A Re-examination of the Financial Development-Growth Nexus in Presence of Structural Breaks: The African Countries Experience

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Abstract

The aim of this paper is to provide new empirical evidence on the relationship between financial development and economic growth for 32 African countries over the period from 1970 to 2009, using recently developed panel cointegration and causality tests. The countries are divided into two groups: civil law and common law countries. We show that there exists a long-run equilibrium relationship between financial development, economic growth, and auxiliaries' variable in African countries. This result is robust to possible cross-country dependence and still holds when allowing for multiple endogenous structural breaks, which can differ among countries. Furthermore, our study confirms previous results of bidirectional causality between financial development and economic growth. Finally, there is a marked difference in the cointegration relationship when country groups are considered.

***Keywords*: Financial development; economic growth; panel causality; panel cointegration, Africa**
***J.E.L. Classification*: O11 – O16 – O33**

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1. Introduction

The relationship between financial development and economic growth has been extensively studied in the economic literature both theoretically and empirically. Although this question dates back at least to Schumpeter (1911), the seminal contribution of King and Levine (1993b) revived a great interest and gave a boost to increasing academic researches. The question of causal relationship between financial development and economic growth is an important phenomenon for economic policy makers and has clear policy implications for developing countries. It is generally admitted that most of African countries have limited financial market linkages with the world economic. This situation has contributed to weak economic growth, a relatively low saving rate and capital flight from the region (Collier and Gunning, 1999). In the economics literature, the direction of causality between financial development and economic growth is crucial because two opposite streams of research have held different points of view: *the supply-leading* and *demand-following* hypothesis (Patrick, 1966). The *supply-leading* hypothesis argues that the financial development is a necessary pre-condition for economic growth. The idea is that financial institutions and markets boost the supply and financial services, thus leading to improved real economic growth. However, the *demand-following* hypothesis assumes that finance is led by, rather than leads economic growth. In this approach, finance plays a minor role in economic growth and is merely considered a by-product or an outcome of growth. Although many empirical studies have examined the causal relationship between financial development and economic growth, the results are still ambiguous.

On the one hand, cross-section and panel data studies find positive effects of financial development on economic growth even after accounting for other determinant of growth as well as for potential biases induced by simultaneity, omitted variables and unobserved country-specific effect on the finance growth link (see for instance, King and Levine, 1993b; Levine et al., 2000; Beck et al. 2000). On the other hand, studies using times series and bivariate causality tests between financial development indicators and growth variables suffer from omitted variable problems and lead to erroneous causal inferences (e.g. Luintel and Khan, 1999; Arestis et al. 2001; and Khalifa al-Yousif, 2002). Furthermore, times series analyses also have the drawback to occult structural breaks. It is well-know that erroneously omitted breaks do not disappear simply because one uses panel data. Lack of careful investigation of these potential structural breaks may thus lead to misspecification of the long-run properties of a dynamic and inadequate estimation and testing procedures (see for example Teng and Liang, 2007; Esso, 2010). Indeed, the occurrence of certain events such economic crisis, financial deregulations, structural adjustments, energetic crisis could have affected the trend of behaviour of the financial development and economic growth in Africa. Regarding the existing literature, less attention has been paid on how the financial development and economic growth relationship evolves over time in Africa. This paper tries to fill this gap.

The contributions of this paper are fourfold. First, we employ recently developed panel methods to test for unit roots, cointegration and Granger causality. Specifically, we employ Westerlund (2007) panel cointegration tests which do not impose common factor restriction and solve the problems of Pedroni's (1999) residual-based tests being also robust to possible cross-country dependence. We also make use of Westerlund (2006) panel cointegration test allowing for multiple endogenous structural breaks, which can differ among series. However, given that this is an overly restrictive assumption in macroeconomics, we draw our empirical

conclusions using bootstrap-based critical value. This method allows us to solve another problem of Pedroni's (1999) cointegration test that cannot accommodate structural breaks. To the best of our knowledge, such an analysis has not performed to study the relationship between financial development and economic growth in Africa. Adoption of such new panel data methods within macropanel setting is preferred to the usual time series techniques to circumvent the well-know problems associated with the low power of traditional unit root cointegration tests in small sample sizes (as it is the case here with just forty observations).

The second contribution of this study is the use of Dynamic Ordinary Least Square (DOLS) estimator. The DOLS method allows for consistent and efficient estimators of the long-run relationship. It also deals with the endogeneity of regressors and accounts for integration and cointegration properties of data.

