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Article

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Research in Globalization

Provided in Cooperation with:

Elsevier

Suggested Citation: Aboagye, Solomon; Kwakwa, Paul Adjei (2023) : The role of international tourism, trade openness and renewable energy in the financial development of selected African countries, Research in Globalization, ISSN 2590-051X, Elsevier, Amsterdam, Vol. 7, pp. 1-12, <https://doi.org/10.1016/j.resglo.2023.100170>

This Version is available at:

<https://hdl.handle.net/10419/331097>

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The role of international tourism, trade openness and renewable energy in the financial development of selected African countries

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ARTICLE INFO

Keywords:

Financial development
Renewable energy
Tourism
Trade openness
Financial markets

ABSTRACT

It is well established that financial development is pivotal to the proper functioning of the real economy and there is a vast body of literature investigating into its determinants. In this study, we shift attention to tourism and renewable energy consumption that are rarely discussed in the financial development debate along with trade openness. Even though, tourism and renewable energy consumption may be less conventional to issues of financial intermediation, they could, along with trade openness, nonetheless contribute to some aspects of financial development in ways consistent with the finance-growth hypothesis. Consequently, this study, while controlling for economic growth, development assistance and government expenditure examines the effects of renewable energy consumption, tourism development and trade openness on financial development in selected African countries. The study relies on data from the World Bank (2023) World Development Indicators for seven African countries (Egypt, Tunisia, Kenya, South Africa, Zimbabwe, Ivory Coast and Morocco) over the periods 1995–2021. Fully Modified Ordinary Least Square (FMOLS) regression estimations reveal that, in the long run, trade openness, international tourism, and renewable energy stimulate financial development. The quantile regression which rendered additional support to this evidence further reveals that, the financial sector gains associated with trade openness, international tourism and renewable energy are greater for countries with lower financial sector development. Thus, a country can still optimize the gains associated with increased trade openness, international tourism, and renewable energy consumption with a relatively less developed financial market. Hence, policies that improve tourism development, promote renewable energy consumption and intensify economic openness may be important catalysts for stimulating further financial development in Africa.

Introduction

The financial market is one of the pivotal sectors of most emerging and developing economies. Even in developed economies, the proper functioning of the financial market cannot be overemphasized. For over a century, numerous studies have identified financial development (FD) as indispensable to the real sector to the extent that it is now well established that financial development is an important catalyst to the pursuit of economic growth (Calderon and Liu, 2003, Ndikumana, 2005; Herwartz and Walle, 2014). There is also a growing body of evidence that suggests that financial development could contribute to other development goals including poverty reduction (Beck et al., 2007), environmental sustainability (Alhassan et al., 2022; Adom et al., 2018) and energy security and sustainability (Kwakwa, 2021). There are

several mechanisms by which financial development translates into the realization of these development goals. Notable among them include the improvement in resource allocation, promotion of savings and financial efficiency and ensuring the efficient management of risk sharing (Levine, 2005; Herwartz and Walle, 2014).

Levine (2005) emphasizes credit by banks and other financial institutions to the non-financial private sector as a major measure of a country's financial development. It is arguably the most suitable measure of financial development as it excludes credit to public institutions and credit issued by the central bank. Therefore, it measures the role of financial intermediaries in channeling the society's savings to investors. According to the International Monetary Fund (IMF), financial development, especially in the context described by Levine (2005), has progressed steadily over the past four decades in most African countries

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<https://doi.org/10.1016/j.resglo.2023.100170>

Received 30 May 2023; Received in revised form 15 August 2023; Accepted 28 October 2023

Available online 31 October 2023

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(IMF, 2016). This form of financial development has been achieved largely through the pursuit of various financial sector reforms aimed at ensuring efficiency and stability in financial intermediations. The liberalization of the financial sector by most African countries post-independence, for instance, is regarded as one of the earliest and major policies towards financial sector development. In some countries, this saw the size of commercial and informal banks growing significantly and thereby improving financial intermediation (Adom, 2019). The overarching purpose of these reforms has been to ensure financial sector development due to linkages between the financial sector and the rest of the economy as well as the role the sector plays in the achievement of important economic goals. However, both financial markets and financial institutions remain less developed in the continent relative to other developing regions as there is still substantial scope for further development, especially in respect of stability and efficiency (IMF, 2016; World Bank, 2023; Allen et al., 2012). Moreover, the financial sector in African countries, except for South Africa, are dominated by the banking sector with stock markets remaining relatively underdeveloped. (Ehigiamusoe and Hooi, 2018; World Bank, 2016; Allen et al., 2012). Currently, there are significant advances in the financial market in the continent, especially in the banking sector with the introduction of mobile banking platforms, enabling unbanked populations to have access to banking services. This has improved financial development through greater financial inclusion and intermediations (Njenga et al., 2022). In addition, the number of stock exchanges on the continent has grown from as low as 5 in 1989 to nearly 30 in 2022, with stock markets growing continuously in the number of listed shares and the traded volume. Also, the capitalization of African stock markets increased tenfold from \$113 billion in 1992 to more than \$1,130 billion in 2022. On the African continent, South Africa, Morocco and Egypt have frequently been ranked among the top in terms of stock market capitalization (World Bank, 2023). For instance, as of 2022, the top four stock exchanges in Africa (in terms of nominal market capitalization) are in South Africa, Morocco and Egypt with each exceeding \$30 billion (World Bank, 2023). The stock market in countries like Tunisia, Kenya, Zimbabwe and Ivory Coast have seen some significant performance in recent times (World Bank, 2023). The capital markets of South Africa have also seen significant steady improvement over the past decade, so is Egypt and Kenya (World Bank, 2023). The banking sector of these countries has grown both in size and depth (World Bank, 2023).

There are several studies evaluating factors that can drive the development of the financial sector so that emerging and developing countries could fully optimize the associated gains. This has culminated into a vast body of evidence that emphasizes financial liberalization (Le Roux and Moyo, 2015; Moyo and Le Roux, 2019; Enwobi et al., 2017; Barrell et al., 2016; Bara et al., 2016; Arestis and Demetriades, 1999), regulation (Azme, 2018, 2020; Chortareas et al., 2012; Barth et al., 2013; Lee and Hsieh, 2013; Klomp and De Haan, 2014), macroeconomic stability (Dabla-Norris and Srivisal, 2013; Mezui et al., 2012; Daniel and Jones, 2007), information (Wu and Wang, 2023; Akerman et al., 2022; Alshubiri et al., 2019; Hendershott et al., 2011; Lapukeni, 2015) and other factors (Ibrahim and Alagidede, 2017; Ishaq and Mohsin, 2015; Neaime, 2015; Ismihan and Ozkan, 2012; Elbadawi et al., 2012) frequently considered traditional and theoretical determinants of financial development. In this study, however, we shift attention to tourism and renewable energy (RE) consumption that are rarely discussed in the financial development debate along with trade openness. While both tourism and renewable energy consumption may be less conventional to issues of financial intermediation, they could along with trade openness contribute to some aspects of financial development in ways consistent with the finance-growth hypothesis as well as the tourism-led growth hypothesis (Ehigiamusoe, 2021; Narayan et al., 2010). For instance, there is no doubt that international tourism generates various positive economic spillovers in the form of stimulating new investment, increasing industrial production, augmenting foreign exchange reserves, and decreasing unemployment in the recipient

