Causal Relationship between Domestic Savings and Economic Growth: Evidence from Seven African Countries

Emmanuel Anoruo and Yusuf Ahmad*

Abstract: This paper utilizes cointegration and the vector error-correction model (VECM) to explore the causal relationship between economic growth and growth rate of domestic savings for Congo, Côte d’Ivoire, Ghana, Kenya, South Africa, and Zambia. Specifically, three analyses were undertaken. First, the time series properties of economic growth and domestic savings were ascertained with the help of the augmented Dickey–Fuller unit root procedure. Second, the long-run relationship between economic growth and growth rate of domestic savings was examined in the context of the Johansen and Juselius (1990) framework. Finally, a Granger-causality test was undertaken to determine the direction of causality between economic growth and growth rate of domestic savings. The results indicate one order of integration [I(1)] for each of the series. The results of the cointegration tests suggest that there is a long-run relationship between economic growth and growth rate of savings. The results from the Granger-causality tests indicate that contrary to the conventional wisdom, economic growth prima facie causes growth rate of domestic savings for most of the countries under consideration.

Résumé: Le présent document utilise la co-intégration et le modèle à vecteur de correction des erreurs (VECM) pour étudier les relations de cause à effet entre la croissance économique et les taux de croissance de l’épargne intérieure au Congo, en Côte d’Ivoire, au Ghana, au Kenya, en Afrique du Sud et en Zambie. Plus précisément, trois analyses ont été effectuées. La première a vérifié les propriétés des séries chronologiques de la croissance économique et de l’épargne intérieure à l’aide de la méthode Dickey–Fuller de racine unitaire augmentée. La deuxième a examiné les relations à long terme entre la croissance économique et les taux de croissance de l’épargne intérieure.

* Department of Management Science and Economics, Coppin State College, Baltimore, USA, e-mail:eanoruo@coppin.edu; and The World Bank, Washington, DC, USA, e-mail:yahmad@worldbank.org. The views expressed in this paper are those of the authors only. They do not reflect the views of the World Bank.
dans le contexte du cadre Johansen et Juselius (1990). Enfin, le test de causalité de Granger a été effectué pour déterminer la direction de la causalité entre la croissance économique et les taux de croissance de l’épargne intérieure. Les résultats montrent un ordre d’intégration \([I(1)]\) pour chacune des séries. Quant aux tests de co-intégration, leurs résultats portent à croire qu’il existe une relation à long terme entre la croissance économique et le taux de croissance de l’épargne intérieure. Les résultats des tests de causalité de Granger indiquent que, contrairement à la croyance populaire, la croissance économique entraîne, de prime abord, l’augmentation des taux de croissance de l’épargne intérieure dans la plupart des pays examinés.

1. Introduction

The relationship between savings and economic growth has received increased attention in recent years. See for example Jappelli and Pagano (1996), Gavin et al. (1997), Sinha and Sinha (1998), and Saltz (1999). These studies have cast doubt on the conventional wisdom that savings engender economic growth as purported by Harrod (1939), Domer (1946), and Solow (1956). The growth models of Harrod (1939), Domer (1946), and Solow (1956) indicate that increases in savings translate into high investment, which in turn stimulates economic growth. The effect of higher savings is to increase the availability of funds for investment. The more capital goods a nation has at its disposal, the more goods and services it can produce. Increases in aggregate demand created by the availability of goods and services will lead to economic growth. The recent studies of Jappelli and Pagano (1996), Gavin et al. (1997), Sinha and Sinha (1998), and Saltz (1999) suggest that it is economic growth that promotes savings and not vice versa.

