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Financial development, trade openness and economic growth in African countries: New insights from a panel causality approach

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ABSTRACT

This paper examines the causal relationship between financial development and economic growth for 21 African countries within a framework which also accounts for international trade. We develop a financial development index based on four different financial development indicators and apply the panel bootstrapped approach to Granger causality. The empirical results show limited support for the finance-led growth and the trade-led growth hypotheses. The results imply that recent attempts at financial development and trade liberalization do not seem to have made a significant impact on growth.

1. Introduction

It is argued that the level of financial development and the degree of international trade openness are among the most important variables the empirical economic growth literature suggests as being highly correlated with growth performance across countries (Beck, 2002; Sachs and Warner, 1995). Financing constraints prevent poor countries from taking full advantage of technology transfer and this causes some of these countries to diverge from the growth rate of the world production frontier (Aghion et al., 2005). Poor countries with an underdeveloped financial system are trapped in a vicious circle, where poor financial development leads to poor economic performance and in turn, poor economic performance leads to poor financial development (Fung, 2009). In contrast, countries with a better-developed financial system tend to grow faster and therefore finance is not only pro-growth but also pro-poor suggesting that financial development helps the poor to catch up with the rest of the economy as it grows (see inter alias, Demirgüç-Kunt and Levine, 2009; Baltagi et al., 2009). Moreover, the endogenous growth theory as articulated by Greenwood and Jovanovic (1990) and Bencivenga and Bruce (1991) and others also stresses that financial development is an important factor in fostering long-run economic growth as finance is able to facilitate growth by enabling efficient intertemporal allocation of resources, capital accumulation and technological innovation (see Levine, 2005). Furthermore, the theoretical model of Blackburn and Hung (1998) also predicts that both financial development and international trade liberalization enhance economic growth. What is unclear, however, is whether these potential benefits of financial development and trade liberalization are being reaped by African countries. There is, however, an opposing view that economic growth and financial development may evolve independently of each other. This is the neutrality hypothesis (Lucas, 1988). This paper, therefore, seeks to explore whether or not financial development and international trade have a role in the growth process in Africa in the light of the limited, conflicting and inconclusive results of prior studies.[1]

This study contributes to the literature by extending the finance-growth nexus studies in three methodological ways for 21 African countries for the period covering 1965–2008. Firstly, unlike previous time series studies for African countries which concentrated on the two-variable case, we include openness to international trade as a third variable. By incorporating trade openness as a third variable, we not only attempt to underline the potential importance of trade openness for economic growth but also test the hypothesis that openness promotes financial development or vice versa (Beck, 2002). Secondly, as there are several controversies surrounding the measurement of the financial development indicator variable, we develop a financial development index using four financial development indicators to comprehensively capture the different dimensions of financial development.[2] Thirdly, we test for causality using a systematic modeling approach within the framework of panel data analysis as proposed by

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[1] The only two studies which have accounted for the impact of financial development and trade openness on economic growth are Gries et al. (2009) based on a sample of 16 SSA countries and the single country study of Kenya by Wolde-Rufael (2009).

[2] Most previous studies such as Gries et al. (2009) used at most three financial indicator variables unlike the four we use in this paper.

Kónya (2006) which, unlike previous studies, accounts for cross-section dependency and cross-country heterogeneity in the empirical modeling.[3] Cross-section dependency can arise because economic dynamics show that a shock to one country may be easily transmitted to other countries through international trade and economic and financial integration. We account for cross-sectional dependency since there is evidence that there is a growing trend toward regional integration within Africa (Beck et al. 2011). This enables us to avoid any misleading inferences regarding the direction of causality which could arise with an individual country study that does not account for such dependence. The panel causality approach we use in this paper is also valid irrespective of unit root and cointegration properties of the variables.

The rest of the paper is structured as follows. In Section 2 we present a brief overview of financial development in SSA countries, followed in Section 3 by a short review of the literature on the relationship between financial development and economic growth on the one hand and between international trade and financial development on the other. Section 4 presents the description of the data. In Section 5 the methodology used is discussed. The empirical evidence is presented in Section 6 while concluding remarks are presented in Section 7.

2. Economic growth, trade and financial development in Africa

While Africa's dismal economic growth can be attributed to a multitude of factors, there is no denying the fact that past barriers to free international trade and lack of financial development are among the prominent factors that could have contributed to the continent's poor economic performance (Beck et al. 2011; Ndulu et al., 2007). Even, after recent policy changes including financial liberalization and development and further attempts at integration into the world market, many African countries are still showing only limited economic progress. Africa's financial systems have progressed over the past 20 years. However, the promise of the efforts in liberalization, privatization and stabilization in the 1980s has only been partly fulfilled and the benefits of deeper, broader, and cheaper finance have not yet been reaped (Beck et al., 2011). Generally, Africa's financial system is still characterized as being segmented, bank-based, government directed and oligopolistic, facing little competition (Honahan and Beck, 2008; Ncube, 2007). Government control implies that resource allocation decisions tend to be based more on political considerations rather than on economic viability (Honahan and Beck, 2008; Ncube, 2007). As can be seen from Table 1, Sub-Sahara Africa's level of financial deepening even towards the latter part of the sample period, 1995–2005 lags behind that of other regions such as East Asia and the Pacific countries.[4] For instance, the level of liquid reserves in SSA is higher than average, which indicates that SSA banks hold a large portion of liquid assets in the form of treasury bills rather than giving out loans to the private sector (see Ncube, 2007). The interest rate spread is also higher than in any other region (see Table 1). Africa has also the lowest saving performance in the world. For instance, while the gross saving rate of the East and Pacific region, South Asia and the world was almost 45%, 33% and 21.3% respectively in 2005, it was only 15% for SSA despite the fact that the average saving rate of SSA was higher than South Asia in the 1970s. Similarly, while gross capital formation was 38.4% for the East and Pacific region and 21% for the world average, it was only 19% for Africa. Despite recent growth, financial systems remain small in low-income regions, especially in much of sub-Saharan Africa. In banking, which is the dominant source of finance in these regions, the high spreads between deposit and lending rates reflect a lack of competition and inhibit firms from growing to take advantage of economies of scale. Banking sector liberalization that promotes competition (and takes due consideration of stability) boosts growth. The IMF estimated that the annual growth rate of developing economies with more open banking sectors exceeded that of economies with less open banking sectors by about 1 percentage point (Ostry et al., 2008). While recent experience suggests that progress has been made, there is still a long way to go to make Africa's financial and payment systems comparable to the other successful regions of the world (Beck et al. 2011; Murinde, 2012). However, whether or not further financial and international trade developments would accelerate the rate of economic growth remains the unresolved empirical question which this study seeks to investigate.

