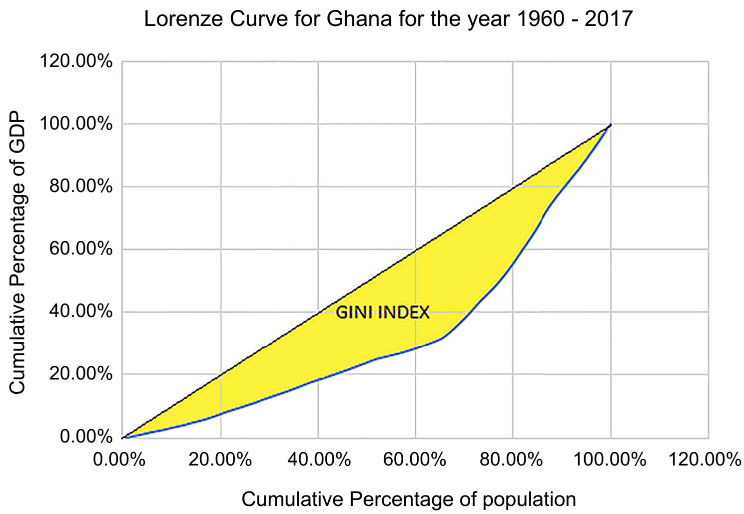
3. Stylized facts on Ghana

In this section, some highlights are provided on the facts relating to the Ghanaian economy. Figure 1 shows the income distribution among Ghanaians from 1960 to 2017. From the graph, it could be observed that the poorest 20% of the lowest income population in Ghana earn below 10% of national income. Furthermore, 60% of the population earns approximately only 27% of the country's income. On the contrary, the richest 20% high-income earners control 45% of the national income. Thus, Ghana's income distribution is avidly skewed, with a small percentage of the population controlling a larger share of the national income.

Figure 2 below shows the relationship between the annual GDP per capita growth in percent and gross savings as a percentage of GDP. The per capita GDP growth rate over the period 1985– 1987 show a period of high growth rate. The underlying reason may be derived from a number of economic policies adopted. From 1989 to the early 1990s, financial sector reforms one and two produced growth amidst a strong population containment drive. The population policy during the period resulted in many urban dwellers and educated middle class giving birth to maximum of three children with strong family planning education across the country. Also, between 2001 and 2006, Ghana adopted the highly indebted poor country (HIPC) initiative which led to debt forgiveness, investment in infrastructure and social services. The HIPC initiative also led to correction of instability of macrofiscal indicators of the Ghanaian economy. The combined effect of these developments over the period may have accounted for the high per capita growth rate.

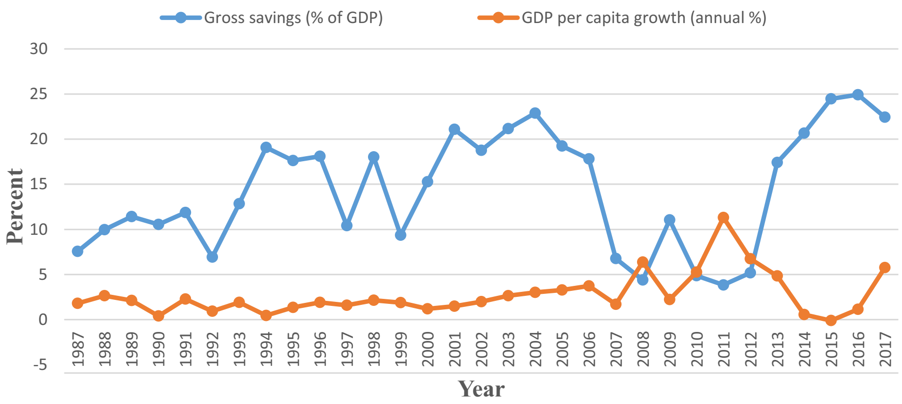
From Figure 2, it is observed that whiles per capita GDP growth showed relatively steady high growth rate, gross savings as a percent of GDP showed a wavy trajectory for most part of the period.