Policymakers, including the World Bank, have long advocated policies that lead to higher savings in order to boost economic growth for developing countries. The question that may arise is whether high savings actually promote economic growth, especially for countries with nascent economies. The recent financial crisis witnessed by the East Asian countries has cast further doubt on the viability of the earlier growth models. Prior to the crisis, a number of Asian leaders, world leaders, as well as economists, praised the region’s high savings rate, which was among the highest in the world.¹ The idea seemed to be that a high savings rate would engender economic growth and thus reduce the region’s reliance on foreign capital for its economic development projects. This assertion proved to be wrong because
despite the impressive savings rate among East Asian countries, their economies still collapsed and their dependency on foreign capital never abated.

In this paper we examine the causal relationship between growth rate of domestic savings and economic growth using theoretically consistent causality and co-integration test procedures. More specifically, the purpose of our paper is to determine whether increases in GDP Granger-cause growth rate of domestic savings or vice versa. The remainder of the paper proceeds as follows: section 2 furnishes the literature review. In section 3, the data and methodology are discussed. Section 4 presents the empirical results and section 5 provides the summary and conclusions of the study.

2. Literature Review

Several researchers have examined the dynamic relationship between economic growth and domestic savings for developed countries. Despite its obvious importance, there has been at best very little empirical attention devoted to developing countries of Africa. In the literature, there has been considerable debate among development economists relative to the relationship between economic growth and savings. Bacha (1990), DeGregorio (1992), Otani and Villanueva (1990), and Stern (1991) using ordinary least squares (OLS) procedure found that a higher growth rate of savings is associated with higher economic growth. This finding is consistent with the conventional wisdom, which stipulates that domestic savings stimulate economic growth through investment. The implication is that since most developing countries are capital importers, domestic savings are therefore needed to acquire more foreign capital for investment purposes. Modigliani (1970, 1990) and Maddison (1992) also found that there is a positive correlation between savings and GDP. However, recent studies by Jappelli and Pagano (1996), Gavin et al. (1997), Sinha and Sinha (1998), Bosworth (1993), Carrol and Weil (1994), and Saltz (1999) found evidence that economic growth Granger-causes savings. The consensus that emerges from these recent studies is that economic growth Granger-causes growth rate of domestic savings. This finding contradicts the traditional view with regard to the relationship between economic growth and growth rate of savings.

Our study differs from the previous studies in five respects. First, our paper uses vector error-correction model (VECM) which incorporates the error-correction term from the cointegrating equation to capture the long-run deviation from the equilibrium relationship
between economic and savings growth rates. Second, we jointly test the lagged values of the independent variables using the $F$-test to determine the direction of causality among the variables in the system. Third, we utilize longer time series from 1960 to 1997. Fourth, most studies in the extant literature make a prior assumption that growth in domestic savings causes economic growth and as a result neglect the possibility of a feedback effect. Finally, our study focuses solely on developing countries of Africa characterized by inadequate domestic savings.

### 3. Data and Methodology

This study uses annual data to examine the causal relationship between economic growth and growth rate of domestic savings (defined as the changes in the log of domestic saving) for Congo, Côte d’Ivoire, Ghana, Kenya, Nigeria, South Africa, and Zambia. The data are collected from the World Bank, World Tables 1998; covering the period 1960–97.

The cointegration procedure requires time series in the system to be non-stationary in their levels. Similarly, it is imperative that all time series in the cointegrating equation have the same order of integration. Consequently, the study first ascertains the time series properties of GDP growth rate and savings by employing the augmented Dickey–Fuller (ADF) test for stationarity (see Dickey and Fuller, 1979, 1981). The equation estimated for the ADF test is as follows:

$$
\Delta X_t = \alpha_0 + \beta_1 X_{t-1} + \delta t + \sum_{i=1}^{m} \theta_i \Delta X_{t-1} + \epsilon_t
$$

where, $\Delta$ is the first-difference operator, $t$ is the time trend, $\epsilon$ is the stationary random error, and $m$ is the maximum lag length. The null hypothesis is that the series contains a unit root which implies that $\beta = 0$. The null hypothesis is rejected if $\beta$ is negative and statistically significant.