3. Finance, openness and economic growth: An overview

3.1. Financial development and economic growth

The debate on the role of financial development in economic growth is still flourishing and is still attracting several theoretical and empirical studies that investigate the causal relationship between the two (Ang, 2008; Murinde, 2012). Central to the debate is (a) whether the financial sector drives economic growth or (b) whether it is economic growth that explains the growth of the financial sector. The first hypothesis, commonly known as 'supply-leading' contends that financial development is a necessary pre-condition for economic growth; consequently finance leads economic growth and causality runs from financial development to economic growth. Proponents of this hypothesis contend that the quantity and the composition of financial development variables induce economic growth by directly increasing savings in the form of financial assets, thereby spawning capital formation and hence economic growth (King and Levine, 1993). In contrast to the above, the second hypothesis usually referred to as 'demand-following', contends that finance is led by rather than leads economic growth and finance plays a minor role in economic growth. In this line of reasoning finance is merely a by-product or an outcome of growth in the real side of the economy (Robinson, 1952). It is therefore argued that when an economy grows, more financial institutions, financial products and services emerge in the market in response to higher demand for financial services. Consequently, as the real sector of the economy grows, the financial system develops thereby increasing the opportunities for acquiring liquidity for funding investment and for reducing risk. According to the proponents of the 'demand-following' hypothesis the lack of financial institutions in developing countries is an indication of the lack of demand for their services. Shan (2005) provides empirical evidence to buttress that view by showing that a well functioning and liberalized financial system did not precede the spectacular economic growth of some Asian countries, including China, Japan and Korea. Additionally, Shan (2005) argues that the recent Asian economic crisis has cast further doubt on the claim that financial development always plays a positive role in economic growth.

In addition to the above two hypotheses, there are those who believe that economic growth and financial development can complement each other making financial deepening and real economic growth mutually causal where there would be a bi-directional causality running between economic growth and financial development (Blackburn and Hung, 1998, Blackburn et al., 2005; Greenwood and Smith, 1997). To the proponents of this hypothesis, financial development is indispensable to economic growth and economic growth inevitably requires a well functioning and an efficient financial system. Still others argue that there is no support for the view that financial development promotes growth (see De Gregorio and Guidotti, 1995).

The conflicting evidence outlined above is also true for Sub-Sahara Africa (see Murinde, 2012). For some authors, there is a long-run relationship between financial development and economic growth but the direction of causality is mixed and conflicting. For instance, Ghirmay (2004) found that financial development played a causal role in the economic growth of eight out of the thirteen countries he investigated. Agbetsiafia (2004) also found mostly unidirectional causality

[3] As pointed out by a referee, although the panel causality approach of Kónya (2006) is widely used in many empirical studies to test for causality in a panel framework, it is purely empirical and it is not validated analytically.

[4] For an excellent summary see Ncube (2007) and Murinde (2012).

Table 1
Financial depth and financial efficiency for the latter part of the sample period.
Source: World Bank, World Development Indicators, 2008.

		World	Sub-Saharan Africa	East Asia & Pacific	South Asia	Middle East & North Africa	Latin America & Caribbean
Domestic credit provided by banking sector (% of GDP)	1995	147.7	79.9	91.6	43.6	63.7	44.1
	2005	164.6	82.3	121.4	57.2	53.6	52.0
Domestic credit to private sector (% of GDP)	1995	113.2	63.9	88.4	23.1	31.4	32.7
	2005	133.8	64.9	101.1	38.7	39.9	27.8
Interest rate spread (lending rate minus deposit rate)	1995	7.3	10.5	6.6	N.A.	N.A.	10.4
	2005	6.5	12.2	5.5	5.9	4.8	7.8
Liquid liabilities (M3) (% of GDP)	1995	95.5	37.2	86.5	43.0	60.2	28.2
	2005	94.8	33.8	141.0	62.7	70.8	40.7
Money and quasi money (M2) (% of GDP)	1995	95.0	33.6	78.2	40.4	54.5	24.5
	2005	95.1	36.6	130.7	58.4	62.9	38.3
Quasi-liquid liabilities (% of GDP)	1995	324.7	19.9	56.3	26.2	31.0	19.7
	2005	741.0	23.0	91.6	41.7	39.0	20.4
Bank liquid reserves to bank assets ratio	1995	9.7	13.1	11.8	13.4	13.2	14.7
	2005	10.1	15.7	10.5	15.5	21.8	10.8
Gross savings (% of GDP)	1995	21.5	14.2	38.3	25.3	25.1	17.8
	2005	21.3	15.1	44.8	32.6	30.4	21.0
Gross capital formation (% of GDP)	1995	22.3	18.4	39.5	25.1	25.1	19.5
	2005	21.8	19.2	38.4	31.9	26.0	20.3

running from financial development to economic growth in seven African countries thus lending support for the supply-leading phenomena of the finance-growth nexus. Atindehou et al. (2005) using three indicators of financial development, found weak causal relationship in almost all the twelve West African countries they studied. Odhiambo (2007) also finds conflicting results for three SSA countries where the demand-following hypothesis was supported in Kenya and South Africa while in Tanzania the supply-leading response was supported. In contrast, using four different proxies of financial development, Wolde-Rufael (2009) found a bi-directional causality running between economic growth and financial development in the case of Kenya. In the case of Ghana, Quartey and Prah (2008) found no convincing evidence that financial development promotes economic growth. The results of studies that used panel econometric methods are also conflicting. For instance, using panel data for 17 African countries, Fowowe (2011) found a homogenous bi-directional causality between financial development and economic growth. In contrast, Demetriades and James (2011) using 18 SSA countries for 1975–2006 found that while bank liabilities in Sub-Saharan Africa are found to follow (but not lead) economic growth, the link between bank credit and growth is altogether absent. Ahmed and Wahid (2010) using data from 15 SSA countries found a long-run equilibrium relationship between financial development and economic growth, where financial development can act as an 'engine of growth' and plays a crucial role in the process of economic development.