Ghana, however, experienced a change in the trends of the two variables in 2007. In 2007, although GDP growth was rising, gross savings continued to fall until 2008. This unusual behavior of the trend was plausibly partially due to the currency redenomination. Again, in 2011 due to the discovery and lifting of oil in commercial quantities, the country experienced a sharp rise of 15% in GDP growth notwithstanding gross savings as a percentage of GDP fell below 5%.



Source(s): Authors' Construct (Data from the World Bank, 2019)

Figure 1.
Lorenz Curve for Ghana covering the period 1960–2017



Note(s): [1]Gross savings are calculated as gross national income less total consumption, plus net transfers which is measured in local currency units (World Bank, 2019)
[2]Annual percentage growth rate of GDP per capita expressed in constant local currency. GDP per capita is gross domestic product divided by midyear population (World Bank, 2019)

Source(s): Authors' Construct (Data from the World Bank, 2019)

Figure 2. Graphs of gross savings as a percentage of GDP[1] and GDP per capita growth in percent[2]

Figure 3 below shows the relationship between population growth and real GDP per capita growth over the period 1987– 2017. It could be observed that increases in population were relatively stable over the period, hovering in the neighborhood of 2.8%. The highest GDP growth rate was recorded in 2011 at 11.28%. This astronomical growth could be essentially attributed to the production of crude oil in commercial quantities in the last quarter of 2011. However, it nosedived thereafter recording as low as 1.6 percent in 2014 and 1.42% in 2015, respectively, which were below the population growth rates.

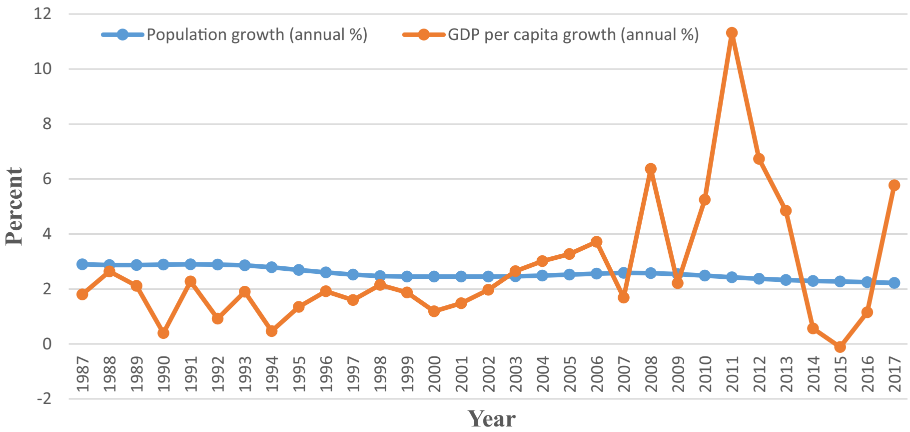
It is evident from Table 1 that demographic factors and geographic conditions influence the level of savings in the country. Approximately 58 percent of the country's total savings population was males as compared to the 41.4% who were females. The data show that males and females have different attitudes toward savings. This behavior could be attributed to difference in perceived risk, educational levels and other external cultural factors that affect the productivity of females in Ghana. Females who are not economically active depend on their male counterparts for a living. As a result, the former is expected to save less than the later who are economically active.

Again, geographically, household's savings were analyzed based on whether the area is urban or rural. The urban areas were sub-divided into Greater Accra Metropolitan Assembly and other urban areas. Furthermore, the rural areas were further divided into rural coastal, forest and savannah. Table 1 shows that 46.4% of the urban population was saving which is twice more than the savings (21.5%) in the rural areas. This shows that majority of savings in Ghana accumulate from the urban areas. These trends in savings behavior may be mainly due to but not limited to allocation of more developmental project and budgetary plans to the urban areas which end up creating more income generating opportunities, accessibility of savings mobilization institutions in the urban areas and lack of financial education in the rural areas.

