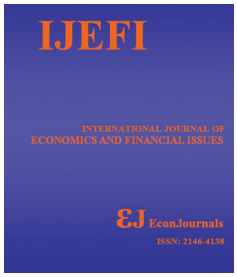

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Revisiting the Financial Development and Poverty Reduction Nexus for Sub-Saharan African Countries: Evidence from Causality Tests in the Time and Frequency Domains

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ABSTRACT

This study reexamines the causal relationship between financial development and poverty reduction for six African countries. To that end, we employ the Granger causality tests in the time and frequency domains. The results from time domain causality analysis indicate that financial development does not causes poverty reduction directly, but poverty reduction causes financial deepening in Nigeria and South Africa. While the frequency domain analysis shows evidence of bidirectional causality between financial development and poverty reduction for Cameroon in long run, and causality from finance to poverty reduction for Gabon in long term. Furthermore, causality from poverty reduction to financial development exists for Nigeria both in short and medium terms and for South Africa over the short, medium and long terms.

Keywords: Poverty Reduction, Financial Development, Frequency Domain Analysis, Sub-Saharan Africa
JEL Classifications: C32, G21, I30, O55

1. INTRODUCTION

The relationship between financial development and poverty reduction has become a subject of interest in economics literature. Theoretically, there are two channels through which financial sector development can reduce poverty. First, financial deepening can impact directly poverty by facilitating transactions and allowing the poor to access to credit opportunities and deposits. Second, financial development can benefit to the poor indirectly through economic growth by improving conditions in the sectors and regions where they live.

However, as noted by Besley and Burgess (2003) and Pradhan (2010), economic growth is not a sufficient condition for poverty reduction. If financial development increases income inequality, then poor cannot benefit from the expected positive economic growth.

Like the finance-growth nexus, it is possible that poverty reduction exerts a positive effect on financial development through an increase in savings and demand for funds. Therefore the causal relationship between financial development and poverty reduction may be either unidirectional or bidirectional. An examination of this relationship not only helps to understand the role of financial deepening in sustainable development but also sets a framework for discussion of financial policies. Consequently, it is important to reveal the direction of causality between finance and poverty alleviation.

A growing body of literature has examined the interaction between financial development and poverty reduction. The empirical evidence from this literature is however mixed and controversial across countries, data and methodologies. Some studies (Jalilian and Kirkpatrick, 2005; Shahbaz, 2009; Pradhan, 2010; Perez-Moreno, 2011; Inoue and Hamori, 2012; Khan et al., 2012; Chemli, 2014) found causality running from financial development to poverty reduction, while others (Ho and Odhiambo, 2011; Uddin et al., 2014) found bidirectional causality between the two variables. Regarding Sub-Saharan African countries, very few studies have been made to empirically examine the finance and poverty reduction nexus. The studies by Odhiambo (2009) for South Africa, Odhiambo (2010a) for Kenya, Odhiambo

(2010b) for Zambia provided support that financial development causes poverty reduction. Aye (2013) found evidence of causality from poverty to financial deepening in the case of Nigeria. Besides, Dauda and Makinde (2014) found that financial sector development has no significant influence on poverty reduction in Nigeria.

Most of the previous studies used the standard approach to Granger causality, which requires pre-testing of unit root and cointegration. In the case of nonstationarity, variables are considered in first differences to make them stationary which cause loss of long-run information. In addition, standard approach of Granger causality ignores the possibility that the strength and direction of the causality could vary over different frequencies.

This study contributes to the financial development-poverty reduction literature by employing the Granger causality in the frequency domain to examine short, medium and long run causality and aims to indicate whether there is a change in causality direction over time. Frequency domain analysis allows analyzing the causal relationship between economic variables in different time periods (short, medium and long terms). To the best of our knowledge, this is the first study investigating causality between financial development and poverty reduction in high and low frequencies. The empirical analysis is based on a sample of six African countries. The remainder of the paper is organized as follows. Section 2 describes the econometric methodology. Section 3 analyses the empirical results and Section 4 concludes the study.