3.2. Trade openness and financial development

Research that looks into the link between international trade and financial development is now emerging (see Baltagi et al., 2009; Kim et al., 2010a, 2010b). The theoretical literature as explained by Rajan and Zingales (2003) argues that vested interest groups who feel threatened by the opening up of the financial system have a strong incentive to resist entry into and also resist the development of the financial system (see Baltagi et al., 2009; Law, 2008). According to Rajan and Zingales (2003) when a country opens its borders to trade and capital flows, it is more likely to benefit from this dual openness because both can promote competition and threaten the vested interests of the incumbents. Using a cross-country and dynamic panel data technique, Law and Demetriades (2006) find support for the Rajan and Zingales (2003) hypothesis that financial development is enhanced when a country's borders are simultaneously open to both capital flows and trade. In a similar vein, Beck (2002) found that countries with a better-developed financial system have a higher export share and trade balance in manufactured goods. Svaleryd and Vlachos (2002) also showed that there was an economically significant relationship between trade policy and financial markets with causation running in both directions. For relatively low-income or high income countries, Kim et al. (2010a) show that there was a positive long-run relationship between trade openness and financial development with a negative short-run relationship. Kim et al. (2010b) also found long-run complementarity between financial development and trade openness with short-run substitution between the two variables for non-OECD countries.

The empirical evidence that looks into the link between international trade and financial development for SSA is rather very limited. In a study based on Kenya, Wolde-Rufael (2009), finds some evidence to support the hypothesis that financial development causes both imports and exports growth but the opposite causality running from trade to financial development was weak. On the other hand, Gries et al. (2009) were not able to identify any prominent relationship between trade openness and financial development or vice-versa for 16 SSA countries.

The conclusion that emerges from the above literature is that even though there is some evidence that financial development may be important for economic growth, neither the cross-section nor the time series evidence is unequivocal in its findings that financial development leads to economic growth. This is also true for the relationship between financial development and trade openness.

4. Data

The annual data for the period 1965–2008 used in this paper comes from the World Bank, World Development Indicators on line (2010). Economic growth (RY) is proxied by real GDP per capita. Trade openness (TO) is measured as [(export + import)/GDP × 100%]. Some of the features of the data for the latter part of the sample period are presented in Table 2. As can be seen from Table 2, there is a wide disparity in the indicators for financial development among African countries. For instance, the level of liquid reserves which indicates that banks hold a large portion of liquid assets in the form of treasury bills rather than giving out loans to the private sector varies from 2.8% in South Africa to 76.7% in the Congo Republic. Similarly, domestic credit to the private sector varies from 2.9% in the Congo Republic to 184.6% in South Africa. There is also a widespread variation in financial deepening with M2 accounting for only 7.6% in Chad to 56.4% in South Africa. Interest rate spread also shows a wide variation ranging from 4.6% in South Africa to 22.2% in Malawi. Bank concentration measured by the assets of the

Table 2
Financial depth and efficiency for the latter part of the sample period.
Source: World Bank World Development Indicators, 2008 and Beck et al. (2008).

	Bank liquid reserves to bank assets ratio		Domestic credit provided by banking sector (% of GDP)		Domestic credit to private sector (% of GDP)		Interest rate spread (lending rate minus deposit rate)		Liquid liabilities (M3) as % of GDP		Money and quasi money (M2) as % of GDP		Quasi-liquid liabilities (% of GDP)		Bank concentration	
	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005
Benin	13.5	15.7	5.4	16.2	6.6	17.3	N.A.	N.A.	23.2	20.4	24.9	25.1	8.6	8.2	1.00	0.90
Burkina Faso	7.7	7.6	16.0	35.1	17.6	20.8	N.A.	N.A.	19.8	27.9	21.0	20.9	5.8	7.5	1.00	0.55
Burundi	3.0	12.3	16.0	35.1	17.6	20.8	N.A.	N.A.	19.8	27.9	20.9	25.9	4.3	7.6	N.A.	N.A.
Cameroon	5.6	28.7	19.2	12.4	9.0	9.4	10.5	12.8	15.7	17.0	16.2	16.7	8.0	7.7	1.00	0.57
CAR[a]	5.4	12.3	11.3	17.5	4.1	6.7	10.5	12.8	21.5	17.8	21.0	16.5	1.6	2.0	N.A.	N.A.
Chad	21.0	18.1	9.9	7.5	3.9	3.1	10.5	12.8	12.9	8.6	10.8	7.6	1.1	0.6	N.A.	N.A.
Congo, Rep.	5.1	76.7	17.3	1.5	8.1	2.9	10.5	12.8	15.1	17.1	15.1	14.8	2.3	2.3	1.00	0.68
Cote d'Ivoire	3.8	9.0	28.0	18.2	18.5	13.8	N.A.	N.A.	26.0	24.1	24.0	23.3	8.8	7.9	1.00	0.77
Egypt	15.5	21.8	81.8	105.5	37.0	52.4	5.6	5.9	82.9	106.9	76.2	92.4	59.4	72.4	0.59	0.62
Gabon	6.7	20.0	18.3	10.4	7.9	8.9	10.5	12.8	14.5	19.8	13.8	17.6	5.7	7.3	1.00	0.99
Gambia	18.8	20.7	7.7	23.7	10.0	13.0	12.5	17.6	25.1	46.6	23.5	43.9	12.2	21.4	18.8	1.00
Kenya	N.A.	9.9	52.7	38.4	34.5	25.9	15.2	7.8	50.9	40.3	42.2	38.9	36.6	20.9	58.1	43.6
Madagascar	17.2	20.1	18.6	12.9	11.6	9.9	19.0	8.3	21.5	20.1	18.1	19.9	5.8	6.1	1.00	0.89
Malawi	47.7	22.5	14.6	22.1	6.5	10.5	10.1	22.2	21.2	27.8	15.9	20.5	9.1	9.2	0.95	0.97
Niger	11.1	15.6	8.7	10.7	4.5	6.8	N.A.	N.A.	14.3	13.8	14.0	13.4	3.6	3.1	0.97	0.81
Nigeria	19.9	16.7	24.0	9.0	10.2	14.9	6.7	7.4	16.1	20.3	14.8	18.8	5.6	8.4	0.65	0.44
Senegal	6.3	13.6	24.1	23.1	16.0	23.8	N.A.	N.A.	22.4	35.7	21.7	34.3	8.3	13.5	0.92	0.64
Sierra Leone	9.2	10.9	64.8	24.9	2.7	4.5	21.8	13.5	10.1	20.6	9.3	18.1	2.5	8.5	N.A.	N.A.
South Africa	2.9	2.8	139.6	184.6	119.3	143.5	4.4	4.6	50.0	45.5	46.6	56.4	29.6	39.1	0.94	0.92
Sudan	25.4	17.7	11.1	12.7	3.1	10.0	N.A.	N.A.	16.5	20.5	13.1	17.4	6.8	8.4	0.75	0.85
Togo	6.4	8.1	26.0	17.2	20.1	16.8	N.A.	N.A.	30.6	27.0	27.8	26.7	10.5	10.9	N.A.	0.84
Zambia	NA	NA	52.3	55.3	33.8	15.8	8.8	144.6	45.1	48.9	26.8	45.4	26.8	14.1	80.6	57.2