4. Data collection and methodology

4.1 Data definition

The data used for the analysis are the real GDP per capita in local currency terms. Gross savings are calculated as gross national income less total consumption, plus net transfers



Source(s): Author's Construct (Data from the World Bank, 2019)

Figure 3.
Graph of annual population growth and GDP per capita growth in percent

Table 1.
Households with a bank account or contributing to a savings scheme by locality and sex

	Households with a bank account			Individuals having savings accounts		
Locality	Savings	No savings	Total	Male	Female	All
Urban	*46.4*	*53.6*	*100.0*	*55.2*	*44.8*	*75.6*
Accra (GAMA)	54.1	45.9	100.0	56.3	43.7	28.2
Other urban	42.9	57.1	100.0	54.5	45.4	52.7
Rural	*21.5*	*78.5*	*100.0*	*69.2*	*30.8*	*24.4*
Rural coastal	22.6	77.4	100.0	70.2	29.8	3.4
Rural forest	23.3	76.7	100.0	67.1	32.9	15.1
Rural savannah	17.6	82.4	100.0	74.0	26.1	5.8
All	*35.4*	*64.6*	*100.0*	*58.6*	*41.4*	*100.0*

Source(s): Ghana Statistical Service (2014)

which is measured in local currency units. The energy consumption refers to the use of primary energy before transformation to other end-use fuels which is measured is kt [1]. Population growth is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship and the values shown are midyear estimates (World Bank, 2019). The data are sourced from the World Development Indicators and spans the period 1987– 2018 [2].

4.2 Unit root test

Most economic and time series data show trending behaviour or are nonstationarity in the mean. The most imperative task is to determine the properties of the trend in the data set. A time series data are said to be stationary if a shift in time does not cause the shape of the distribution to change. Thus, the basic properties like the mean variance, and covariance are constant over time and vice versa. According to Granger and Newbold (1974), using a nonstationary time series data may produce a spurious result. A unit root tests is normally used to determine if trending data should be first differenced or regressed on deterministic functions of time to make the data stationary. Inferring from the finance and economic theory, nonstationary time series variables usually produce long run equilibrium relationships among the variables. The augmented Dickey–Fuller (ADF) test is used to examine the data generating process of the various variables been considered. The major disadvantage of the ADF test is that it is liable to under-rejecting the null hypothesis. This applies mostly to series that are trend stationary with structural breaks. To cater for this problem, Kwiatkowski–Phillips–Schmidt–Shin (KPSS) and the Phillips and Perron (1988) tests are used as alternative models. This is particularly important because of the unique properties of each of the approaches.

4.3 Cointegration test

Once it is proven that there exist a unit root in the data set, the next question that needs to be tackled is whether there is a long-run relationship among the variables. The existence of long-run equilibrium relationship among the variables will imply that the variables are cointegrated. There is a possibility of the existence of common trends within the variable as a group. If this happens to be the case, then estimating any function using the first difference of the series could result in wrong specification as it eliminates some important level terms (Engle and Yoo, 1987). A two-step method for testing cointegration as suggested by Engle and Granger (1987) could be used to determine whether there exist a long-run relationship among the variables. This means of testing for cointegration looks for a unit root in the residuals of a first-stage regression which are estimates of the disturbance term. This causes the asymptotic distribution of the test static to differ from the one for ordinary series. However, there is the need to add that, this test can only estimate single cointegration relation since it cannot give a consistent estimate when there are multiple cointegration relation making. This, therefore, makes it an inappropriate test for variables with multiple long-run relationship.

In the light of this, Johansen (1991, 1995) and Johansen and Juselius (1990) cointegration approach and the ARDL bounds test approach by Pesaran *et al.* (2001) were used to examine the existence of cointegration. Johansen (1991,1995) and Johansen and Juselius (1990), unlike the Engle–Granger's (1987) two-step method, deals with endogenous factors as well as more than one cointegrating relationships when there are at least three variables in the study. Relatively, the ARDL also exhibits the following advantages over the Johansen (1991, 1995) and Johansen and Juselius (1990) approach. Unlike the later approaches, the ARDL approach does not impose a restrictive assumption that all the variables under consideration must be of the same order of integration. Again, the ARDL is the ideal approach for small sample analysis. Last but not the least advantage is that the ARDL approach traditionally produces balanced estimates of the long-run model and valid *t*-statistics, regardless of whether some of the underlying series are endogenous (Narayan, 2005). Thus, endogenous issues have no adverse effect on the outcome of the analysis. The various ARDL models will be expressed with the following variables as the dependent variables: gross domestic product, population, energy consumption and savings. Engle and Granger (1987) on the other hand posited that a linear combination of these nonstationary series might be stationary, in which case it can be concluded that the series are cointegrated. The unrestricted error correction model (UECM) within the framework of the ARDL is estimated by taking into consideration each variable in turn.