To determine the long-run relationship between economic growth and growth rate of savings, the Johansen cointegration procedure is utilized (see Johansen 1991, and Johansen and Juselius 1990). The procedure involves the estimation of a VECM in order to obtain the likelihood-ratios (LR). The VECM used in the study is as follows:
\[
\Delta Y_t = \theta_0 + \sum_{i=1}^{k-1} \theta_i \Delta Y_{t-1} + \alpha \beta' Y_{t-k} + \epsilon_t
\]  

(2)

where, \( \Delta \) is the difference operator, \( Y_t \) is \((LGDP_t, LSAV_t)\) (see below), \( \theta_0 \) represents the intercept, and \( \epsilon \) represents the vector of white noise process. The matrix \( \beta \) consists of \( r \) \( (r \leq n - 1) \) cointegrating vectors. Similarly, the matrix \( \alpha \) consists of \( r \) \( (r \leq n - 1) \) cointegrating vectors. In equation (2), the null hypothesis is that the matrix \( (\pi = \alpha \beta') \) has a reduced rank of \( r \leq n - 1 \). The alternative hypothesis, on the other hand, is that the matrix \( (\pi = \alpha \beta') \) has full rank. The Johansen cointegration technique produces two likelihood ratio test statistics namely the trace test and the maximum eigenvalue (\( \lambda\)-max) test.\(^2\) The number of significant non-zero eigenvalues determines the number of cointegrating vectors in the system. The existence of cointegration between the two variables suggests the presence of causality between GDP and growth rate of domestic savings in at least one direction.

The causal relationship between economic growth and growth rate of domestic savings is examined with the help of a Granger-causality procedure based on VECM in the cases where the two series are cointegrated. This procedure is particularly attractive over the standard VAR because it permits temporary causality to emerge from (1) the sum of the lagged coefficients of the explanatory differenced variable and (2) the coefficient of the error-correction term. In addition, the VECM allows causality to emerge even if the coefficients of the lagged differences of the explanatory variable are not jointly significant (see Miller and Russek, 1990; Miller, 1991; Engle and Granger, 1987; Granger, 1983). It must be pointed out that the standard Granger-causality test omits the additional channel of influence \( (z_{t-1}) \). In this study, the error-correction models are based on the following regression equations:

\[
\Delta LGDP_t = \alpha z_{t-1} + \sum_{i=1}^{a} \beta_i \Delta LGDP_{t-i} + \sum_{j=1}^{b} \phi_j \Delta LSAV_{t-1} + \mu_t
\]  

(3)

\[
\Delta LSAV_t = \varphi z_{t-1} + \sum_{i=1}^{c} \theta_i \Delta LSAV_{t-i} + \sum_{j=1}^{d} \lambda_j \Delta LGDP_{t-1} + \epsilon_t
\]  

(4)

where \( z_{t-1} \) represents the error-correction term lagged by one period, \( LGDP \) is the growth rate of GDP (defined as the changes in the log of real GDP), \( LSAV \) stands for growth rate of savings (defined as the changes in the log of domestic savings), and \( a, b, c, \) and \( d \) represent the
optimal lag lengths obtained from the Akaike Information Criterion (see Akaike, 1973). In equation (3), the null hypothesis that growth rate of savings does not cause economic growth is rejected on the condition that either the sum of $\phi_j$’s or $\alpha$ is statistically significant. Similarly, in equation (4) the null hypothesis that economic growth does not Granger-cause growth rate of savings is rejected provided either the sum of $\lambda_j$’s or $\varphi$ is statistically significant.

4. Empirical Results

The results of the augmented Dickey–Fuller (ADF) unit root tests are presented in table 1. The null hypothesis of non-stationarity of economic growth and growth rate of savings is tested against the alternative hypothesis of stationarity. The results indicate that both time series are not stationary in their levels. After first differencing, however, the null hypothesis of no unit root is rejected in all of the cases. In all, the results indicate one order of integration $I(1)$ for economic growth and growth rate of domestic savings.