N.A. = not available.
[a] CAR = Central African Republic.

three largest banks as a share of the assets of all commercial banks, shows a wide disparity where in Nigeria it accounts for 40% while in Malawi, Gabon and Gambia the assets of the three largest banks accounted for all (100%) of the assets of all commercial banks.

Since financial development is a multi-dimensional concept, there is not a single variable that can capture the extent of financial development. This multidimensionality, however, leads to close interrelations between the financial development indicators and results in higher correlations among them to the extent that using several indicators can provide some redundancy of information. In particular, the close interrelations are likely to cause a multicollinearity problem which can lead to misleading inferences. To overcome these problems, we use a comprehensive index of financial development based on principal component analysis (see inter alia, Gries et al., 2009). The financial development index (FD) is constructed from the commonly used four financial development indicators in the literature: (1) log of M2 to GDP, (2) log of liquid liabilities to GDP (M3 to GDP), (3) log of total domestic credit provided by the banking sector to GDP and (4) log of domestic credit to the private sector to GDP. The financial sector is mainly dominated by the banking sector in the African region and therefore these indicators are expected to adequately capture the developments in the financial sector of African countries.

5. Methodology

In order to determine the direction of causality between the variables of interest, we use the panel data framework due to the well-known fact that panel data methods increase the power of the tests. In examining causal linkages within the panel framework, two key issues have to be addressed. The first issue is to control for cross-sectional dependence across the members of panel, because a shock affecting one country may also affect other countries through the high degree of globalization as well as of international trade and financial integration. The Monte Carlo experiment carried out by Pesaran (2006) shows the importance of testing for cross-sectional dependence in a panel data study and also illustrates the substantial bias and size distortions when cross-sectional dependence is ignored in the estimates (Pesaran, 2006).

The second issue is to consider whether the data can be pooled across countries and whether panel estimates account for country specific heterogeneity (Luintel and Khan, 2004; Pesaran and Yamagata, 2008). First of all, the assumption that the slope coefficients are homogeneous is unlikely to hold because countries differ in their stages of development (Luintel and Khan, 2009). Furthermore, in a panel causality analysis, imposing the joint restriction for the whole panel is the strong null hypothesis (Granger, 2003) and assumes that homogeneity may mask the country specific characteristics (Breitung, 2005).

As the above discussion shows, testing for cross-sectional dependence and slope homogeneity in a panel causality analysis is a crucial step in selecting the appropriate causality testing method. For this reason, we start by investigating whether or not there is cross-sectional dependence and heterogeneity across the countries under study. We therefore outline the preliminary tests for cross-section dependence and slope homogeneity tests, before providing the details of the panel Granger causality test.

5.1. Preliminary analysis: Cross-section dependency and homogeneity

To test for cross-sectional dependency, one of the well-known tests is the Lagrange multiplier (LM hereafter) test developed by Breusch and

Table 3
Cross-section dependence and homogeneity tests.

Test	Statistic	p-Value
LM	953.235***	0.0000
CD_{LM}	36.266***	0.0000
CD	7.796***	0.0000
LM_{adj}	38.799***	0.0000
$\tilde{\Delta}$	31.894***	0.0000
$\tilde{\Delta}_{adj}$	33.413***	0.0000

The data for these tests cover the whole sample period, 1965–2008.
*** Denotes statistical significance at 1%.

Table 4
Panel causality between financial development and economic growth.