Thus, the UECM for the economic growth function can be expressed as follows:

$$\begin{aligned}\Delta lnY &= \varphi + \alpha_T T + \alpha lnY_{t-i} + \beta lnP_{t-i} + \lambda lnE_{t-i} + \mu lnS_{t-i} + \sum_{i=1}^{n} \theta \Delta lnY_{t-i} \\ &\quad + \sum_{i=0}^{n} \varphi \Delta lnP_{t-i} + \sum_{i=0}^{n} \partial \Delta lnE_{t-i} + \sum_{i=0}^{n} \theta \Delta lnS_{t-i} + \varepsilon_{1t}\end{aligned} \tag{1}$$

where Y_t denotes gross GDP per capita in real terms; P_t is population growth; E_t is energy consumption and S_t stands for gross savings Also, Δ is the first difference operator, T denotes time trend; ln denotes the natural logarithm, t is the time index ε_t and is a white noise error term.

The Akaike information criterion (AIC) and the Schwarz information criterion (SIC) were used as the bases for selecting the maximum lag order. Thus, the joint significance of the coefficients of the various one-period lagged series is established with reference to the standard F-statistic. Once the optimal structure for the ARDL specification has been established, the next step is to determine whether there exist cointegration relationship among the variables. This is done by conducting the null hypothesis of noncointegration using an F-statistic for the combined meaning of the offset levels of the variables involved in the ARDL equation so that

$$H_0 : \alpha = \beta = \lambda = \mu = 0$$

Against the alternative hypothesis of cointegration:

$$H_1 : \alpha \neq \beta \neq \lambda \neq \mu \neq 0$$

Thus, the asymptotic distribution of the ideal nonstandard F-statistic under the null hypothesis is derived for cases in which the exogenous variables are either all I (0) or I (1) or are mutually cointegrated. Two sets of asymptotic critical values are provided by Pesaran *et al.* (2001) for choosing whether the data sets are cointegrated or not. According to Narayan (2005), however, the critical values advanced above are for large sample sizes. In effect, he proposed critical values for small data set, between 30 and 80 data points. According to the critical values provided by Pesaran (2001), if the F-statistic is below the lower critical bound, I (0), then the null hypothesis of no cointegration should be accepted. The null hypothesis of no cointegration should be rejected if the F-statistic is below the upper critical bound I (1). Furthermore, the decision becomes inconclusive if the F-statistic falls in-between the two critical bounds.

4.4 ARDL long and short-run elasticities

Once it is confirmed that there is a long-term relationship among the variables, the causal relationship among the variables is investigated. In effect the error correction model within the framework of the ARDL is estimated as follows:

$$\begin{aligned}\Delta \ln Y_t = \pi_0 + \sum_{i=1}^{m} \pi_1 \Delta \ln Y_{t-i} + \sum_{j=1}^{n} \pi_2 \Delta \ln P_{t-j} + \sum_{k=1}^{q} \pi_3 \Delta \ln E_{t-k} + \sum_{v=1}^{r} \pi_4 \Delta \ln S_{t-v} \\ + \eta_1 ECT_{t-1} + \mu_{1t}\end{aligned} \tag{2}$$

$$\begin{aligned}\Delta \ln P_t = \tau_0 + \sum_{i=1}^{m} \tau_1 \Delta \ln P_{t-i} + \sum_{j=1}^{n} \tau_2 \Delta \ln Y_{t-j} + \sum_{k=1}^{q} \tau_3 \Delta \ln E_{t-k} + \sum_{v=1}^{r} \tau_4 \Delta \ln S_{t-v} \\ + \eta_2 ECT_{t-1} + \mu_{2t}\end{aligned} \tag{3}$$

$$\begin{aligned}\Delta \ln E_t = \delta_0 + \sum_{i=1}^{m} \delta_1 \Delta \ln E_{t-i} + \sum_{j=1}^{n} \delta_2 \Delta \ln P_{t-j} + \sum_{k=1}^{q} \delta_3 \Delta \ln Y_{t-k} + \sum_{v=1}^{r} \delta_4 \Delta \ln S_{t-v} \\ + \eta_3 \mathrm{ECT}_{t-1} + \mu_{3t}\end{aligned} \tag{4}$$