economy (Shahbaz et al., 2019). Similarly, given that the financial market has become an integral part of the energy sector, by providing financing options to energy projects and infrastructure, changes in renewable energy consumption could trigger important variations in the investment and credit portfolios of the financial market especially against the backdrop of increasing concerns for climate change, environmental degradation and hence green financing. The financial market may also find it prudent to restructure its credit and investment portfolios away from non-renewable energy especially fossils that are considered key drivers of environmental degradation, greenhouse gases and climate change. In addition to contributing to the global fight against these environmental and climate concerns, focusing credit and investments on renewable energy could also help the financial market to minimize its excessive risk exposure to the fossil energy market given its energy insecurity implication (Ünlü et al., 2022). On the other hand, RE projects have very high start-up costs relative to the expected monetary returns and lengthy payback periods (Saygin and Iskenderoglu, 2022). Therefore, RE projects typically require long-term maturity loans and this could have stern implications for the development of the financial market. Likewise, the classical theory of international trade traces both direct and indirect linkages between FD and trade openness (Svaleryd and Vlachos, 2002; Shahbaz et al., 2013; Baltagi et al., 2009). For instance, for FD to occur, Rajan and Zingales (2003) argues that trade openness is non-negotiable because the new opportunities created by openness may generate sufficient new profits for the financial markets that outweigh the negative effects of increased competition. This is corroborated by Baltagi et al. (2009) which argues that international trade in a relatively closed economy can benefit FD significantly. Hence, trade openness, whether in the form of export and/or import, could have a symbiotic relationship with the financial markets. Both importers and exporters as well as related agencies rely on the financial market for various forms of financing (Rajan and Zingales, 2003). The financial markets, particularly the banking sector, also serve as an intermediary for payments and receipts of trade activities.

The foregoing is a reflection that the mechanisms regarding tourism, renewable energy consumption and trade openness could have some implications for the development of the financial market of the recipient country or region. Yet, only a few studies have empirically exploited their contributions to financial development. Some of the few notable exceptions include Cannonier and Burke (2017) who find conservative estimates that suggest that by increasing tourism expenditures per capita by about \$1200 (USD) in the Caribbean improves the depth and efficiency of the financial system by about 10–15 % and 34 % respectively. Shahbaz et al., (2019) similarly found a bidirectional causality between tourism development and financial development in Malaysia. In South Africa, Musakwa and Odhiambo (2022a), Musakwa and Odhiambo (2022b) also observed a bidirectional causality between several measures of financial development and tourism share of GDP. Başarir and Çakir (2015) observe the same causal link but between tourist arrivals and financial development in several EU countries from 1995 to 2010. In contrast, Ohlan (2017) found that in India tourism and financial development are independent. With regards to the RE-FD nexus, Ünlü et al. (2022) observed increases in total demand for renewable energy to improve the financial development of G-8 countries as the authors found the credit gap risk, a leading indicator of systemic banking crises, to be mitigated by the rise in the demand for renewable energy. This confirmed an earlier study by Hassine and Harrathi (2017) and Wang et al. (2021) who established a unilateral causality from RE consumption to FD in China. Rajan and Zingales (2003) remains one of the influential studies examining the effect of trade openness on FD using data as far back as 1913 up to about 2000. Kim et al. (2010) found a positive non-linear long-run relationship between trade openness and financial development for relatively low- and high-income countries even though in the short run trade openness was found to negatively affects financial development within the same sample. Moreover, Chortareas et al. (2015) reported that the long-run relationship between finance and

economic growth only holds after accounting for trade openness and for this reason the authors were quick to admit that trade openness appears to be more essential for developing countries. Similarly, [Huang and Temple \(2005\)](#) concluded that trade openness generally promotes financial development. In contrast, [Gries et al. \(2009\)](#) found little to no evidence in support of any causal relation between financial development and trade openness for 16 Sub-Saharan African countries while [Wolde-Rufael \(2009\)](#) only found a weak causality from trade to financial development for Kenya. Also, [Menyah et al. \(2014\)](#) found absence of causality between financial development and trade openness for 21 Sub-Saharan African countries.

Within the African continent, both tourism and renewable energy appear not have been developed significantly and the investment usually allocated to them are often meagre relative to other developing regions of the world. For instance, East Asia and Pacific registered international tourism receipts of 145.1 billion in 2019 relative to 33.7 in 2003 while the number of arrivals of international tourists rose from 112.9 million to 490.8 million during the period. Between 2006 and 2016, over US\$ 27 billion was invested in the (non-large hydro) renewable power sector which is a growing sector with a market size of \$205 billion and capital investments totaling \$11 billion between 2020 and 2022. Nonetheless, both international tourism and renewable energy in Africa have been increasing quite steadily in the last decades. For instance, international tourism receipts increased for the continent from US\$7.2 billion in 1995 to US\$35.29 billion in 2019, while the number of arrivals of international tourists rose from 14.23 million to 55.25 million during the period ([World Bank, 2023](#)). Similarly, renewable energy investment and consumption keeps on increasing in Africa ([World Bank, 2023](#); [IEA, 2022](#)). Of the total investment made into the power sector in 2020, the International Energy Agency (IEA) reveals that 45 % was for renewable energy and its network infrastructure ([IEA, 2022](#)). There has been about 300 % growth in investment for renewable energy between 2001 and 2009 and 2010–2019 ([UNEP, 2019](#)). Also, from 2007 to 2015, the share of global renewable energy in total final energy consumption has increased from 16.6 % to 17.54% ([World Bank, 2023](#)). Again, the [World Bank \(2023\)](#) reports that Africa's financial development in the form of credit to private sector as a ratio of GDP also increased from 28.4 % to 45.0 % between 2010 and 2020. Thus, the outcome of this study would potentially inform policies whether the expansion or otherwise of tourism development, renewable energy consumption and trade openness could be harnessed to effectively stimulate financial sector development. The study therefore examines the role of international tourism, renewable energy consumption and trade openness in the financial sector development of selected African countries.