	FD does not cause *RY*				*RY* does not cause *FD*			
	Statistic	Critical values			Statistic	Critical values		
		10%	5%	1%		10%	5%	1%
Benin	7.879***	6.519	9.142	16.773	0.882	10.596	14.954	26.101
Burkina Faso	1.650	6.035	8.808	15.423	0.057	13.298	18.561	31.657
Burundi	0.001	8.240	12.137	22.641	0.072	11.862	16.969	29.580
Cameroon	6.432	7.943	11.641	20.863	0.002	11.435	16.453	28.754
CAR[a]	3.847	7.392	10.874	20.346	8.805	12.775	17.730	30.285
Chad	6.892	8.276	12.074	21.668	3.193	9.844	14.334	27.364
Congo	2.820	6.998	10.065	18.228	0.003	11.302	16.187	27.429
Cote d'Ivoire	0.003	6.552	9.587	16.548	5.519	12.500	17.892	32.702
Gabon	4.160	7.889	11.546	22.770	1.847	8.309	11.864	21.594
Gambia	0.233	8.726	12.628	23.085	2.474	9.398	13.410	22.557
Kenya	0.016	7.983	11.795	21.751	0.259	9.113	13.187	24.367
Madagascar	1.282	6.473	9.483	17.688	6.508	13.898	18.923	32.692
Malawi	2.552	7.791	11.465	21.378	4.738	8.732	12.651	23.930
Niger	0.805	7.368	10.789	19.674	2.007	14.380	19.547	31.614
Nigeria	0.002	9.127	13.452	24.532	30.251***	8.780	12.973	23.934
Senegal	0.008	9.012	12.974	22.780	0.694	11.566	16.153	29.358
Sierra Leone	16.787**	8.025	11.688	20.840	0.015	8.619	12.569	22.825
South Africa	23.085***	7.459	10.672	19.403	0.038	10.088	14.441	25.447
Sudan	0.283	5.996	8.589	15.382	0.643	12.725	18.235	31.626
Togo	1.199	7.158	10.494	18.278	0.346	11.900	16.940	29.521
Zambia	15.795**	8.373	11.886	22.580	24.895***	9.981	14.268	25.010

Notes:
The data used in the results reported in the table above covers the full sample period from 1965 to 2008.
** and *** denote statistical significance at 5 and 1%, respectively. Critical values are based on 10,000 bootstrap replications.
[a] Central African Republic.

Pagan (1980). The procedure to compute the LM test requires the estimation of the following panel data model:

$$y_{it} = \alpha_i + \beta_i' x_{it} + \varepsilon_{it} \quad \text{for } i=1,2,\ldots,N;\ t=1,2,\ldots,T \tag{1}$$

where i is the cross section dimension, t is the time dimension, x_{it} is $k \times 1$ vector of explanatory variables, α_i and β_i are respectively the individual intercepts and slope coefficients that are allowed to vary across states.[5] The null hypothesis of no cross-sectional dependence–H_0:$Cov(\varepsilon_{it},\varepsilon_{jt}) = 0$ for all t and $i \neq j$–is tested against the alternative hypothesis of cross-section dependence–H_1:$Cov(\varepsilon_{it},\varepsilon_{jt}) \neq 0$–for at least one pair of $i \neq j$. The LM test is calculated by:

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^2 \sim \chi^2_{N(N-1)/2} \tag{2}$$

where $\hat{\rho}_{ij}$ is the sample estimate of the pair-wise correlation of the residuals from individual ordinary least squares (OLS) estimation of the Eq. (1) for each i. The LM test is valid for panels in which N is relatively small and T is sufficiently large. For large panels where $T \to \infty$ first and then $N \to \infty$, Pesaran (2004) proposed the scaled version of the LM test as follows:

$$CD_{lm} = \left(\frac{1}{N(N-1)}\right)^{1/2}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\left(T\hat{\rho}_{ij}^2 - 1\right) \sim N(0,1). \tag{3}$$

The CD_{lm} test is subject to substantial size distortions when N is large and T is small. Pesaran (2004) developed a more general cross-sectional dependency tests that is valid for panels where $T \to \infty$ and $N \to \infty$ in any order. The new test is calculated as follows:

$$CD = \sqrt{\left(\frac{2T}{N(N-1)}\right)}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \sim N(0,1). \tag{4}$$

Pesaran (2004) shows that the CD test has a mean of zero for fixed T and N and is robust to heterogeneous dynamic models including multiple breaks in slope coefficients and/or error variances, so as long as the unconditional means of the dependent and independent variables are time-invariant and their innovations have symmetric distributions. However, the CD test will lack power in certain situations where the population average pair-wise correlations are zero, but the underlying individual population pair-wise correlations are non-zero (Pesaran et al., 2008, p. 106). For large panels when first $T \to \infty$ and then $N \to \infty$, Pesaran et al. (2008) propose a bias-adjusted test which is a modified version of the LM test by using the exact mean and variance of the LM statistic. The bias-adjusted LM test is:

$$LM_{adj} = \sqrt{\left(\frac{2}{N(N-1)}\right)}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\sqrt{\nu_{Tij}^2}} \sim N(0,1) \tag{5}$$

where k is the number of regressors, μ_{Tij} and ν^2_{Tij} are respectively the exact mean and variance of $(T-k)\rho_{ij}^2$, that are provided in Pesaran et al. (2008, p. 108).

With respect to testing for slope homogeneity, Pesaran and Yamagata (2008) proposed the so-called delta $\left(\tilde{\Delta}\right)$ test for testing slope homogeneity–H_0:$\beta_i = \beta$ for all i–against the alternative hypothesis of slope heterogeneity-H_1:$\beta_i \neq \beta_j$ for a non-zero fraction of pair-wise slopes for $i \neq j$-. The $\tilde{\Delta}$ test is valid as $(N,T) \to \infty$ without any restrictions on the relative expansion rates of N and T when the

[5] In our case, we estimate the panel regression model by using real income as dependent variable and financial development and trade openness as the explanatory variables.

Table 5
Panel causality between financial development and trade openness.