2. DATA AND METHODOLOGY

2.1. Data Description

This study uses annual time series data for a sample of six Sub-Saharan African countries, namely Cameroon, Gabon, Ghana, Kenya, Nigeria and South Africa. Given that time series data on poverty in African countries are very limited, we follow many empirical studies (see Odhiambo, 2009; Khan et al. 2012; Aye, 2013; Uddin et al., 2014; Chemli, 2014) by using household final consumption per capita as a proxy for poverty. The ratio of domestic credit to private sector by banks as share of gross domestic product (GDP) is used as an indicator of financial development. This indicator measures the role of financial intermediaries in channeling funds to private agents. We also include per capita real GDP as control variable. Poverty and per capita real GDP are in constant 2005 US dollars. The study covers the time period from 1970 to 2013 except for Nigeria for which data start from 1980. All data are obtained from the World Development Indicators by the Word Bank. In the empirical analysis all variables are used in their natural logarithms.

2.2. Toda and Yamamoto Causality Test in the Time Domain

To make a comparison with the causality test in the frequency domain, we first apply the Granger causality tests in the time domain to gain first insights into the causal link between finance and poverty reduction. To that end, we apply the Toda and Yamamoto (1995) approach. This approach does not require testing for cointegration and estimating vector error correction model and is robust to the unit root and cointegration properties of the series. While the standard Granger causality analysis requires estimating a first-difference VAR(p) augmented with an error correction term, the Toda and Yamamoto (1995) procedure requires estimating a level VAR(p+d) where d is the maximum integration order of the variables:

$$\begin{bmatrix} P_t \\ F_t \\ Y_t \end{bmatrix} = \begin{bmatrix} \varphi_1 \\ \varphi_2 \\ \varphi_3 \end{bmatrix} + \sum_{i=1}^{p+d} \begin{bmatrix} \beta_{1i} & \gamma_{1i} & \varphi_{1i} \\ \beta_{2i} & \gamma_{2i} & \varphi_{2i} \\ \beta_{3i} & \gamma_{3i} & \varphi_{3i} \end{bmatrix} \times \begin{bmatrix} P_{t-i} \\ F_{t-i} \\ Y_{t-i} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \end{bmatrix} \quad (1)$$

The lag length p is determined using the Akaike Information Criterion (AIC). The null hypothesis of Granger causality is then tested by imposing zero restriction on the first p parameters using a standard Wald statistic. For instance, $\gamma_{11}=\gamma_{12}=\ldots=\gamma_{1p}=0$ shows that financial development does not Granger-cause poverty reduction whereas $\beta_{21}=\beta_{22}=\ldots=\beta_{2p}=0$ indicates that poverty reduction does not Granger-cause financial development. The same hypothesis can be drawn for other variables.

2.3. Causality Analysis in the Frequency Domain

Causality analysis in the frequency domain was developed by Granger (1969) and Geweke (1982). In the present study, we follow the description in Breitung and Candelon (2006). Let $Z_t=(X_t,Y_t)'$ be a two-dimensional vector of time series. It has a finite-order VAR representation of the form:

$$\theta(L)\begin{pmatrix} X_t \\ Y_t \end{pmatrix} = \begin{pmatrix} \theta_{11}(L) & \theta_{12}(L) \\ \theta_{21}(L) & \theta_{22}(L) \end{pmatrix}\begin{pmatrix} X_t \\ Y_t \end{pmatrix} = \mu_t \quad (2)$$

Where $\theta(L)=1-\theta_1 L-\theta_2 L^2-\ldots-\theta_p L^p$ is a 2×2 lag polynomial, $\theta_1, \theta_2, \ldots, \theta_p$ are 2×2 autoregressive parameter matrices, and L is the lag operator. The error vector μ_t is white noise with $E(\mu_t)=0$ and $E(\mu_t\mu_t')=\Sigma$; where Σ is positive definite. Let G be the lower triangular matrix of the Cholesky decomposition $G'G=\Sigma^{-1}$ such that $\eta_t=G\mu_t$ and $E(\eta_t\eta_t')=I$. If Z_t is stationary, the MA representation is:

$$\begin{pmatrix} X_t \\ Y_t \end{pmatrix} = \varphi(L)\eta_t = \begin{bmatrix} \varphi_{11}(L) & \varphi_{12}(L) \\ \varphi_{21}(L) & \varphi_{22}(L) \end{bmatrix}\begin{pmatrix} \eta_{1t} \\ \eta_{2t} \end{pmatrix} \quad (3)$$