The next step of our study involves the application of the Johansen

<table>
<thead>
<tr>
<th>Country/Period</th>
<th>Series</th>
<th>Level</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congo 1960–1997</td>
<td>LGDP</td>
<td>−0.78</td>
<td>−3.38***</td>
</tr>
<tr>
<td></td>
<td>LSAV</td>
<td>−2.83</td>
<td>−6.35*</td>
</tr>
<tr>
<td>Côte d’Ivoire 1960–1997</td>
<td>LGDP</td>
<td>−1.64</td>
<td>−3.60**</td>
</tr>
<tr>
<td></td>
<td>LSAV</td>
<td>−1.58</td>
<td>−3.40***</td>
</tr>
<tr>
<td>Ghana 1960–1997</td>
<td>LGDP</td>
<td>−1.39</td>
<td>−4.02**</td>
</tr>
<tr>
<td></td>
<td>LSAV</td>
<td>−2.65</td>
<td>−5.72**</td>
</tr>
<tr>
<td>Kenya 1960–1997</td>
<td>LGDP</td>
<td>−1.12</td>
<td>−5.02**</td>
</tr>
<tr>
<td></td>
<td>LSAV</td>
<td>−0.52</td>
<td>−7.09**</td>
</tr>
<tr>
<td>Nigeria 1960–1997</td>
<td>LGDP</td>
<td>−2.55</td>
<td>−4.21**</td>
</tr>
<tr>
<td></td>
<td>LSAV</td>
<td>−1.65</td>
<td>−3.56**</td>
</tr>
<tr>
<td>South Africa 1960–1997</td>
<td>LGDP</td>
<td>−2.30</td>
<td>−4.48**</td>
</tr>
<tr>
<td></td>
<td>LSAV</td>
<td>−1.50</td>
<td>−5.16**</td>
</tr>
<tr>
<td>Zambia 1960–1997</td>
<td>LGDP</td>
<td>−2.23</td>
<td>−4.82**</td>
</tr>
<tr>
<td></td>
<td>LSAV</td>
<td>−2.72</td>
<td>−4.95**</td>
</tr>
</tbody>
</table>

** and *** indicate statistical significance at the 5% and 10% level, respectively. The critical values at the 5% and 10% significance levels are −3.54 and −3.20, respectively. LGDP = GDP growth rate; LSAV = saving growth.
procedure to ascertain whether economic growth and growth rate of savings are cointegrated for each of the countries under consideration. The results of the tests are presented in table 2. The null hypothesis of no cointegration between economic growth and growth rate of savings (i.e. \( r = 0 \)) is rejected at the 5 percent significance level in all of the cases except for Nigeria. However the null hypothesis that \( r \leq 1 \) could not be rejected for all of the sample countries. We infer from the fact that economic growth and growth rate of savings are cointegrated for these countries (1) that there is a long-run equilibrium relationship between the two time series and (2) the existence of causality in at least one direction. The disconnection between growth rate of savings and economic growth in Nigeria can be attributed to the inability of the country to turn its savings into productive ventures. It also reflects the mistrust that most savers have for the Nigerian financial system.3

Given the results of the cointegration tests, we next estimate the VECM of equations (3) and (4) to determine the direction of causality between economic growth and growth rate of savings for those countries where the two series are cointegrated. For Nigeria, however, whose economic growth and growth rate of savings were not cointegrated, the standard Granger-causality test based on a vector autoregressive (VAR) was used to ascertain the direction of causality.4

The results of the bivariate causality tests from the VECM and VAR are presented in Panels A and B of table 3. The results indicate that there is a bi-directional causality (feedback) between economic growth and growth rate of domestic savings in the cases of Côtes d’Ivoire and South Africa. For Congo, however, the results reveal that growth rate of domestic savings causes economic growth. For the rest of the sample countries, namely Ghana, Kenya, Nigeria, and Zambia, causality runs from economic growth to growth rate of domestic savings.