	FD does not cause *TO*				*TO* does not cause *FD*			
	Statistic	Critical values			Statistic	Critical values		
		10%	5%	1%		10%	5%	1%
Benin	3.623	10.931	15.154	26.908	0.540	10.261	14.224	24.169
Burkina Faso	9.837	13.045	18.153	31.512	0.012	12.994	18.103	32.051
Burundi	56.488***	13.345	19.031	33.588	7.398	15.396	21.044	33.330
Cameroon	4.415	11.471	16.177	27.507	1.539	10.218	15.253	26.583
CAR[a]	0.130	9.000	13.124	23.602	0.960	9.127	13.369	24.148
Chad	0.000	10.763	15.324	26.818	1.480	10.390	14.897	26.027
Congo	0.437	10.417	14.405	25.043	2.760	10.064	14.341	26.806
Cote d'Ivoire	0.255	10.097	14.192	25.452	2.247	10.586	15.115	28.379
Gabon	0.207	8.555	12.627	22.991	8.213*	7.970	11.753	22.507
Gambia	0.000	10.902	15.797	27.063	3.664	9.931	14.169	25.403
Kenya	0.063	8.187	11.702	20.815	0.257	9.641	14.392	29.489
Madagascar	0.303	8.151	11.985	20.774	0.000	7.852	11.901	22.151
Malawi	42.426***	8.496	12.713	22.100	0.310	8.808	13.076	23.380
Niger	17.626*	12.934	18.189	31.041	0.563	12.181	16.848	29.528
Nigeria	4.928	11.373	16.199	28.865	0.176	8.964	12.605	22.607
Senegal	10.036*	9.415	13.589	24.887	1.040	10.147	14.672	26.239
Sierra Leone	3.956	9.343	13.611	25.745	0.546	8.401	12.126	22.545
South Africa	0.026	8.545	12.074	23.095	1.492	13.445	18.596	32.383
Sudan	35.585***	12.288	17.593	31.445	4.776	11.436	16.718	30.186
Togo	2.763	10.025	14.367	25.460	0.036	10.541	15.102	27.721
Zambia	0.998	8.019	11.649	23.019	0.286	9.865	14.190	25.086

Notes:
The data used in the results reported in the table above covers the full sample period from 1965 to 2008.
* and *** denote statistical significance at 10 and 1%, respectively. Critical values are based on 10,000 bootstrap replications.
[a] Central African Republic.

error terms are normally distributed. In the $\widetilde{\Delta}$ test approach, the first step is to compute the following modified version of Swamy, 1970 test:

$$\widetilde{S} = \sum_{i=1}^{N} \left(\widehat{\beta}_i - \widetilde{\beta}_{WFE}\right)' \frac{x_i' M_\tau x_i}{\widetilde{\sigma}_i^2} \left(\widehat{\beta}_i - \widetilde{\beta}_{WFE}\right) \tag{6}$$

where β_i is the pooled OLS and $\widetilde{\beta}_{WFE}$ is the weighted fixed effect pooled estimation of the Eq. (1), M_τ is an identity matrix of order T, the $\widetilde{\sigma}_i^2$ is the estimator of σ_i^2.[6] The standardized dispersion statistic is then defined as:

$$\widetilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\widetilde{S} - k}{\sqrt{2k}}\right). \tag{7}$$

Under the null hypothesis with the condition of (N,T) → ∞ so long as $\sqrt{N}/T \to \infty$ and the error terms are normally distributed, the $\widetilde{\Delta}$ test has asymptotic standard normal distribution. The small sample properties of the $\widetilde{\Delta}$ test can be improved under normally distributed errors by using the following bias adjusted version:

$$\widetilde{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\widetilde{S} - E(\widetilde{z}_{it})}{\sqrt{\mathrm{var}(\widetilde{z}_{it})}}\right) \tag{8}$$

where the mean $E(\widetilde{z}_{it}) = k$ and the variance $\mathrm{var}(\widetilde{z}_{it}) = 2k(T-k-1)/T+1$.

The results reported in Table 3 indicate that the null hypothesis of no cross-sectional dependence is rejected at 1% level of significance. This finding implies that a shock that occurs in one African country may be transmitted to other countries. Table 3 also shows that the results from the slope homogeneity tests reject the null hypothesis of slope homogeneity which therefore supports country specific heterogeneity.

5.2. Panel Granger causality test

After determining the existence of both cross-sectional dependence and country-specific heterogeneity, we use the bootstrap panel causality method proposed by Kónya (2006) which accounts for both cross-sectional dependence and slope heterogeneity.[7] This method is based on seemingly unrelated regression (SUR) estimates of a set of equations and therefore provides the Wald tests for each country in the panel. This approach is also robust to the unit root and cointegration properties of the variables where the testing procedure does not require any pre-testing for unit root and cointegration and the variables are therefore used in their levels (Kónya, 2006, p. 981). This is important because using the levels of the variables directly in empirical analysis may play a crucial role in determining causal linkages since differencing variables to make them stationary may lead to a loss in the trend dynamics of the series (Clarke and Mirza, 2006). To ensure that the empirical distribution of the critical values of the Wald statistics for causality is robust irrespective of the unit root and cointegration properties of the variables, Kónya (2006) proposed the use of bootstrapped empirical sampling distribution to generate the country-specific critical values. In what follows, we outline the bootstrap panel causality method.

The first step of the bootstrap panel causality approach requires estimating the equation system specified below:

$$\begin{aligned}
RY_{1t} &= \alpha_{11} + \sum_{l=1}^{p_1}\beta_{11l}RY_{1t-l} + \sum_{l=1}^{p_1}\delta_{11l}FD_{1t-l} + \sum_{l=1}^{p_1}\varphi_{11l}TO_{1t-l} + \varepsilon_{11t} \\
&\vdots \\
RY_{Nt} &= \alpha_{1N} + \sum_{l=1}^{p_1}\beta_{1Nl}RY_{Nt-l} + \sum_{l=1}^{p_1}\delta_{1Nl}FD_{Nt-l} + \sum_{l=1}^{p_1}\varphi_{1Nl}TO_{Nt-l} + \varepsilon_{1Nt} \\
FD_{1t} &= \alpha_{21} + \sum_{l=1}^{p_2}\beta_{21l}RY_{1t-l} + \sum_{l=1}^{p_2}\delta_{21l}FD_{1t-l} + \sum_{l=1}^{p_2}\varphi_{21l}TO_{1t-l} + \varepsilon_{21t} \\
&\vdots
\end{aligned} \tag{9}$$

[6] In order to save space, we refer readers to Pesaran and Yamagata (2008) for the details of Swamy's test and the estimators described in Eq. (7).

[7] We refer an interested reader to Kar et al. (2011) for a discussion of panel causality methods.

Table 6
Panel causality between trade openness and economic growth.