The third contribution consists in analyzing causality using Pooled Mean Group (PMG) estimator proposed by Pesaran et al. (1999). The Pooled Mean Group is an intermediate estimator that allows the short-term parameters to differ between groups while imposing the equality of the long-run coefficients between groups.[1]

The fourth contribution is to consider a mix of African countries comprising both civil law and common law countries. Indeed, recent economic research suggests that a variety of legal rules (e.g., those governing both investor protection and legal procedure) can influence the protection of outside investors and hence financial markets. For example, La Porta et al. (1998, 2008) show that English common law countries have generally the strongest legal protections of investors while civil law countries the weakest. We apply here La Porta et al. (1997, 1998)'s framework, by examining whether legal origins can significantly affect the impact of financial development on economic growth in African countries.

The paper is organized as follows. Section 2 briefly surveys the theoretical and empirical results linking financial development and economic growth. Section 3 introduces the empirical methodology whereas Section 4 presents and discusses the empirical results. Section 5 suggests some policy implications and offers some concluding remarks.

2. Financial development and growth in economic literature: an overview

2.1. Theoretical considerations

The relationship between financial development and economic growth has been comprehensively treated in the economic literature. The theoreotical foundation of this relationship dated back to the work of Schumpeter (1911). Later, others economists including McKinnon (1973), Shaw (1973), Kapur (1976), Mathieson (1980) have underlined the importance of the financial system in promoting economic growth. They advocated that financial development is seen as exerting positive effects on economic growth. The view that a liberalized financial system contributes to economic growth has policy implications for less-developed countries. In 1989 the World Bank described a developed financial sector as being a "cornerstone of a growing economy" (p. 1). The recent endogenous growth models have

[1] Pesaran et al. (1999) argue that there are often good reasons to expect the same long-run equilibrium relationships across countries, due to budget or solvency constraints, arbitrage conditions, or common technologies influencing all groups in a similar way. The reasons for assuming that short-run dynamics and error variance should be the same tend to be less compelling.

reinforced the point of view that financial intermediaries can boost economic growth through three main channels.

The first channel through which financial development can affect growth is diversification or risk reduction. For example, Greenwood and Jovanovic (1990) show that financial intermediaries allow better sharing of information and diversification of idiosyncratic risk. They highlight the capacity of financial institutions to acquire and analyze information about the state of technology and to channel investible funds into investment activities that yield the highest return. Similarly, King and Levine (1993b) show that financial institutions can boost the rate of technological innovations by identifying those entrepreneurs with the best chance of successfully identifying new goods and production processes. In a theoretical model, Levine (1991) shows that stock markets emerge to allocate risk. He also explores how the stock markets alter investment incentives in a way that changes steady state growth rate. In this approach stock markets accelerate growth for two reasons. First, they facilitate the trade of firms' ownership without disrupting the productive processes occurring within firms. Second, they allow agents to diversify portfolios. Saint-Paul (1992) also highlights how financial markets can allow individuals to diversify their investment portfolio to insure themselves against negative demand shocks and, at the same time, choose the more productive technology. In a similar development, Bencivenga and Smith (1991) show how financial intermediaries eliminate liquidity risk and enable the economy to reduce the fraction of savings held in the form of unproductive liquid assets. In this way, improve on the composition of savings, which in turn affects the equilibrium growth rate.

The second channel is the intermediation efficiency, i.e. the transformation of savings into investment. Pagano (1993) suggests in a basic endogenous growth model that the development of financial sector through intermediation efficiency may positively affect economic growth, because it can raise the proportion of funneled savings to investment. According to Pagano (1993), financial development may also increase the social marginal productivity of capital, and has favorable influence on the private saving rate. Berthelemy and Varoudakis (1994) extend Pagano's model and show that intermediation efficiency may be an increasing function of labor employed in the financial sector. They suggest that interaction between the real and financial sectors leads to multiple equilibria due to reciprocal externality between both sectors. Then, growth in the real sector causes the financial market to expand, thereby increasing banking competition and efficiency. In return, the development of the banking sector raises the net yield on savings and enhanced capital accumulation and growth.

The third channel is the reduction of informational problems. Another role of financial development in economic growth process is to reduce asymmetric information, moral hazard and credit rationing problems between borrowers and lenders. According to Bencivenga and Smith (1998), when intermediation costs are high due to market imperfections, the financial equilibrium characterized by strong growth cannot be achieved. In the same vein, Zilibotti (1994) shows that for low levels of financial development, the costs of intermediation are high and the economy stays in the poverty trap. Blackburn and Hung (1998) and de la Fuente and Marin (1996) also show that financial intermediaries emerge endogenously to avoid the duplication of monitoring activities and negotiate contracts with innovators which induce optimal effort through a combination of incentives and monitoring.