<table>
<thead>
<tr>
<th>Country</th>
<th>Trace ((r = 0))</th>
<th>(\lambda_{\text{max}}) ((r = 0))</th>
<th>Trace ((r = 1))</th>
<th>(\lambda_{\text{max}}) ((r = 1))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congo</td>
<td>25.60**</td>
<td>21.17**</td>
<td>4.43</td>
<td>4.43</td>
</tr>
<tr>
<td>Côtes d’Ivoire</td>
<td>35.40**</td>
<td>29.00**</td>
<td>6.40</td>
<td>6.40</td>
</tr>
<tr>
<td>Ghana</td>
<td>32.19**</td>
<td>23.85**</td>
<td>8.34</td>
<td>8.34</td>
</tr>
<tr>
<td>Kenya</td>
<td>32.32**</td>
<td>27.08**</td>
<td>5.28</td>
<td>5.28</td>
</tr>
<tr>
<td>Nigeria</td>
<td>12.56</td>
<td>9.98</td>
<td>2.58</td>
<td>2.58</td>
</tr>
<tr>
<td>South Africa</td>
<td>41.68**</td>
<td>35.69**</td>
<td>5.99</td>
<td>5.99</td>
</tr>
<tr>
<td>Zambia</td>
<td>32.63**</td>
<td>26.57**</td>
<td>6.06</td>
<td>6.06</td>
</tr>
</tbody>
</table>

** indicates the rejection of the null hypothesis at the 5% level of statistical significance. The critical values for the \(\lambda_{\text{max}}\) test hypotheses \( r = 0 \) and \( r = 1 \) are 15.87 and 9.16 respectively. The critical values for the trace test hypotheses \( r = 0 \) and \( r = 1 \) are 20.18 and 9.16, respectively. The critical values are obtained from the Microfit 4.0 program.
Table 3: Causality tests based on VECM: F-statistic

Panel A: LGDP growth equation

<table>
<thead>
<tr>
<th>Country</th>
<th>ẑ_t-1</th>
<th>LSAV</th>
<th>LGDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congo</td>
<td>0.84</td>
<td>0.95</td>
<td>12.29**</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>3.58**</td>
<td>2.85***</td>
<td>2.61***</td>
</tr>
<tr>
<td>Ghana</td>
<td>0.25</td>
<td>1.82</td>
<td>5.79***</td>
</tr>
<tr>
<td>Kenya</td>
<td>0.98</td>
<td>0.78</td>
<td>9.11*</td>
</tr>
<tr>
<td>South Africa</td>
<td>4.82**</td>
<td>13.81*</td>
<td>4.82**</td>
</tr>
<tr>
<td>Zambia</td>
<td>0.05</td>
<td>0.07</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Panel B: Saving growth equation

<table>
<thead>
<tr>
<th>Country</th>
<th>ẑ_t-1</th>
<th>LGDP</th>
<th>LSAV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congo</td>
<td>2.67*</td>
<td>1.55</td>
<td>0.64</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>4.08**</td>
<td>0.14</td>
<td>0.79</td>
</tr>
<tr>
<td>Ghana</td>
<td>10.64***</td>
<td>0.02</td>
<td>2.30*</td>
</tr>
<tr>
<td>Kenya</td>
<td>3.72**</td>
<td>4.36**</td>
<td>0.52</td>
</tr>
<tr>
<td>South Africa</td>
<td>1.37</td>
<td>3.49**</td>
<td>9.20***</td>
</tr>
<tr>
<td>Zambia</td>
<td>9.80***</td>
<td>0.08</td>
<td>0.48</td>
</tr>
</tbody>
</table>

*, **, *** associated with the F-statistic represent statistical significance at the 10%, 5% and 1% level, respectively. For convenience, equations 3 and 4 are reproduced below.