	TO does not cause *RY*				*RY* does not cause *TO*			
	Statistic	Critical values			Statistic	Critical values		
		10%	5%	1%		10%	5%	1%
Benin	13.341*	9.348	13.768	24.999	4.827	11.070	16.071	27.902
Burkina Faso	0.184	7.470	10.945	20.237	2.449	14.314	19.727	33.947
Burundi	1.345	7.736	11.438	21.580	3.725	10.994	15.995	27.514
Cameroon	0.511	8.059	11.456	21.228	5.738	11.347	15.911	28.470
CAR[a]	2.186	8.224	11.911	21.514	0.024	8.949	12.960	23.208
Chad	3.226	9.548	13.933	25.098	0.067	10.766	15.215	27.097
Congo	1.568	8.044	11.911	22.914	0.096	9.974	14.625	25.508
Cote d'Ivoire	1.713	7.044	10.119	19.322	2.370	9.856	13.832	25.156
Gabon	11.728**	7.635	11.076	20.771	11.145*	8.512	12.328	21.711
Gambia	4.833	7.983	11.539	19.969	1.867	8.753	12.888	22.777
Kenya	0.001	9.238	14.854	38.365	47.522***	6.750	9.778	17.905
Madagascar	0.233	8.728	13.634	30.113	7.611*	7.341	10.514	19.294
Malawi	2.177	7.877	11.541	20.867	4.401	8.838	12.844	21.975
Niger	0.088	8.420	11.953	22.858	0.033	14.624	20.210	32.871
Nigeria	0.000	6.883	10.123	18.410	1.744	10.302	15.041	27.387
Senegal	0.245	8.380	12.410	23.100	0.001	9.444	13.586	25.000
Sierra Leone	38.258***	7.145	10.402	18.998	0.061	10.720	15.487	28.705
South Africa	16.167**	8.343	12.072	21.844	0.653	9.429	13.365	24.821
Sudan	2.242	6.005	8.844	16.119	1.079	12.206	17.218	29.644
Togo	2.779	7.487	10.745	19.456	1.245	11.384	15.996	28.341
Zambia	0.899	6.449	9.403	16.868	1.054	8.632	12.832	23.185

Notes:
The data used in the results reported in the table above covers the full sample period from 1965 to 2008.
*, ** and *** denote statistical significance at 10, 5 and 1%, respectively. Critical values are based on 10,000 bootstrap replications.
[a] Central African Republic.

$$FD_{Nt} = \alpha_{2N} + \sum_{l=1}^{p_2}\beta_{2Nl}RY_{Nt-l} + \sum_{l=1}^{p_2}\delta_{2Nl}FD_{Nt-l} + \sum_{l=1}^{p_2}\varphi_{2Nl}TO_{Nt-l} + \varepsilon_{2Nt}$$
$$TO_{1t} = \alpha_{31} + \sum_{l=1}^{p_3}\beta_{31l}RY_{1t-l} + \sum_{l=1}^{p_3}\delta_{31l}FD_{1t-l} + \sum_{l=1}^{p_3}\varphi_{31l}TO_{1t-l} + \varepsilon_{31t} \quad (10)$$
$$\vdots$$

$$TO_{Nt} = \alpha_{3N} + \sum_{l=1}^{p_3}\beta_{3Nl}RY_{Nt-l} + \sum_{l=1}^{p_3}\delta_{3Nl}FD_{Nt-l} + \sum_{l=1}^{p_3}\varphi_{3Nl}TO_{Nt-l} + \varepsilon_{3Nt} \quad (11)$$

where *RY* is the GDP per capita, *FD* is the financial development index obtained through principal component analysis, *TO* is the trade openness, *N* is the number of countries of panel ($i = 1,\ldots,N$), *t* is the time period ($t = 1,\ldots,T$), and l is the lag length. In this system, each equation has the different predetermined variables[8] while the error terms might be cross-sectionally dependent (Kónya, 2006: p 981). It is important to note here that trade openness is treated as an auxiliary variable in examining causal linkages between financial development and economic growth; financial development is used as an auxiliary variable in testing for causal linkages between trade openness and economic growth, and finally economic growth is considered as the auxiliary variable in detecting the nature of causality between trade openness and financial development.

In testing for Granger causality, alternative causal relations for a country are likely to be found. For example, there is one-way Granger causality from *FD* to *RY* if not all $\delta_{1,i}$ are zero, but all $\beta_{2,i}$ are zero; there is one-way Granger causality from *RY* to *FD* if all $\delta_{1,i}$ are zero, but not all $\beta_{2,i}$ are zero; there is two-way Granger causality between *FD* and *RY* if neither $\delta_{1,i}$ nor $\beta_{2,i}$ is zero; there is no Granger causality between *FD* and *RY* if all $\delta_{1,i}$ and $\beta_{2,i}$ are zero. This description can easily be extended to causal relations between economic growth and trade openness, and between financial development and trade openness. To determine the direction causality, Wald statistics for Granger causality are compared with the country specific critical values that are obtained from the bootstrap sampling procedure.[9]

6. Empirical results

As emphasized in Kónya (2006), the selection of the estimator for Eqs. (9)–(11) and the generation of the bootstrap critical values depend on whether there is cross-section dependency across countries. If there is no cross-section dependence, the equations are estimated for each country by the OLS estimator. In the presence of cross-sectional dependence, the appropriate approach is the use of the feasible generalized least squares (FGLS) estimator. As shown in Table 3, we find that there is strong evidence for the existence of cross-sectional dependence, and therefore we use the seemingly unrelated regression (SUR) estimator which is a FGLS estimator developed by (Zellner, 1962) for testing causality and generating the bootstrap critical values.

In testing for panel causality we then determine the optimal lag structure in Eqs. (9)–(11). Too few lags mean that some important variables are omitted from the model and such a specification error will usually cause bias in the retained regression coefficients, leading to incorrect conclusions. On the other hand, too many lags waste observations and this specification error will usually increase the standard errors of the estimated coefficients, making the results less precise. For large panels, varying the lag structure for both equations and variables would lead to a substantial computational burden. We make the maximal lags to differ across variables, but to be the same across equations. The system is estimated by using 1 to 4 lags and then choosing the combinations which minimize the Schwarz Bayesian Criterion.[10]

Table 4 presents the results for panel causality analysis between financial development and economic growth. The table shows that

[8] In our specification in Eqs. (9)–(11), each equation belongs to a different country and hence is estimated with a different sample. In other words, the variables are the same in every equation but the observations are different. Therefore, each equation has a different predetermined variable and the only possible link among individual regressions is the cross-section dependence (contemporaneous correlations among the error terms). Hence these sets of equations described in the Eqs. (9)–(11) are not the VAR but the SUR systems (Kónya, 2006:981).