By contrast, a few economists hold skeptical view on the decisive role played by financial development in the economic growth process. Robinson (1952, p. 52) questions this one-way causality, arguing that "by and large, it seems to be the case that where enterprise leads

finance follows". According to Lucas (1988) economists overstress the role of finance. Chandavarkar (1992, p. 134) argues that "none of the pioneers of development economics… even lists finance as a factor of development". Moreover, the view that financial development fosters economic growth seems inconsistent with recent experience. The rapid growth of many Asian economies in the 1970s and 1980s has been accomplished with domestic financial sectors that could not be regarded as "developed". Furthermore, many OECD countries engage on financial reforms in the 1980s, yet savings, investment and growth in them have not accelerated. In this regard, in 1993 the World Bank modified its policy recommendations regarding the role of finance sector in the process of economic development. It seems to endorse a more regulated approach, noting that "our judgment is that, in some cases, government intervention resulted in higher and more equal growth than otherwise would have occurred" (p. 6).

2.2. Empirical assessments

Since there is no general consensus among economists on the relationship between financial development and economic growth, one way to solve this controversy is to look at the issue empirically. The empirical literature on finance-growth nexus can be summarized as follows. A first stream of literature examines the correlation between financial development and economic growth using cross-section and panel data analysis. For example, King and Levine (1993a) investigate the relationship between four indicators for financial development and long-run growth using a cross-section of about 80 countries for the period 1960-1989. They find that financial development is strongly associated with economic growth. The authors claim that "data are consistent with Schumpeter's view that the services provided by financial intermediaries stimulate long-run growth". In the same vein, Levine and Zervos (1998) examined whether measures of stock market liquidity, size, volatility and international integration are robustly correlated with economic growth. They found a strong, positive link between financial development and economic growth. As their results suggest that financial factors are an integral part of the growth process, they conclude that banking development predicts economic growth. Using a GMM estimator, Levine et al. (2000) confirm that financial intermediary development exert a statistically significant and positive influence on economic growth. The authors therefore conclude to a strong, positive, correlation between financial intermediary development and economic growth.

Contrary to previous findings, De Gregorio and Guidotti (1995) find that the ratio between bank credit to private sector and GDP is negatively correlated with growth from a sample of 12 Latin America countries. They argue that this finding is the result of financial liberalization policy in poor regulatory environment. In the same vein, Ram (1999) shows from a sample of 95 countries that a negative correlation is more likely to happen in the relationship between financial development and economic growth.

However, cross-sectional methodology has many drawbacks. Quah (1993) formally shows the lack of balanced paths across country – which violates the hypothesis of averaging and pooling of cross country data. Evan (1995) also points out the heterogeneity of slope coefficients across countries as a main limit of a cross-section analysis. Finally, Apergis, et al. (2007) show the inability to discuss the integration and cointegration properties of data. These difficulties lead some authors to use time series approach.

Arguing the merits of a time series approach, Shan (2005) proposed a VAR approach to re-examine the relationship between financial development and economic growth. Using

quarterly time-series data from 10 OECD countries and China, he founds weak support for the hypothesis that financial development leads economic growth. Arestis and Demetriades (1997) use time series analysis and Johansen cointegration test for the USA and Germany and report mixed results. While in Germany financial development effects economic growth, in USA real GDP contributes to both banking system and stock market development. Neusser and Kugler (1998) study the finance–growth relationship by using financial sector GDP and manufacturing GDP as proxies for financial development and economic growth, respectively. The findings of their causality tests are consistent with the view that finance plays an important role in economic development. Similar findings are obtained by Demetriades and Luintel (1996), Luintel and Khan (1999), Xu (2000), and Rousseau and Vuthipadadorn (2005).

Previous researches on African countries provide mixed results. The majority of these studies mainly have used the residual-based cointegration test associated with Engel and Granger (1987) and the maximum likelihood test based on Johansen (1988) and Johansen and Juselius (1990). For example, Ghali (1999) investigated empirically the question of whether financial development leads to economic growth in a small country like Tunisia. He shows the existence of a stable long-run relationship between the development of the financial sector and the evolution of per capita real output that is consistent with the view that financial development can be an engine of growth in this country. Ghirmay (2004) provides evidence of the existence of a long-run relationship between financial development and economic growth in 12 out of 13 sub-Sahara African countries. With respect to the direction of long-term causality, the results show that financial development plays a causal role on economic growth, again in eight of the countries. At the same time, evidence of bidirectional causal relationships is found in six countries. Applying cointegration and error-correction model on data for Kenya, South Africa and Tanzania, Odhiambo (2007) shows that, the direction of causality between finance and growth is sensitive to the choice of measures for financial development. In addition, the strength and clarity of the causality evidence is found to vary from country to country and over time. He finds that, on balance, a demand-following response is found to be stronger in Kenya and South Africa, whilst in Tanzania a supply-leading response is found to be dominant. Employing the same approach to study the relationship between financial depth, savings and economic growth in Kenya for the period 1969-2005, Odhiambo (2008) shows unidirectional causal flow from economic growth to financial development. The results also reveal that economic growth Granger causes savings, while savings drive the development of the financial sector in Kenya.