\[
\Delta LGDP_t = \alpha z_{t-1} + \sum_{i=1}^{a} \beta_i \Delta LGDP_{t-i} + \sum_{j=1}^{b} \phi_j \Delta LSAV_{t-1} + \mu_t \tag{3}
\]

\[
\Delta LSAV_t = \varphi z_{t-1} + \sum_{i=1}^{c} \theta_i \Delta LSAV_{t-i} + \sum_{j=1}^{d} \lambda_j \Delta LGDP_{t-1} + \epsilon_t \tag{4}
\]

Panel C. Granger-causality tests based on VAR: F-statistic

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>F-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria: GDP growth does not cause saving growth</td>
<td>3.35**</td>
</tr>
<tr>
<td>Saving growth does not cause GDP growth</td>
<td>0.04</td>
</tr>
</tbody>
</table>

** indicates the rejection of the null hypothesis at the 5% significance level. The VAR estimated takes the form:

\[
\Delta LGDP_t = \alpha_0 + \sum_{i=1}^{a} \beta_i \Delta LGDP_{t-i} + \sum_{j=1}^{b} \phi_j \Delta LSAV_{t-1} + \mu_t
\]

\[
\Delta LSAV_t = \varphi_0 + \sum_{i=1}^{c} \theta_i \Delta LSAV_{t-i} + \sum_{j=1}^{d} \lambda_j \Delta LGDP_{t-1} + \epsilon_t
\]

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5. Summary and Conclusions

This paper uses a cointegration procedure to investigate the causal relationship between economic growth and the growth rate of domestic savings for seven African countries, namely Congo, Côte d’Ivoire, Ghana, Kenya, Nigeria, South Africa, and Zambia. Specifically, the study adopted the Johansen cointegration approach to determine the rank(s) of the cointegration space spanned by the stochastic process of economic growth and growth rate of domestic savings. The VECM is estimated to ascertain the direction of causality between the two series.

This study finds that economic growth and growth rate of domestic savings are cointegrated in all of the cases except for Nigeria. The causality tests indicate that for Ghana, Kenya, Nigeria, and Zambia economic growth Granger-causes growth rate of domestic savings. However, in the case of Congo, growth rate of domestic savings was found to Granger-cause economic growth. Finally, for Côte d’Ivoire and South Africa, bi-directional (feedback) causality was found. In all, our study finds that economic growth engenders domestic savings for most of the sample countries. This finding that economic growth Granger-causes growth in domestic savings is consistent with Sinha and Sinha (1998), and Saltz (1999). The policy implication that emerges from this study is that the authorities should be aware of the possibility of causality running from economic growth to domestic savings. To this effect, policymakers should formulate and implement policies that promote economic growth, since such strategies will lead to higher growth in domestic savings.

Notes

1. It has been documented that, on average, East Asians tend to save more of their earned incomes than most developing countries. See, for example, Adams and Prazmowski (1996), and World Bank (1993).

2. The trace test statistic is implemented by

\[ TR = T \sum_{i=r+1}^{N} \ln(1 - \lambda_i) \]

where \( \lambda_{r+1}, \ldots, \lambda_{N} \) are the \( N - r \) smallest squared canonical correlation between \( Y_{t-k} \) and \( \Delta Y_{t} \) series, corrected for the effect of
the lagged differences of the $Y_t$. The maximum eigenvalue statistic is given by

$$\lambda_{\text{max}} = T \ln (1 - \lambda_{r+1})$$

Since the asymptotic distributions of the trace and maximum eigenvalue test statistics follow $\chi^2$ distributions, a simulation procedure is needed to identify proper critical values for each test (see Osterwald-Lenum, 1992).

3. Many people lost their life-savings due to a record number of bank failures in the last 10 years. To avoid making the same mistake, most Nigerians are reluctant to deposit their money in banks.

4. First differences of GDP and saving growth rates are included in the VAR because they were found to be non-stationary in their levels.

References