[9] For details of the bootstrap sampling procedure see Kónya (2006).

[10] For the sake of brevity, results from the lag selection procedure are not reported here but are available upon request.

Table 7
Panel causality between financial development, trade openness and economic growth.

	FD and *TO* do not cause *RY*			
	Statistic	Critical values		
		10%	5%	1%
Benin	12.721*	9.347	13.863	25.957
Burkina Faso	0.557	7.517	11.088	22.257
Burundi	1.934	7.728	11.205	20.306
Cameroon	1.104	7.975	11.455	20.312
CAR[a]	3.695	7.991	11.718	22.629
Chad	1.851	9.685	14.126	25.510
Congo	1.828	8.063	11.638	22.031
Cote d'Ivoire	1.669	7.139	10.101	17.952
Gabon	12.819**	7.712	11.087	20.227
Gambia	4.029	8.174	11.696	20.985
Kenya	0.159	9.187	14.802	41.364
Madagascar	0.155	9.110	14.073	29.952
Malawi	2.476	7.605	11.181	20.528
Niger	0.361	8.204	12.250	23.732
Nigeria	0.379	7.316	10.458	19.133
Senegal	0.306	8.246	11.915	21.945
Sierra Leone	39.161***	7.108	10.474	19.934
South Africa	13.185**	8.343	12.031	22.158
Sudan	2.503	6.250	9.023	15.986
Togo	3.313	7.270	10.400	19.324
Zambia	3.573	6.336	9.037	15.482

Notes:
The data used in the results reported in the table above covers the full sample period from 1965 to 2008.
*, ** and *** denote statistical significance at 10, 5 and 1%, respectively. Critical values are based on 10,000 bootstrap replications.
[a] Central African Republic.

there was a unidirectional causality running from financial development to economic growth in Benin, Sierra Leone and South Africa where the 'supply-leading' hypothesis was supported. Our findings for Sierra Leone and South Africa are consistent with the findings reported by Gries et al. (2009). However, the opposite unidirectional causality running from economic growth to financial development was detected only for Nigeria where the demand-following' hypothesis was supported. This contrasts with the results of Gries et al. (2009) who report significant demand following results for Cameroon and Madagascar included in our sample. In the case of Zambia there was a bi-directional causality running between economic growth and financial development implying support for the "complementarity" hypothesis. For the remaining fifteen countries or for almost three-quarters of the sample, the "neutrality" hypothesis is supported as there was no causality in any direction between financial development and economic growth. This is in sharp contrast to previous studies.

Table 5 reports the results for panel causality between financial development and trade openness. The results indicate a unidirectional causality running from financial development to trade openness in the case of Burundi, Malawi, Niger, Senegal and Sudan. This contrasts sharply with the results of Gries et al. (2009) who found such unidirectional causality for Gabon, Kenya, Nigeria and Sierra Leone which are included in our sample. The opposite causality running from trade openness to financial development was supported only in Gabon. For the remaining sixteen countries, that is for more than three-quarters of the sample, there was no causality running in any direction between financial development and trade openness implying that financial development and trade openness do not have predictive power on each other.

In Table 6, we show the results from panel causality analysis between trade openness and economic growth. For Benin, Sierra Leone and South Africa, there was a unidirectional causality running from trade openness to economic growth, supporting the trade-led growth hypothesis which implies that a high level of trade liberalization is related to income increases. In contrast, in the case of Kenya and Madagascar there was a unidirectional causality running from economic growth to trade openness. It is only in the case of Gabon that we found support for the feedback hypothesis where there was a bi-directional causality running between trade openness and economic growth. In the remaining fifteen countries or for more than three-quarters of the sample there was no causality running in any direction between trade openness and economic growth —evidence consistent with the neutrality hypothesis.

Finally in Table 7, we report the results of tests of whether both financial development and trade openness cause economic growth. To do this, we impose zero restrictions on both financial development and trade openness where economic growth is the dependent variable. The results initially suggest that there is neutrality for most of the countries. In particular, the null hypothesis of non-causality is not rejected for Burkina Faso, Burundi, Cameroon, the CAR, Chad, Congo, Cote d'Ivoire, Gambia, Kenya, Madagascar, Malawi, Niger, Nigeria, Senegal, Sudan, Togo, and Zambia. On closer inspection, we find evidence of causality from financial development and trade openness to economic growth in the case of Benin, Gabon, Sierra Leone, and South Africa.

The evidence presented in this paper seems to indicate that there is hardly any causality in any direction between financial development and economic growth or between financial development and trade openness in the majority of the 21 SSA countries, which supports the neutrality hypothesis. Our findings therefore provide support for studies that argue that economic growth and financial development may evolve independently of each other (Lucas, 1988) which has found empirical support in some countries as reported in Shan (2005) and Shan et al. (2001).

7. Conclusion

This paper examined the causal relationships between financial development, trade openness, and economic growth for 21 SSA countries during the period 1965–2008 within a trivariate bootstrapped panel causality analysis. We developed a financial development index from four financial development indicators using principal component analysis and applied to a panel causality analysis which accounts for cross-country dependency and country-specific heterogeneity. The empirical results indicate that out of the 21 countries studied we find support for the 'demand following' hypothesis in only in one country and for the 'supply leading' hypothesis in three countries. Similarly, we found limited causal relationship between financial development and trade openness. The hypotheses of finance-led growth and trade-led growth seem to be rejected for the overwhelming number of the 21 SSA countries studied during the period 1965–2008. Overall, the evidence seems to indicate that despite the past liberalization efforts in financial development and international trade, there is still very limited support for the hypothesis that financial development leads economic growth in SSA countries.

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