The study makes three distinctive contributions to both literature and policy. Foremost, the study explores several proxies of financial development instead of the conventional domestic credit to private sector (%GDP). These proxies are domestic credit to private sector (% of GDP), domestic credit to private sector by banks (% of GDP), broad money (% of GDP), Foreign direct investment net inflows (% of GDP). To keep up with best practices, we also utilize an index for financial development encompassing the various proxies. The advantage is that it affords the rare opportunity of tracking financial development not only from a broader perspective but also to ascertain the responses of the different aspects of financial development. Secondly, the study simultaneously explores three variables – renewable energy consumption, tourism development and trade openness – that constitute an integral part of the future of many developing economies including those under study and yet are less discussed in the financial development literature, especially renewable energy consumption and tourism development. More importantly, modelling these variables simultaneously offers insights into the trajectory of financial development based on the potential symbiotic relationship that could exist. This is because in an era of global energy transition towards renewable energy in response to the fight against climate change and global warming, it is important to guard against pollution haven syndrome which results from the influx of

polluting-intensive plants to developing countries through greater openness to trade. Tourism, on the other hand, could also be a pragmatic way of reducing production activities that contribute to massive environmental degradation. Thus, the study is looking at how these three variables that can effectively be harnessed to promote environmental sustainability could also contribute to financial development or otherwise. Finally, the study extends extant literature by analyzing the heterogeneous and distributional impact across quantiles of financial development. This allows for assessment into exact level(s) of financial development within which renewable energy consumption, tourism development and greater trade openness generate the greatest/least gains. These contributions are non-trivial given that despite the vast body of literature on financial development, these aspects remain largely unexamined even though there are potential theoretical and empirical linkages.

Literature review and hypotheses development

The importance of financial development has been well documented in the literature. It has first and foremost been argued that it promotes economic growth and development by increasing access to credit ([Schumpeter \(1911\)](#)). Many studies have confirmed that financial development increases economic growth ([Alhassan et al., 2022](#); [Kwakwa et al., 2022](#); [Valickova et al., 2015](#); [Ibrahim and Alagidede, 2017](#)). Beyond economic growth some researchers believe that financial development has the capacity to enhance development through reduction of environmental pollution ([Kwakwa et al., 2023](#)); poverty reduction ([Jalilian and Kirkpatrick, 2005](#)) and improve health care ([Rahman and Alam, 2022](#)). These developmental effects of financial sector development make it necessary to ascertain the drivers. Over the years an increasing number of studies have therefore explored the determinants of financial development of some countries and economic regions. For instance, [Asratie \(2021\)](#) examined the drivers of financial development in Ethiopia between 1980 and 2019. The empirical analysis revealed that financial development measured by broad money supply increases with political freedom, economic growth and international trade but it is reduced by interest rate, reserve requirement and exchange rate. It was further reported that inflation, political freedom, economic growth and international trade increase credit to private sector, but it is reduced by external debt, reserve requirement and lending interest rate. [Ellahi et al., \(2021\)](#) assessed the effect of institutional quality on the financial development in South Asian Association of Regional Cooperation (SAARC) region. They modelled financial development by controlling for trade openness, inflation, legal origin, and real gross domestic product (GDP) and found all these variables and institutional quality to have positive effect except inflation rate on financial development. [Khalfaoui \(2015\)](#) assessment of the determinants of financial development for developed and developing countries revealed that market value, human capital, investment help in the development of the financial sector of developing and developed countries. Also, while nonperforming loans and inflation were found to reduce financial development in both categories, trade openness favoured the developed countries' financial sector. [Caskey and Dutta \(2022\)](#) also found that labour force participation, trade, urbanization and language to improve financial development while economic growth reduces it for developed and developing countries over the period 2001 to 2018.

In their work, [Takyi and Obeng \(2013\)](#) found in the Ghanaian economy that financial development is positively influenced by trade openness and per capita income but negatively influenced by inflation, interest rate, and reserve requirement. Government spending was found not to be statistically significant. Also, [Adom \(2019\)](#) reported that financial development in Ghana is enhanced by economic growth, democracy and trade openness but reduced by higher energy cost and energy intensity. [Bzhalava \(2014\)](#) analysed the determinants of financial development in 39 countries and observed that tax revenue,

inflation, political freedom and economic growth increase financial development. Hauner (2009) examined the effect of public debt on the financial development of 73 countries. It was found that income improves the efficiency of the financial sector, but inflation and debt reduce efficiency of the sector. For the Mediterranean countries it was found by Ayadi et al., (2015) that institutional quality, capital and income improve financial sector development while inflation and government debt reduce financial development. Cherif and Dreger (2016) analysed the institutional determinants of financial development in the countries of the Middle East and North African (MENA) region. Among other things, it was found that trade openness and institutional quality improved financial development. However, inflation and income did not have significant effect. İlgün (2016) in a study focusing on emerging economies also found that government borrowing, and economic instability reduces financial development while trade openness increases financial development. Pedersoli and Presbitero (2023) found for developing economies that better management of debt and income improve financial development.

From the above although studies on the financial sector development are increasing most of them did not include trade openness, tourism and renewable energy in their analysis. There are thus, few studies that (in recent times) have focused on are drawing the attention of the academic community and policymakers to the role of tourism, energy and trade openness. The subsequent sub-sections review and develop the hypotheses for trade-financial development nexus, tourism-financial development nexus, and renewable energy-financial development nexus.

Trade openness and financial development

Trade openness is argued to support financial development through some channels. For instance, according to Rajan and Zingales (2003), and Braun and Raddatz (2005) trade openness weakens the power of few firms and groups that reduce competition and financial development respectively. This therefore supports external financial supply thereby improving the financial sector of a country. Empirical studies such as Naceur et al., (2014) reported that trade openness promotes financial sector development of countries in the MENA region. Specifically, trade enhances liquid liability and stock market development of these countries even though its effect on credit to private sector is insignificant. Also, Braun and Raddatz (2005) found that strengthening trade openness increases financial development of countries. In China, Zhang et al. (2019) reported that trade significantly affect financial efficiency and competition. However, when it comes to the size of financial development, the converse is observed. A study by Law (2009) found that financial sector development in developing countries is positively affected by trade openness. In addition, Ibrahim and Sare (2018) found for African countries that trade openness affects the level of financial development through private and domestic credit while trade interacts with human capital to reduce financial development. Based on the above it is hypothesized that:

1. Ho: Trade openness promotes financial development

International tourism and financial development

The financial sector of a country can be promoted by tourism development through its effect on growth, foreign currency earnings, new investment, increased industrial production, increased foreign exchange reserve, employment opportunities and infrastructural development (Ehigiamusoe, 2021; Shahbaz et al., 2019). Empirically some studies have assessed the relationship between tourism and financial development through causality analysis and regression analysis. For instance, Li and Qamruzzaman (2022) found for BRICS economies that tourism promotes financial development to attain higher human development while Cannonier and Burke (2017) found tourism to propel

financial development in Caribbean countries. Shahbaz et al. (2019) investigated the effect of tourism on Malaysia's financial development. Regression analysis revealed that tourism expansion positively affects financial development in the country. In South Africa, Musakwa and Odhiambo (2022) found that tourism granger causes financial development when the latter is measured as broad money, market capitalization and domestic credit by financial sector. A causality analysis by Ohlan (2017) for India also shows that tourism sector development affects financial sector development of the country. Similarly, a unidirectional causality from tourism to financial development was found by Başarir and Çakir (2015) for Turkey, France, Spain, Italy and Greece. For three-tourism based cities in China, Liao et al., (2018) observed a unidirectional causality from tourism to financial development. In Turkey, Katircioglu et al., (2018) found that tourism development enhances the financial sector. Kumar (2014) explored the nexus between tourism, remittances and growth in Kenya and found that tourism development granger causes remittance which has the capacity to promote the country's financial sector. In contrast, Musakwa et al., (2022) reported for the Kenyan economy that tourism does not have significant effect on financial development. Nevertheless, based on the significant economic contribution of tourism sector in Africa, it hypothesized that:

2. Ho: International tourism increases financial development

Renewable energy-financial development

Energy is the lifeblood of every economy and thus, any shock to its supply affects economic activities (Kwakwa, 2017a; Kwakwa, 2017b). However, owing to the carbon dioxide emissions associated with increased energy consumption there is a clarion call for economies to shift to renewable energy. The effect of renewable energy on financial development can be argued from the angle that it is more reliable and efficient than fossil fuel source of energy (Gyamfi et al., 2023). Consequently, it can enhance the operations of the financial sector to be more vibrant. Moreover, because of the capital requirement for renewable energy development, it would require a strong financial sector to offer such support (Saygin and Iskenderoglu, 2022). Also, Carse (2000) argues that the financial sector can expand because of the need to develop renewable energy, and this could cause financial firms to give more credit towards renewable energy development. Empirical studies on the effect of renewable energy on the financial sector are scarce. However, studies like Adom (2019) reported that Ghana's financial sector development improves with energy efficiency. Başarir and Çakir (2015) also found energy efficiency to granger cause financial development among MENA economies. Similarly, energy efficiency is reported to increase financial development through a reduction in energy cost, loan default and mortgage delinquency risk (Burt et al., 2010; Rauterkus et al., 2010). Accordingly, it is hypothesized that:

3. Ho: Renewable energy has a positive effect financial development.

Methodology

Model specification

In the literature, there are various determinants of financial development, many of which has been empirically investigated by several studies (Shahbaz et al., 2017; Adom, 2019; Park, 2015). The approach adopted by this study, therefore, is not to examine these determinants but to evaluate whether tourism development, renewable energy consumption and trade openness do have any systematic effect on the levels of financial development of some selected African countries based on the several transmission mechanisms and the brief literature highlighted in the preceding sections. Consequently, following Baltagi et al. (2009) and Shahbaz et al., (2017, 2019) this study adopts a basic model in which financial development (FD) is a function of renewable energy

consumption (RE), trade openness (TO) and tourism development (TOUR) while controlling for income (Y), government expenditure (GOV) and development assistance (ODA) as suggested from empirical literature (Adom, 2019; Asratie, 2021; Ellahi et al., 2021; Othman et al., 2018; Park, 2015) is given by equation (1).

$$FD = f(RE, TO, TOUR, Y, GOV, ODA) \tag{1}$$

We utilize a double-log transformation to the model variables to reduce the effects of outliers in resulting in non-constant error variance and estimate the elasticity coefficients. The resulting estimable equation of the model can be expressed as given by equation (2)

$$LFD_{it} = \beta_0 + \beta_1 LRE_{it} + \beta_2 LTO_{it} + \beta_3 LTOUR_{it} + \beta_4 LY_{it} + \beta_5 LGOV_{it} + \beta_6 LODA_{it} + \varepsilon_{it} \tag{2}$$

where $\beta_1 \dots \beta_6$ are coefficients of the explanatory variables, t is the time dimension; i is the individual countries, β_0 is the intercept and ε contains the error term and country specific effect.

Data and estimation techniques

The study relies on data from the World Bank (2023) World Development Indicators for seven African countries over the periods 1995–2021. The countries are Egypt, Tunisia, Kenya, South Africa, Zimbabwe, Ivory Coast and Morocco. The basis for selecting these countries is that they are leading tourist destinations in Africa. Moreover, they are among the leading renewable energy capacity in Africa and have posted some impressive terms of trade (World Bank, 2023). The dependent variable, financial development was represented by the following four indicators/proxies: Domestic credit to private sector (% of GDP) [FD-CP], Domestic credit to private sector by banks (% of GDP) [FD-BP], Broad money (% of GDP) [FD-BM], Foreign direct investment net inflows (% of GDP) [FD-FDI] and FD-INDEXT, an index constructed by using principal component analysis method from the four indicators (see Table 3). Income is measured as real per capita GDP in 2010 USD. Tourism is measured using international tourism receipts (% of total exports); renewable energy is measured as renewable energy consumption (% of total); trade openness is also measured as sum of export and import (% of GDP); government expenditure is measured as general government final consumption expenditure (% of GDP); and development assistance is measured as net official development assistance received (constant 2020 US\$).

The descriptive statistics of the variables and the correlation among the variables are reported in Table 1 and Table 2 respectively. The correlation results show a positive association between all the selected explanatory variables except renewable energy and financial development. However, since this association does not depict causation, it is important for the regression analysis to be done. Among the explanatory variables too there appears to be low correlation among them which may not affect the precision of the regression coefficients. This is later confirmed from the variance inflation factor after the regression analysis. Also, the financial development index constructed from the Principal Component Analysis reported in Table 3 shows that foreign direct investment, Domestic credit to private sector by banks (% of GDP) [FD-BP] and Broad money (% of GDP) (FD-BM) combined to explain about 99 % of the changes in the original data.

Panel data often have cross-sectional dependence (CD) which can

lead to biased estimates and forecasting errors (Pesaran, 2004). To avoid this situation studies of this nature, do a preliminary assessment to determine the presence or otherwise of cross-sectional dependence among the variables. The existence of such a situation necessitates the use of an appropriate unit root test. Unit root test is conducted to check the stationarity of the selected variables. A cointegration test is subsequently performed to assess the existence of a long run relationship among the variables. In this study, the Pedroni panel cointegration test (Pedroni, 1995) was used to test the existence of cointegration among the variables. After the cointegration test, the long-term coefficients are estimated using the panel Fully Modified Ordinary Least Square (FMOLS) model developed by Phillips and Hansen (1990). The FMOLS is applied to estimate the long-run effect of the covariates on financial development. The panel FMOLS model has several advantages over the OLS such as its ability to address both endogeneity and serial correlation issues. Following the works of Bai and Kao (2006) and Alhassan (2021), the panel FMOLS is expressed as given below.

$$\Omega pfmol = \left[\sum \sum (x_{it} - x_i) \right]^{-1} \sum (\sum (x_{it} - x_i) y_{it}^+ + T \Delta_{\varepsilon_{it}}^+) \tag{3}$$

where $\Delta_{\varepsilon_{it}}^+$ is the serial correlation correction term and y_{it}^+ is the transformed dependent variable of y_{it} to achieve the endogeneity correction. x_{it} is an n -dimensional vector of independent variables. To ensure the robustness of the estimated results, the ARDL and the DOLS regressions are also performed and compared with that of the FMOLS.