Where $\phi(L)=\theta(L)^{-1}G^{-1}$. Using this representation the spectral density of X_t can be expressed as:

$$f_x(\omega)=\frac{1}{2\pi}\left(\left|\varphi_{11}(e^{-i\omega})\right|^2+\left|\varphi_{12}(e^{-i\omega})\right|^2\right) \quad (4)$$

The measure of causality suggested by Geweke (1982) is defined as follows:

$$M_{y\to x}(\omega)=\log\left[1+\frac{\left|\varphi_{12}(e^{-i\omega})\right|^2}{\left|\varphi_{11}(e^{-i\omega})\right|^2}\right] \quad (5)$$

To test the hypothesis that Y does not cause X at frequency ω, the null hypothesis is:

$$M_{y\to x}(\omega)=0 \Leftrightarrow \left|\varphi_{12}(e^{-i\omega})\right|^2=0 \quad (6)$$

Breitung and Candelon (2006) show that:

$$\left|\varphi_{12}(e^{-i\omega})\right|=0 \Leftrightarrow \left|\sum_{j=1}^{p}\theta_{12j}\cos(j\omega)-\sum_{j=1}^{p}\theta_{12j}\sin(j\omega)i\right|$$

$$=0 \Leftrightarrow \begin{cases}\sum_{j=1}^{p}\theta_{12j}\cos(j\omega)=0\\ \sum_{j=1}^{p}\theta_{12j}\sin(j\omega)=0\end{cases} \quad (7)$$

Breitung and Candelon (2006) proposed a much simpler approach to these linear restrictions. They consider the VAR equation for X specifies as follows:

$$X_t=\alpha_1X_{t-1}+\ldots+\alpha_pX_{t-p}+\beta_1Y_{t-1}+\ldots+\beta_pY_{t-p}+\mu_{1t} \quad (8)$$

The null hypothesis is equivalent to the linear restriction:

$$H_0:R(\omega)\beta=0 \quad (9)$$

Where $R=[\beta_1, \beta_2,\ldots\beta_p]'$ and

$$R(\omega)=\begin{bmatrix}\cos(\omega) & \cos(2\omega) & \ldots & \cos(p\omega)\\ \sin(\omega) & \sin(2\omega) & \ldots & \sin(p\omega)\end{bmatrix} \quad (10)$$

The causality measure for $\omega\epsilon[0,\pi]$ can be tested using the standard F-test for linear restrictions. The F-statistic follows an F distribution with (2, T-2p) degrees of freedom where 2 is the number of restrictions, T and p are the number of observations and order of VAR model, respectively.

3. EMPIRICAL RESULTS

First of all, we present in Table 1 statistics on all variables over two sub-periods. The most striking feature is the low level of financial deepening in most countries. South Africa has the highest average level of financial development. The statistics indicate disparity in GDP with Gabon having the highest level followed by South Africa. Also evident from the Table is the positive association between financial development and poverty reduction. For instance, credit ratio and private consumption have decreased from 1970-1990 to 1991-2013 in Cameroon and Gabon. On the contrary, the two variables have increased in the other countries. However, correlation does not mean causality. Our goal in this study is to find out whether this positive association implies that more credit to private agents causes higher consumption or higher consumption leads to more credit to private agents. It is possible that the association between the two variables is not causal in any direction but just coincidental.