$$\begin{aligned}\Delta \ln S_t = \vartheta_0 + \sum_{i=1}^{m} \vartheta_1 \Delta \ln S_{t-i} + \sum_{j=1}^{n} \vartheta_2 \Delta \ln Y_{t-j} + \sum_{k=1}^{q} \vartheta_3 \Delta \ln P_{t-k} + \sum_{v=1}^{r} \vartheta_4 \Delta \ln E_{t-v} \\ + \eta_4 \mathrm{ECT}_{t-1} + \mu_{4t}\end{aligned} \tag{5}$$

The ECM discriminates between the long-run and the short-run relationships. The coefficients of the parameters ϑ_1, ϑ_2, ϑ_3 and ϑ_4 show the short-run adjustment dynamics. Equally,

μ_{1t}, μ_{2t}, μ_{3t} and μ_{4t} are the uncorrelated white noise error terms. However, the error correction term, ECT_{t-1} which is lagged one period signals the presence of long-term causal relationship. The ideal sign should be negative and statistically significant to confirm the presence of long-term dynamic relationship. If the sign of the ECT_{t-1} is positive, it shows that any deviation from the equilibrium relationship is not restored but rather explosive. The Wald test is applied on the lagged values of the variables as well as that of the error correlation term to establish the presence of the short-run and long-run causality in the variables.

5. Empirical results and discussion

5.1 Unit root test

The results of the unit root tests at levels are mixed. Thus, for example, the KPSS test shows that energy consumption is stationary at levels whiles that of the ADF and PP tests shows that there is unit root. However, after taking first difference, the unit root tests show that all the variables are stationary. However, the different orders of integration do not pose any econometric analysis problem given that the ARDL model is suitable to handle situations like this (see Table A1).

5.2 Cointegration test

Furthermore, the long-run relationship between the variables under consideration is examined. To this end, the ARDL bounds test approach by Pesaran *et al.* (2001) cointegration approach is employed to test for cointegration. Regarding the bounds test framework, the calculated F-statistics are compared with the critical values at various levels of significance. Given that the sample size is relatively small (30), the Narayan (2005) critical values which are specific to sample sizes are employed to conclude on the cointegration relations among the variables. Thus, the calculated F-statistics are above the critical values at various levels of significance, and, therefore, it is concluded that there are cointegrating relationships among the variables.

As a way of verifying the results of the ADRL bounds test approach, the Johansen (1991, 1995) cointegration test was conducted. The AIC and SIC information criteria suggested lag three as the optimal lag length for the cointegration test. Therefore, the null hypothesis of at most four cointegrating relation at 5% significance level is rejected as the trace statistic (9.22) and max-eigen statistics (9.22) are above the critical values of 3.84 (see Table A2). Therefore, a conclusion is drawn that the are at most four cointegrating equations (Table 2).

5.3 Estimated long-run and short-run elasticities

Since the variables are cointegrated, the long-run model is estimated following the ARDL specification (Equation 1). Based on the AIC, a maximum of four lags was used for the model such that $I_{\max} = 4$. Table 3 presents the long-run elasticities of the model (lnGDP|lnPOP, lnEC|lnS) with GDP as the dependent variable. The coefficients of all the parameters are statistically significant at various levels of significance.

In the long run, there is a negative relationship between population growth and real GDP per capita. This implies that a 1% rise in population may lead to approximately 3.43% fall in real per capita GDP. This finding is consistent with the argument by Kelly (1973) that a decrease in the proportion of dependents all things being equal leads to a higher growth in income per head.

Therefore, the negative effect of population on economic growth may be due to the combined effect of a host of economic factors. First, Ghana's labor force with advanced education is still relatively low with serious implications for low productivity (World Bank, 2019). Also, Ghana has a high age-dependency ratio of approximately 69%

(World Bank, 2019) with its attendant potential consequences of low investment in productive capital.