Another analysis performed is the quantile regression analysis to assess the conditional median or a diverse range of response. It is used to establish the heterogeneous consequence of the explanatory variables on financial development. The quantile regression for the panel data is therefore given below:

$$Y_{it} = \alpha_i + \beta(q)x_{it} + U_{it} \tag{4}$$

where i is the individual countries and t is the time dimension. The dependent variable is y while x represents the explanatory variables. q denotes the quantile ($0 < q < 1$) of the conditional distribution, and α denotes the presence of fixed effects. The impact of the explanatory variables is allowed to be determined by the quantile (q). Following Koenker and Bassett (1978), the estimation of Equation (4) for several quantiles simultaneously is obtained through minimization in Equation (5).

$$\min_{\alpha, \beta} \sum_{k=1}^T \sum_{j=1}^n \sum_{i=1}^m wk P_{qk} (Y_{ij} - \alpha_i - \beta(qk)x_{ij}) + \lambda \rho(\alpha) \tag{5}$$

where $\rho_{qk} = u(q - I(u < 0))$ is the piecewise linear quantile loss function provided by Koenker and Bassett (1978). The weights wk control the relative influence of the τ quantiles ($q1, \dots, q\tau$) on the estimation of the α_i parameters.

Results

Cross sectional dependence and unit root

Results reported in Table 4 shows there is cross sectional dependence among the variables which indicates the values of the variables across the countries are related. It is therefore necessary to use the appropriate

Table 1
Descriptive statistics of variables.

Statistic	LFD-INDEXT	LFD-BM	LFD-BP	LFD-FDI	LFD-PC	LGOV	LODA	LY	LREN	LTO	LTOUR
Mean	0.491598	3.984980	3.644639	0.338708	3.851299	2.699476	20.69956	7.892163	3.014064	4.070694	2.634992
Median	0.966022	4.008121	3.880656	0.503873	3.987086	2.790502	20.58713	7.948156	2.648300	4.011624	2.825104
Maximum	2.417636	4.782339	4.270333	2.243319	4.958795	3.075036	22.35139	8.745899	4.421848	4.739208	3.408854
Minimum	-3.590764	2.658987	1.773126	-3.459379	1.779980	1.892369	18.35955	6.846445	1.629241	3.409382	0.537549
Std. Dev.	1.347093	0.469604	0.516319	1.000023	0.711370	0.240557	0.712200	0.546550	0.982901	0.307642	0.607061

Table 2
Correlation among variables.

Correlation	LFD-INDE	LGOV	LODA	LY	LREN	LTO	LTOUR
LFD-INDE	1.000000						
LGOV	0.430632	1.000000					
LODA	0.027969	-0.33037	1.000000				
LY	0.766277	0.244682	-0.079632	1.000000			
LREN	-0.788090	2.19E-05	-0.063992	-0.799027	1.000000		
LTO	0.253905	0.468580	-0.509657	0.079877	-0.09074	1.000000	
LTOUR	0.458472	-0.05665	0.108792	-0.012455	-0.40010	0.083777	1.000000

Table 3
Results of Principal Component Analysis.

Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
Eigenvalues: (Sum = 4, Average = 1)					
1	3.014176	2.295861	0.7535	3.014176	0.7535
2	0.718314	0.471967	0.1796	3.732490	0.9331
3	0.246347	0.225184	0.0616	3.978837	0.9947
4	0.021163	—	0.0053	4.000000	1.0000
Eigenvectors (loadings):					
Variable	PC 1	PC 2	PC 3	PC 4	
LFD-BP	0.557887	-0.226222	0.227151	-0.765498	
LFD-BM	0.522478	-0.090772	-0.832461	0.160580	
LFD-FDI	0.355145	0.925962	0.126304	0.022662	
LFD-CP	0.538192	-0.288406	0.489345	0.622666	

Table 4
Results for series Cross-Section Dependence Test.

Series	Tests			
	Breusch-Pagan LM	Pesaran scaled LM	Bias-corrected scaled LM	Pesaran CD
LODA	153.18***	19.31***	19.17***	8.29***
LGOV	134.18***	16.38***	16.25***	-0.74
LY	276.94***	39.49***	39.35***	10.74***
LREN	195.97***	26.99***	26.85***	5.826***
LTOUR	115.96***	14.64***	14.50***	5.39***
LTO	124.785***	16.014***	15.878***	5.58***
LFD-BP	155.09***	20.69***	20.55***	0.0019
LFD-CP	122.87***	14.63***	14.49***	-1.81*
LFD-BM	132.52***	16.12***	15.98***	5.89***
LFD-FDI	58.66***	4.73***	4.59***	4.10***
LFD-INDEX	73.55***	7.02***	6.88***	0.28

***<1% level of significance.

Table 5
CIPS Unit root test results.

Series	At levels (t-statistic)	At 1st difference t-statistic	Conclusion
LY	-1.06	-2.53**	I(1)
LREN	-1.65	-4.17***	I(1)
LTOUR	-1.13	-5.73***	I(1)
LTO	-1.67	-4.79***	I(1)
LFD-CP	-0.22	-3.47**	I(1)
LFD-BM	-0.12	-3.41***	I(1)
LFD-FDI	-0.15	-3.55***	I(1)
LFD-INDE	-0.25	-3.92***	I(1)
LFD-BP	-0.16	-3.241***	I(1)
LODA	-0.19	-3.57***	I(1)
LGOV	-0.29	-4.40***	I(1)

*** and ** 1% and 5% level of significance respectively.

unit root test to ascertain the stationarity of the variables. The CIPS unit root results as reported in Table 5 shows that the variables are stationary at first difference. This makes it appropriate to use FMOLS for regression analysis.

Cointegration results

The cointegration analysis is meant to assess the long run relationship between financial development and the covariates of interest. The results obtained for each model yield similar outcomes. However, to avoid overcrowding of table results we only report the model that has financial development index as the dependent variable here. The rest can be found at APPENDIX 1A. From Table 6, it is observed that the Panel PP-statistic, Panel ADF-statistic, Group PP-statistic and Group ADF-statistic unambiguously confirm the variables are cointegrated and thus they have a long run relationship. The Westerlund cointegration test also confirms the existence of cointegration among the variables (Table 7). The implication is that trade openness, international tourism, and renewable energy, along with the control covariates can be regarded as the factors that influence financial development for the selected countries in the long run.