In the next step, we test for the order of integration of the series by means of unit root tests. To this end, we perform the well-known unit root test of Phillips and Perron (1988). This test has been

Table 1: Sample means of variables

Country	1970-1990			1991-2013		
	Consumption (P)	Finance (F)	GDP (Y)	Consumption (P)	Finance (F)	GDP (Y)
Cameroon	658.7	23.2	992.9	635.1	10.8	887.3
Gabon	2265.3	18.5	7519.9	2094.7	10.2	6710.8
Ghana	332.7	4.7	408.1	386.2	11.1	500.4
Kenya	362.2	18.8	501.9	402.0	24.8	536.1
Nigeria	435.5	14.6	598.3	482.7	15.2	718.9
South Africa	2713.4	49.9	5270.5	3245.5	65.6	5275.7

Source: World Development Indicators Online, World Bank, GDP: Gross domestic product

Table 2: Results of unit root tests

Country	P	F	Y	ΔP	ΔF	ΔY
Cameroon	−2.191	−1.667	−1.911	−6.294	−4.622	−4.210
Gabon	−2.795	−2.593	−3.529	−8.028	−7.357	−4.406
Ghana	−1.992	−2.085	−0.143	−7.205	−6.008	−4.057
Kenya	−4.920	−3.869	−4.292	−10.693	−9.156	−5.382
Nigeria	−3.253	−2.276	−2.529	−7.254	−8.594	−4.678
South Africa	−1.322	−2.962	−0.808	−3.575	−7.288	−4.234

Critical values at the 5% level are −3.518 (level) and −2.933 (difference)

Table 3: Results of Toda and Yamamoto (1995) Granger-causality test

Country	Lag	F→P	P→F	Y→P	P→Y	F→Y	Y→F
Cameroon	5	7.822 (0.166)	2.662 (0.057)**	14.144 (0.014)*	17.744 (0.003)*	22.287 (0.000)*	21.605 (0.000)*
Gabon	5	8.546 (0.128)	1.631 (0.897)	11.405 (0.043)*	6.998 (0.220)	10.692 (0.057)**	9.149 (0.103)
Ghana	5	3.577 (0.611)	3.817 (0.576)	1.279 (0.315)	4.074 (0.538)	20.222 (0.001)*	7.535 (0.183)
Kenya	2	2.746 (0.253)	2.880 (0.236)	13.895 (0.001)*	1.299 (0.522)	0.665 (0.717)	3.465 (0.176)
Nigeria	5	3.392 (0.639)	12.831 (0.025)*	3.949 (0.556)	10.035 (0.074)**	15.860 (0.007)*	22.500 (0.000)*
South Africa	2	0.509 (0.774)	7.811 (0.020)*	12.393 (0.002)*	10.717 (0.004)*	0.754 (0.685)	3.417 (0.181)

Numbers in parentheses are the P values. * and **denote statistical significance at the 5% and 10% levels, respectively

performed under the model with constant and trend for the level series and with constant for series in first difference. The results displayed in Table 2 show that the variables are non-stationary in their level but are stationary after taking the first difference in all countries except Kenya. Therefore, the variables under study are I(1) series in all countries except Kenya for which all variables are stationary.

The third step of our empirical analysis consists in testing Granger causality using the Toda and Yamamoto (1995) approach. According to the results of unit root tests, the maximum integration order of the variables is one. The lag length p is determined using the AIC. The results shown in Table 3 indicate that there is a unidirectional Granger causality running from poverty reduction to financial development for Cameroon, Nigeria and South Africa, and from economic growth to poverty reduction for Gabon and Kenya. There is no direct causal relationship from financial development to poverty reduction.

The final, and the main step of our empirical investigation, is to present the results of the frequency domain analysis. To measure short, medium and long terms causal dynamics, we calculate test statistics for frequencies $\omega \epsilon \{0.5; 1; 1.5; 2; 2.5; 3\}$. The frequency ($\omega$=2.5) corresponds to a periodicity of 2.5 years, the frequency (ω=1.5) corresponds to a periodicity of 4.2 years, and the frequency (ω=1) corresponds to a periodicity of 6.3 years. In this study, we follow the suggestion of Dolado and Lütkepohl (1996) by augmenting the VAR model with one lag to eliminate the need for pretesting cointegration among the variables and also to avoid taking the differences of the non-stationary variables. We then test the restrictions by using a level VAR(p+1) model, so the frequency domain causality test will be robust to the cointegration property of the variables (Breitung and Candelon, 2006).