There is also an adverse relationship between economic growth and gross savings. Thus, a 1% increase in gross savings will lead to approximately 0.04% decrease in real GDP per capita. This finding is at odds with the standard endogenous growth model which states that savings have positive impact on economic growth (Aghion *et al.*, 2016). However, the direction of the effect of the savings on economic growth have empirically be proven to depend on whether the economy is advanced or developing. Thus, the findings from this study is consistent with that of the studies conducted by Sahoo *et al.* (2001) and Bist and Bista (2018) who found negative relationship between savings and economy growth. With regards to Ghana's case, underlying the expansion of the Ghanaian economy is growth in the financial sector with a rise in access to credit and other financial services. One of the implications of this development is that the increasing accessibility to credit plausibly has reduced the motivation for domestic savings and partly may explain the negative relationship between economic growth and savings in the long-run. Also, in line with the argument by Aghion (2016), Ghana like many developing countries lack the technological innovation to spur economic growth with increased savings. In addition, the negative relationship between savings and economic growth in the long-run may reflect less mature, complex and efficient financial markets for the allocation of surplus funds for productive activities. Moreover, there is a positive relationship between energy consumption and economic growth. Again, there is a positive effect of lagged economic growth on current growth in the long-run horizon. Thus, a rise of 1% in energy consumption may lead to a 0.24% increase in economic growth, approximately. This results reflect how critical energy is the development of the Ghanaian economy and the recent increase in Ghana's power production is beginning to yield some positive results albeit marginal.

Furthermore, the short-run dynamics shows that in the short run, lagged economic growth significantly influences current economic growth at the 1% significance level. In a similar

Table 2.
ARDL bounds testing results for cointegration

Dependent variable	Function	*F*- test statistic
Model 1	F(lnGDP|lnPOP,lnS,lnEC)	4.7582[c]
Model 2	F(lnPOP|lnGDP,lnEC,lnS)	86.4432[a]
Model 3	F(lnEC|lnGDP,lnPOP,lnS)	4.9653[c]
Model 4	F(lnS|lnGDP,lnPOP,lnEC)	5.9524[b]
	Asymptotic critical values	
1%	5%	10%
I (0) I (1)	I (0) I (1)	I (0) I (1)
5.333 7.063	3.710 5.018[b]	3.008 4.150[c]

Note(s): [a], [b] and [c] denote significance levels at 1%, 5% and 10%, respectively. Source of critical values: Narayan (2005, p. 1900)

Table 3.
Estimated long-run elasticities using the ARDL (2, 2, 3, 4) approach, dependent variable is lnGDPt

Independent variables	Coefficients	Standard error	*T*-ratio	*p*-values
C	6.7911	2.0962	3.2397	0.0102[a]
lnGDPt	1.1372	0.2226	5.0264	0.0007[a]
lnPOPt	−3.4328	1.5868	−2.1632	0.0588[c]
lnSt	−0.0402	0.0129	−3.1204	0.0123[a]
lnEt	0.2437	0.1073	2.2714	0.0492[b]

Note(s): [a], [b] and [c] indicate significance at 1%, 5% and 10%, respectively vein, energy consumption does have significant impact on economic growth in the short run. However, the short-run impact (0.42) of energy consumption on real per capita GDP is more than that of the long run (0.24) comparatively. On the contrary, both gross savings and population growth have adverse effects on economic growth in the short run, which are consistent with the dynamics in the long run. The coefficient, (−0.298), of the lagged error correction term (ECT_{t-1}) is of the right sign (negative) and statistically significant implying that there is long-term dynamic relationship between GDP per capita, population growth, gross savings and energy consumption, and that the feedback mechanism is effective in stabilizing the Ghanaian economy's external imbalances. Thus, the adjustment to equilibrium anytime there is a shock to the equilibrium relationship is approximately 30% in each year. In this context, it takes on average of three years and four months for the equilibrium relationship be to be restored following any shock.

5.4 Model diagnostics

Model diagnostics were further conducted to assess the fitness of the model. To this end, the Lagrange multiplier test of residual serial correlation shows there is no serial correlation in the residual. In addition, the ARCH LM test shows there are no autocorrelations in the residual. Therefore, the null hypothesis of no ARCH effect is accepted at the 1% significance level. The Ramsey RESET test shows that the model is well specified (i.e. the null hypothesis that the functional form is correctly specified is not rejected). Moreover, the normality test shows that the residuals are normally distributed (see Table 4). Furthermore, to check the stability of the model parameters, the CUSUM and CUSUM of squares by Brown *et al.* (1975) are plotted. The mean curve stays within the 5% critical boundaries in the case of the CUSUM graph therefore implying the stability of the model parameters (see Figure A1). Also, the CUSUM of squares graph shows that the mean path stays within the 5% critical lines for most of the period except in year 2010 when it marginally crossed the critical line for a short period (see Figure A2). In effect, it is concluded that the model parameters are stable over the period (structural stability).