Regression results

Long results from FMOLS

Results from the FMOLS in Table 8 show that in the long run trade openness, international tourism, and renewable energy have significant effects on financial development indicators. The results further show that with the exception of government expenditure which reduces foreign direct investment net inflows (% of GDP) [FD-FDI], the

Table 6
Cointegration results for LFD-INDE.

	Alternative hypothesis: common AR coeffs. (Within-dimension)			
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	-0.546355	0.7076	-0.289315	0.6138
Panel rho-Statistic	0.243474	0.5962	-0.201613	0.4201
Panel PP-Statistic	-1.923947	0.0272	-3.603350	0.0002
Panel ADF-Statistic	-1.765205	0.0388	-3.215089	0.0007
Alternative hypothesis: individual AR coeffs. (Between-dimension)				
	Statistic	Prob.		
Group rho-Statistic	1.093500	0.8629		
Group PP-Statistic	-4.550158	0.0000		
Group ADF-Statistic	-4.005016	0.0000		

Table 7
Westerlund Cointegration results for LFD-INDEXT.

Model with	Westerlund Statistic	P-value
LFD-INDEXT LREN LTOUR LTO LY LODA LGOV	-1.485	0.051

Table 8
FMOLS estimates for determinants of financial development.

Variable	LFD-BP model	LFD-CP model	LFD-BRM model	LFD-FDI model	LFD-INDEXT model
	Coefficient (std. error)				
LREN	0.168** (0.084)	0.341*** (0.082)	0.066* (0.040)	0.470*** (0.058)	0.793*** (0.199)
LTO	0.157*** (0.053)	0.063 (0.045)	0.219*** (0.025)	0.257*** (0.076)	0.395*** (0.110)
LTOUR	0.174*** (0.049)	0.1268*** (0.045)	0.117*** (0.023)	0.839*** (0.066)	0.420*** (0.110)
LY	0.301*** (0.096)	0.240** (0.098)	0.747*** (0.045)	2.358*** (0.025)	1.666*** (0.238)
LGOV	0.904*** (0.066)	0.827*** (0.055)	0.318*** (0.031)	-0.633*** (0.028)	1.450*** (0.132)
LODA	0.152*** (0.018)	0.127*** (0.014)	0.045*** (0.008)	0.099* (0.052)	0.253*** (0.037)
Adj-R ²	0.86	0.94	0.95	0.23	0.90

***, **, * means 1%, 5% and 10% level of significance respectively.

remaining variables have positive effects on financial development measured by domestic credit to private sector (% of GDP) [FD-CP], domestic credit to private sector by banks (% of GDP) [FD-BP], broad money (% of GDP) [FD-BM], foreign direct investment net inflows and FD-INDEXT.

Energy has generally been regarded as an input for the smooth operation of every sector of the economy. Without regular supply of energy many establishments will come to halt. However, the carbon dioxide emission effect associated with using more energy has led to suggestions to switch to renewable energy (Alhassan et al., 2022). The argument is renewable energy is cleaner and emit less carbon dioxide emission (Kwakwa, 2021). This means economies can benefit from it without polluting the environment. Since renewable energy is reliable in terms of supply, the findings imply that it enables firms in the financial sector to have smooth and uninterrupted operations. The quest to use more renewable energy also helps to build strong financial sector because as argued by Carse (2000) the financial requirement for cleaner environment like renewable energy sector enables financial institutions to advance more credit helping in its expansion. Because it is also environmentally friendly there is less risk for firms in the renewable energy sector to be sued which could cause financial damage to financial institutions. Thus, advancement in the use of renewable energy has been helpful in promoting financial development via domestic credit to private sector, domestic credit to private sector by banks, broad money and foreign direct investment. Its positive effect on FDI is also an indication that increased renewable energy use might have led to influx of foreign firms that are conscious of cleaner environment or firms that would want to explore avenues for increasing renewable energy development in the selected countries. The work of Adom (2019) found that lower energy cost and improved energy efficiency increases financial development in Ghana. The positive effect observed in this study is a corroboration of the previous evidence in the literature that energy efficiency helps in the development of the financial sector through a reduction in energy cost, loan default and mortgage delinquency risk (Burt et al., 2010; Rauterkus et al., 2010).

Indeed, tourism has become a force to reckon with in the growth and development agenda of countries. It is noted for its contribution to poverty reduction, employment, export revenue and community development (Scheyvens and Momsen, 2008; Witt et al., 2004). The

reported evidence in this study from Tables 8 and 9 is that tourism development helps in the development of the financial sector of countries in this study. International tourism entails tourists converting their foreign currencies into the local currencies. This helps to increase the foreign exchange of the host country, thereby increasing the strength of the financial sector. The spending activities of these foreign visitors further improves the financial sector. Hence, it is not surprising that increasing international tourism increases financial development. The results remain the same irrespective of the measurements used for international tourism which are tourism receipt and the number of tourists. Receipts from international tourism would help increase government revenue (Cannonier and Burke, 2017). This helps the government to execute and finance its projects through financial institutions. Also, with more receipts from international tourists, operators of the sector may be desirous to secure financial support from financial institutions to expand their operations. Through this the financial sector becomes vibrant. Also, as the number of visitors increases their expenditure would increase the revenues of firms. These revenues are usually deposited with financial institutions thereby boosting their ability to give more credit. The expansion of the tourism sector could have also attracted foreign firms to invest in the tourism industry. It is well known that in many African countries many of the top tier hotels and other accommodation facilities are either owned by foreigners or jointly owned by locals and foreigners. The increased number of international tourists could send positive signals for more foreigners to invest in such ventures which helps to expand the financial sector. The results from the study are in line with Musakwa and Odhiambo (2022a), Musakwa and Odhiambo (2022b), Cannonier and Burke (2017) and Shahbaz et al. (2018) that reported a positive effect of tourism on financial development.

Engaging in international trade is also noted to increase the financial development of the countries in the study. Foremost, international trade, especially export increases the market size of some domestic firms. This could enable them to secure funds from financial institutions to expand their business (Rajan and Zingales, 2003). Through this the financial institutions can create more money for business activities. Many of the transactions involved in the trade process require the use of financial institutions like banks. The monies that will pass through these banks will be useful in their expansion. Importation also makes firms acquire efficient technology for operations and as such firms that take loans from banks may become more profitable and thereby enable them to settle their debt. Moreover, since trade openness allows foreign investors into the countries (Kwakwa et al., 2018) it helps in the development of the financial sector via foreign direct investment in the country. There is also the element of competition the foreign firms offer local firms as well as the transfer of knowledge to local firms. These help local firms to also be efficient in their operations, make more profit and reduce their loan default. Firms in the financial sector can secure IT infrastructure that enables them to monitor their debtors for necessary action. It could be as a result of these mechanisms that the selected countries have witnessed a positive effect of trade openness on their financial sector development. The works of Ibrahim and Sare (2018) also obtained similar results on the effect of trade of financial development.