Table 4 presents the causality test results in frequency domain. The results suggest bidirectional causality between financial development and poverty reduction for Cameroon in long run, and unidirectional causality from finance to poverty reduction for Gabon in long term. On the other hand, the causality from poverty reduction to financial development exists for Nigeria both in short and medium terms and for South Africa over the short, medium and long terms. This implies that improving the welfare of Nigerian and South African citizens has positive effect on the development of the financial sector. Therefore, policies that increase the income of the poor encourage them to save more with the banks. On the contrary, there is no evidence of causal relationship between financial development and poverty reduction in Ghana and Kenya, suggesting that the movements of financial development and poverty do not have significant impacts upon each other.

Table 4: Results of frequency domain Granger-causality test

Country	Finance does not cause poverty						Poverty reduction does not cause finance					
	Long term		Medium term		Short term		Long term		Medium term		Short term	
	ω=0.5	ω=1.00	ω=1.50	ω=2.00	ω=2.50	ω=3.0	ω=0.5	ω=1.00	ω=1.50	ω=2.00	ω=2.50	ω=3.0
Cameroon	3.701* (0.045)	1.233 (0.314)	0.221 (0.803)	0.026 (0.974)	0.149 (0.862)	0.211 (0.811)	3.160** (0.067)	1.646 (0.220)	0.131 (0.878)	0.009 (0.991)	1.260 (0.307)	2.457 (0.114)
Gabon	3.815* (0.041)	0.467 (0.634)	0.199 (0.821)	0.545 (0.588)	0.403 (0.674)	0.196 (0.823)	0.298 (0.745)	0.235 (0.792)	0.328 (0.724)	0.361 (0.701)	0.236 (0.791)	0.148 (0.862)
Ghana	0.085 (0.918)	0.168 (0.846)	0.945 (0.407)	1.218 (0.319)	1.103 (0.353)	0.953 (0.403)	1.652 (0.219)	0.700 (0.509)	0.290 (0.751)	0.234 (0.793)	0.231 (0.795)	0.169 (0.845)
Kenya	1.373 (0.266)	1.373 (0.266)	1.373 (0.266)	1.373 (0.266)	1.373 (0.266)	1.373 (0.266)	1.440 (0.250)	1.440 (0.250)	1.440 (0.250)	1.440 (0.250)	1.440 (0.250)	1.440 (0.250)
Nigeria	0.187 (0.832)	0.628 (0.561)	0.639 (0.555)	0.501 (0.626)	1.324 (0.325)	1.240 (0.345)	2.110 (0.191)	0.814 (0.480)	4.458** (0.056)	6.366* (0.026)	6.296* (0.027)	6.218* (0.028)
South Africa	0.255 (0.776)	0.255 (0.776)	0.255 (0.776)	0.255 (0.776)	0.255 (0.776)	0.255 (0.776)	3.905* (0.032)	3.905* (0.032)	3.905* (0.032)	3.905* (0.032)	3.905* (0.032)	3.905* (0.032)

Numbers in parentheses are the P values. * and **denote statistical significance at the 5% and 10% levels, respectively

4. CONCLUSION

In this article, we reexamined the causal relationship between financial development and poverty reduction for six African countries. We first applied the Toda and Yamamoto (1995) Granger causality approach in time domain. The results indicate that financial development causes poverty reduction indirectly through economic growth in Cameroon and Gabon, and that

poverty reduction causes financial deepening in Nigeria and South Africa. There is no direct causal relationship from financial development to poverty reduction. Since time domain causality test does not consider time varying nature of the relationship, we performed the frequency domain causality test which allows us to distinguish short, medium and long run causality. The frequency domain analysis shows evidence of bidirectional causality between financial development and poverty reduction for Cameroon in long run, and causality from finance to poverty reduction for Gabon in long term. Furthermore, causality from poverty reduction to financial development exists for Nigeria both in short and medium terms and for South Africa over the short, medium and long terms.

In light of these findings, we can conclude that the general belief that financial development reduces poverty does not hold for most Sub-Saharan African countries. In other words, an increase in the private credit ratio does not necessarily translate into improved well-being for the poor. This is attributed to the attitude of banks that do not sufficiently channel savings to the poor mainly due to government deficit financing and high default rate among the poor. It is therefore useful to encourage the development of micro-finance institutions specially committed to loans to the poor. To avoid crowding out the real sector, governments should minimize their borrowing activities most especially from domestic financial market.

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