6. Conclusion and policy implications

This study investigates the interactions among economic growth, population growth, gross savings and energy consumption over the period 1987– 2017. The bounds tests approach has

Independent variables	Coefficients	Standard error	*T*-ratio	*p*-values
C	6.7911	1.4781	4.5945	0.0013
$\Delta \ln GDP_{t-1}$	0.4355	0.1283	3.3939	0.0079[c]
$\Delta \ln POP_{t-2}$	−2.8214	0.7175	−3.9319	0.0034[c]
$\Delta \ln S_{t-3}$	−0.0123	0.0058	2.1168	0.0634[c]
$\Delta \ln E_{t-2}$	0.4244	0.1036	4.0941	0.0027[a]
ECT_{t-1}	−0.2982	0.0650	−4.5861	0.0013[a]
Diagnostic tests				
LM (2)	0.0267 [0.28][a]			
ARCH (1)	0.9449 [0.95][a]			
J-B normality	1.8765 [0.39][a]			
Ramsey's RESET (2)	0.3985 [0.55][a]			

Note(s): [a], [b] and [c] indicate significance at 1%, 5% and 10%, respectively. Figures in parenthesis are *p*-values; LM: the Lagrange multiplier test of residual serial correlation. ARCH: autoregressive conditional heteroscedasticity test of residuals. Heteroscedasticity: this is based on the regression of squared residuals on squared fitted values. Normality is based on a test of skewness and kurtosis of residuals**.** The White test is a test for heteroscedasticity

Table 4. Error correction representation for the selected ARDL model, dependent variable is $\Delta \ln Y_t$

been employed to investigate the relationship between the variables in both the short-run and long-run dynamics. The results show that in both the short run and long run, savings and population growth are affront to economic growth. However, in the short run, energy consumption has significant negative effect on economic growth but in the long run, and it has a positive impact on the Ghanaian economy. The above results has a portfolio of policy implications.

Thus, the negative effect of savings on economic growth is a serious reflection of the absence of robust, mature and efficient financial markets to channel surplus funds efficiently to more productive sectors of the economy. To this end, policy makers could put out policies to vitalize the financial markets to be more efficient. In an effort to develop the financial market, policy makers could tighten the financial regulations to monitor the disbursement of funds to various sectors of the Ghanaian economy. This is particularly important at the background of the recent liquidity issues in the financial sector which may essentially but arguably be attributed to passive monitoring on the part of the regulatory authorities of these financial sectors. Moreover, population growth has negative effect on real GDP per capita, and, therefore, the policy makers could invest in human capital development to improve productivity.

Finally, energy is critical for the development of the nation as shown in the results. This implies that more effort should be made to supply energy at affordable prices to spur on economic growth.

Notes

1. Gross savings are calculated as gross national income less total consumption, plus net transfers which is measured in local currency units (World Bank, 2019).
2. This is the annual percentage growth rate of GDP per capita based on constant local currency. GDP per capita is gross domestic product divided by midyear population (World Bank, 2019).
3. This is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport.
4. Note that all these definitions are according to source of the data (World Bank, 2019).
5. This is expressed in constant local currency