The effect of income on financial development is positive. Frequently, as the economy expands, and people have more income their

Table 9
Variance Inflation Factors.

Variable	Coefficient Variance	Uncentered VIF
LGOV	0.421707	1.135655
LODA	0.035496	1.453715
LY	0.886073	3.221566
LTO	0.276571	1.258347
LREN	0.674392	2.592244
LTOUR	0.236642	1.511980

financial transactions also increase. This is because an increase in income has the tendency to increase savings with financial firms. High income groups are likely to engage in online transactions that require the support of their financial institutions (Raman and Viswanathan, 2011). With the high level of income, individuals and households that resort to financial firms for financial assistance are likely to honor their financial obligations which will reduce loan default and non-performing loans. The effect will be that the financial sector will be stronger. With recent higher levels of economic growth in Africa including the selected countries (World Bank, 2023) it is therefore not surprising that income has a positive effect on the development of the financial sector of the selected African countries including the attraction of direct foreign investment. Studies including Adom (2019) reported similar findings.

The effect that government expenditure has on financial development indicators is positive for all except FDI. Government expenditure exerting a positive effect on the indicators of financial development is fathomable since government must channel its expenses through financial institutions. Consequently, the financial institutions' excess reserve for lending activities increases thereby leading to financial sector growth. Moreover, government expenditure that focuses on capital investment offers strong support for the activities of financial sector. Works including Pedersoli and Presbitero (2023) İlgin (2016) found that government spending improves financial sector development. The literature also offers reasons why government expenditure may reduce FDI in cases where government expenditure may increase public debt and deficit issues. When foreign investors regard government debt as unsustainable their willingness to invest in a country will reduce (Othman et al., 2018). This could therefore explain the negative effect of government expenditure on FDI as a measure of financial development in this study.

It is observed that official development assistance exerts positive effect on financial sector. Development assistance has been instrumental in shaping financial sector regulations in many developing countries which leads to a vibrant sector. In countries characterized by low savings with financial institutions, development assistance can improve financial sector development (Park, 2015). By promoting economic transactions through financial institutions, development assistance also leads to an improved financial sector (Oche et al., 2016). The variance inflation factors reported in Table 9 suggest that there is no high correlation among the explanatory variables. As such the coefficients are precise.

Quantile regression analysis

To analyze the heterogeneous and distributional impact across quantiles, the study proceeds to perform quantile regression analysis (see Table 10). It is observed that renewable energy, tourism, trade openness, government expenditure and income have significant effects

on financial development. However, their effects differ from quantile to quantile. Focusing on the individual effects along the distributions, it is noted that renewable energy has positive effect at the lower quantiles (10th to 50th) but exerts negative effects on financial development at higher quantiles (60th to 90th). It implies that renewable energy increases financial development through the various channels only at lower financial development quantiles but reduces financial development at higher quantiles. It is an indication that in terms of financial development, renewable energy benefits countries with lower financial development than those with higher financial development sector. Thus, as renewable energy use increases countries with lower financial sector development benefit the more. African leaders are eager to increase the share or renewable energy in final energy consumption and the success of this partly depends on a strong financial sector. Consequently, from the results it could be that countries with lower levels of financial sector development are positioning their financial sector to support renewable energy development. Thus, the more renewable energy is developed the more their financial sector also grows suggesting state officials or policymakers must strategize to expand the financial sector to respond to meet renewable energy demand (Carse, 2000). For renewable energy to reduce financial sector development at higher quantiles could also be explained to some extent – investing in renewable energy sector does not yield immediate financial returns. Therefore, in countries with higher level of financial sector, financial support to renewable energy sector reduces the funds available to be given to other sectors which promise short to medium term financial returns which may affect the growth of the financial sector. The above suggests that a reduction in renewable energy development is not likely to harm the financial sector of countries with high level of financial development but the opposite is likely to be the case for countries with lower levels of financial development.

Tourism exerts a positive effect throughout the quantiles. Even though there are fluctuations in the coefficients across the distributions, its effect is generally higher at the lower quantiles than the higher quantiles. This goes to confirm the impact of tourism on financial development may not be uniform but varies across the quantiles of financial development. The inference is that at lower quantiles the greater effect tourism may attributed to the fact that authorities in countries with lower financial sector development are relying on tourism as one of the key sectors to promote the financial sector. On the other hand, countries with higher financial sector development may have other channels to promote the development of the financial sector. This would mean that a negative shock to the tourism sector in Africa will hamper the financial sector development of countries with low financial development more than those with a high level of financial development.

Trade openness is observed to positively influence financial development, especially from the 10th quantile to the 50th quantile.

Table 10
Quantile regression results.

Variable	10th qtl	20 ^h qtl	30th qtl	40th qtl	50th qtl	60th qtl	70th qtl	80th qtl	90th qtl
LREN	0.092*(0.051)	0.013(0.051)	-0.006(0.054)	0.010(0.054)	0.027(0.052)	-0.078(0.049)	-0.104** (0.443)	-0.071*(0.04)	-0.009(0.051)
LTO	0.231*** (0.084)	0.184** (0.084)	0.242*** (0.0886)	0.186** (0.088)	0.188** (0.085)	0.012(0.080)	-0.036(0.072)	-0.019(0.068)	0.075(0.083)
LTOUR	0.392*** (0.049)	0.368*** (0.048)	0.361*** (0.051)	0.359*** (0.051)	0.366*** (0.049)	0.292*** (0.046)	0.264*** (0.041)	0.300*** (0.0390)	0.296*** (0.048)
LY	0.811*** (0.086)	0.657*** (0.085)	0.627*** (0.090)	0.641*** (0.089)	0.685*** (0.087)	0.558*** (0.081)	0.533*** (0.073)	0.564*** (0.069)	0.554*** (0.084)
LGOV	1.020*** (0.109)	1.081*** (0.108)	0.871*** (0.114)	0.679*** (0.114)	0.551*** (0.110)	0.606*** (0.104)	0.617*** (0.093)	0.603*** (0.087)	0.438*** (0.108)
LODA	0.050(0.034)	0.044(0.034)	0.109*** (0.0362)	0.123*** (0.036)	0.111*** (0.035)	0.087*** (0.032)	0.083*** (0.029)	0.086*** (0.027)	0.079** (0.034)
c	-9.06*** (1.275)	-7.34*** (1.263)	-7.95*** (1.332)	-7.60*** (1.329)	-7.37*** (1.288)	-4.70*** (1.212)	-4.08*** (1.089)	-4.59*** (1.022)	-4.37*** (1.257)
Adj-R ²	0.75	0.65	0.64	0.63	0.60	0.58	0.57	0.54	0.49

***, **, * means 1%, 5% and 10% level of significance respectively.

However, there are fluctuations in the coefficients along the distributions. The differences in the significance of the effect of trade openness could be due to the presence of other weightier drivers of financial sector development in countries with a higher level of financial sector development than those in lower quantiles. The effects of income, government expenditure and development assistance although are positive, they also show some variations across the distributions. At the lower quantiles their effects appear higher than at the higher quantiles. It does not only confirm that their effect is heterogeneous but also means that the gains to the financial sector via government spending, development assistance and income are higher in countries with lower financial sector development than it is in those with higher financial sector development.