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Appendix

Series	ADF (C) *t*-value	ADF (C + T) *t*-value	P-P (C) *t*-value	P-P(C + T) *t*-value	KPSS (C) *t*-value	KPSS (C + T) *t*-value
$\ln GDP_t$	2.5896	−1.1165	2.5896	−0.6066	1.542928	0.3816
$\ln POP_t$	−0.7461	−3.0577	−0.7465	−1.6056	1.0099	0.1615
$\ln S_t$	−2.6526	1.6817	−2.5174	−3.1278	0.7841	0.5806
$\ln E_t$	−1.1657	−2.9472	−1.3206	−1.6372	0.7781	0.1662
$\Delta\ln GDP_t$	−3.1726[b]	−3.7577[b]	−2.9319[b]	−3.5470[b]	0.4424[a]	0.1026[a]
$\Delta\ln POP_t$	−5.1407[a]	−4.9064[a]	−3.7143[a]	−5.8258	0.1131[a]	0.1017[a]
$\Delta\ln S_t$	−2.7346	−4.1793[a]	−11.509[a]	−11.2509[a]	0.0604[a]	0.0573[a]
$\Delta\ln E$	−4.2519[a]	−4.1521[a]	−4.2599[a]	−4.1614[a]	0.1481[a]	0.1357[a]

Note(s): The Mackinnon (1996) critical values for ADF test are used. Critical values with C (C + T) at the 5% significance are −2.92 (−3.49) and at the 1% significance is −3.56 (−4.14). The critical values for KPSS with C (C + T) at the 5% significance are 0.463 (0.15) and at the 1% significance is 0.739 (0.22). [a] and [b] indicate significance at 1%, 5% and 10%, respectively. KPSS, Kwiatkowski *et al.* (1992, Table 1) refers to testing the null hypothesis of stationarity against the alternative of unit root. C = constant and C + T = constant and trend

Table A1.
Unit root test

Hypothesized no. of CE(s)	Trace statistic	0.05 Critical value	*p*-value
Panel A			
r=0	116.499[b]	47.8561	0.0000
r>1	55.3097[b]	29.7970	0.0000
r>2	27.9785[b]	15.4947	0.0000
r>3	9.2249[b]	3.8415	0.0024
Hypothesized no. of CE(s)	**Max-eigen statistic**	**0.05 Critical value**	***p*-value**
Panel B			
r=0	61.1896[b]	27.5843	0.0000
r>1	27.3312[b]	21.1316	0.0059
r>2	18.7543[b]	14.2646	0.0091
r>3	9.2242[b]	3.8415	0.0024

[b]Denotes rejection of the hypothesis at the 0.05 test level
[c]MacKinnon *et al.* (1999) *p*-value

Table A2.
Johansen cointegration test results

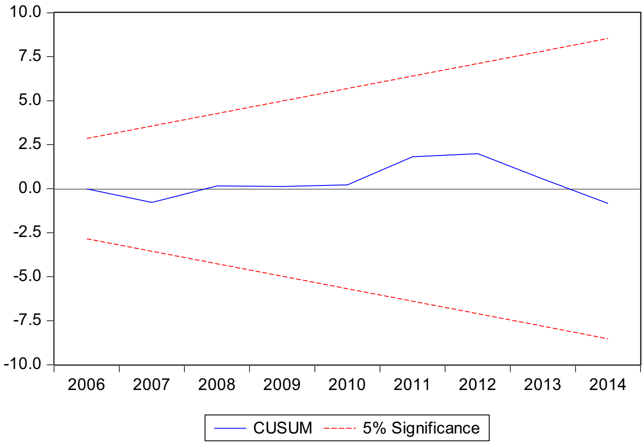

Figure A1.
Graph of CUSUM

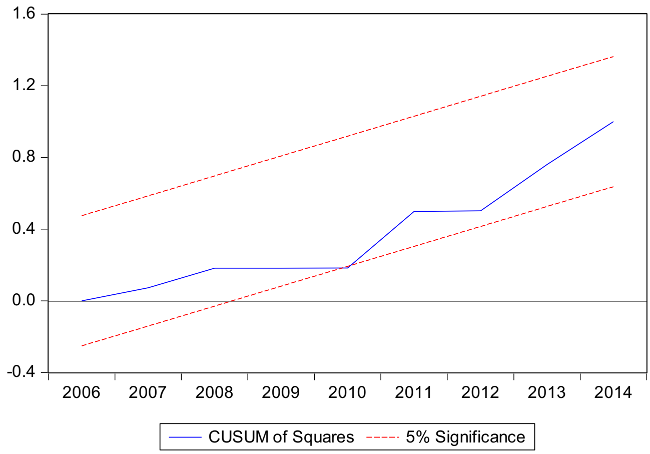

Figure A2.
Graph of CUSUM of squares

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