In general, the results from the quantile regression have proven that renewable energy, tourism, trade openness, along with the control covariates have significant effect on financial development of the selected African countries. In specific terms it has shown that the financial sector development of the countries in this study is positively influenced, foremost, by renewable energy, trade openness and tourism and that the impacts are even higher at lower quantiles of financial development. This suggests that policies or shocks that negatively affect renewable energy, tourism, trade openness, and the control covariates would have greater effects on countries with lower level of financial sector development than those in higher financial sector development.

Conclusions

There is no doubt that the development of the financial sector cannot be overemphasized in contemporary development agenda. At the same time, many global development policies identify renewable consumption as the future of development as it considered as effective panacea to climate change and environmental deterioration. Similarly, many developing and emerging economies have been increasing the attractiveness of their domestic economies toward tourism and trade given their growth potential. Nevertheless, not much improvement has been observed especially relative to other developing regions. In particular, the financial market remains less developed in Africa despite some steady progress while tourism development and renewable energy consumption continue to witness little improvement. Even though, there are a plethora of studies examining various aspects of these macroeconomic variables, particularly financial development, the same cannot be said about body of knowledge on the ways in which renewable energy consumption, tourism development and openness work to ensure financial development or otherwise.

Consequently, this study, while controlling for economic growth, development assistance and government expenditure, examines the effects of renewable energy consumption, tourism development and trade openness on financial development in selected African countries. The

FMOLS results suggest a positive long run effects of trade openness, international tourism, income and renewable energy on financial development. This conclusion particularly affirms the notion that financial development could also result from improvements in sectors that may not necessarily belong to its conventional determinants. The quantile regression gives additional credence to the FMOLS results. However, in addition, the quantile regression reveals that the positive effects of trade openness, international tourism, and renewable energy on financial development are broadly greater at the lower quantiles of financial. Thus, a country can still optimize the gains associated with increased trade openness, international tourism, and renewable energy consumption with a relatively less developed financial market. The implication emanating from the ensued conclusions is that, in addition to the traditional methods of ensuring financial development, policies that improve tourism development, promote renewable energy consumption and intensify economic openness are important catalyst to stimulating further financial development within the African continent and particularly in the countries selected for the study. Also, given that the quantile results are strikingly heterogeneous, the policy is highly recommended even for countries whose financial markets have less developed financial markets.

Even though, the study attempted to utilize multiple dimensions of financial development, it appears the stock market dimensions were generally unrepresented. This was partly to the evidence that financial development in the continent is driven predominantly by the banking sector with the stock market of most countries remaining largely underdeveloped. Nonetheless, future studies may consider exploring adequate inclusion of the stock market. Perhaps, an insightful approach could involve the evaluation of the responses of a bank-based financial development relative to a stock market-based financial development.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRedit authorship contribution statement

Solomon Aboagye: Conceptualization, Writing – original draft.
Paul Adjei Kwakwa: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix 1A: Cointegration test results

Pedroni Residual Cointegration Test

Series: LFINPC LGOV LODA LY LREN LTO LTOUR

Alternative hypothesis: common AR coeffs. (within-dimension)

	Statistic		Weighted	
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	-3.053996	0.9989	-3.577281	0.9998
Panel rho-Statistic	4.345280	1.0000	3.810314	0.9999
Panel PP-Statistic	-25.49498	0.0000	-57.11515	0.0000
Panel ADF-Statistic	0.112204	0.5447	-1.545287	0.0611
Alternative hypothesis: individual AR coeffs. (between-dimension)				
	Statistic	Prob.		
Group rho-Statistic	4.794590	1.0000		
Group PP-Statistic	-78.37695	0.0000		
Group ADF-Statistic	-1.640607	0.0504		

Pedroni Residual Cointegration Test

Series: LFINFDI LGOV LODA LY LREN LTO LTOUR

Alternative hypothesis: common AR coefs. (within-dimension)

	Weighted			
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	5.108363	0.0000	-2.423738	0.9923
Panel rho-Statistic	4.898513	1.0000	4.918767	1.0000
Panel PP-Statistic	-3.743710	0.0001	-0.823820	0.2050
Panel ADF-Statistic	2.171762	0.9851	1.838178	0.9670
Alternative hypothesis: individual AR coefs. (between-dimension)				
	Statistic	Prob.		
Group rho-Statistic	5.694869	1.0000		
Group PP-Statistic	-47.71021	0.0000		
Group ADF-Statistic	2.221196	0.9868		

Pedroni Residual Cointegration Test

Series: LFD-BM LGOV LODA LY LREN LTO LTOUR

Alternative hypothesis: common AR coefs. (within-dimension)

	Weighted			
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	11.85582	0.0000	-3.021245	0.9987
Panel rho-Statistic	4.923202	1.0000	4.929357	1.0000
Panel PP-Statistic	-11.41217	0.0000	-8.617273	0.0000
Panel ADF-Statistic	0.288544	0.6135	0.656281	0.7442
Alternative hypothesis: individual AR coefs. (between-dimension)				
	Statistic	Prob.		
Group rho-Statistic	5.629052	1.0000		
Group PP-Statistic	-83.39998	0.0000		
Group ADF-Statistic	-1.032060	0.1510		

Pedroni Residual Cointegration Test

Series: LFD LGOV LODA LY LREN LTO LTOUR

Alternative hypothesis: common AR coefs. (within-dimension)

	Weighted			
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	-0.876665	0.8097	-2.088661	0.9816
Panel rho-Statistic	4.723421	1.0000	4.857276	1.0000
Panel PP-Statistic	-9.819080	0.0000	-17.97791	0.0000
Panel ADF-Statistic	0.176912	0.5702	0.251303	0.5992
Alternative hypothesis: individual AR coefs. (between-dimension)				
	Statistic	Prob.		
Group rho-Statistic	5.353977	1.0000		
Group PP-Statistic	-65.58818	0.0000		
Group ADF-Statistic	-0.609941	0.2710		

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