Abu-Bader and Abu-Qarn (2008a) applied Granger technique to assess the causal relationship between financial development and economic growth in Egypt during the period 1960-2001. They found that financial development causes economic growth through both increasing resources for investment and enhancing efficiency. Abu-Bader and Abu-Qarn (2008b) results strongly support the hypothesis that finance leads to growth in 5 out of 6 Middle Eastern and North African countries. Akinlo and Egbetunde (2010) re-examined the long-run and causal relationship between financial development and economic growth for ten countries in sub-Saharan Africa using cointegration and error-correction modeling techniques. They show that financial development Granger causes economic growth in Central African Republic, Congo Republic, Gabon and Nigeria while economic growth Granger causes financial development in Zambia. However, bidirectional relationship between financial development and economic growth was found in Kenya, Chad, South Africa, Sierra Leone and Swaziland. Aka (2010) suggests from a study on 22 African countries that, the causal relationship between financial

development and growth is bidirectional, whereas only financial development causes global factor productivity.

One problem with the previous results for time series is that they cannot accommodate structural breaks. It is now convenient in times-series analysis to check whether models chosen for describing data are subject to structural breaks. The need to take account for structural breaks in financial development and economic growth comes from the possibility of external factors causing violent exogenous shocks. To solve this problem, Teng and Liang (2007) employed the unit root and tests and cointegration allowing for structural breaks to empirically examine the causality between financial development and economic growth for 11 emerging countries. They found that financial developing is positively and significantly related to economic growth in only half of the sample countries. Taking together, the analysis also indicated that the source of the mixed results on the finance-growth nexus may due to the length of data span and the different econometric procedure. Esso (2010) analyzed the cointegration and causal relationship between financial development and economic growth for fourteen ECOWAS countries during the period 1960-2005. Using the Gregory and Hansen (1996a, 1996b) approach to cointegration with structural breaks, he found that there is a long-run relationship between financial development and economic growth in six countries, namely Burkina Faso, Cape Verde, Ivory Coast, Ghana, Liberia, and Sierra Leone. Furthermore, the study showed that financial development lead economic growth in Ghana and Mali while economic growth causes finance in Burkina Faso, Ivory Coast and Sierra Leone, and bidirectional causality in Cape Verde and Liberia.

Unfortunately, most of these studies relied upon limited time series data, usually 30 to 45 observations, which reduces the power and sizes properties of conventional unit root and cointegration tests. Moreover, they did not take into account the endogeneity of regressors in panel methods. Recent empirical studies on the relationship between financial development and growth have used panel causality and cointegration techniques to control for possible shortcomings of previous methodologies. Christopoulos and Tsionas (2004) investigate the long-run relationship between financial development and economic growth for 10 developing countries over the period 1970-2000. Using panel cointegration analysis, they found a unique cointegrating vector between financial development, growth and auxiliary variables. They also establish that the only cointegrating relationship implies unidirectional causality from financial development to growth. But on the one hand, the long-run relationship is estimated using Fully Modified OLS (FMOLS). Furthermore, work by Christopoulos and Tsionas (2004) lacks robustness since they use only one measure of financial development. Using the Geweke decomposition test on pooled data of 109 developing and developed countries from 1960 to 1994, Calderon and Liu (2003) find a bi-directional causality between financial development and economic growth. However, financial development contributes more to the causal relationships in developing countries than in developed countries. Apergis et al. (2007) check whether there exists a long-run relationship between financial development and economic growth. They use panel integration and cointegration techniques of 15 OECD and 50 non OECD countries over the period 1975-2000. Their results support a bi-directional causality between financial development and economic growth. This finding remains robust across various specifications of the sample. In the same vein, using PANIC (panel data analysis to the idiosyncratic and common components) analysis, Dufrénot et al. (2010) reappraise the finance-growth link on a sample of 89 developed and developing countries on the 1980-2006 period. Their empirical investigation suggests that, while financial intermediation variables positively influence growth in the OECD countries, it acts negatively on the economic growth of developing countries. These outcomes can also be explained by

the use of different methodology according to the country groups. Indeed, in consideration of stationary properties of data, the authors use the Pooled Mean Group (PMG) estimator for OECD countries, whilst the GMM method is employed for non OECD countries. More recently, Bangake and Eggoh (2011) found from a sample of 71 countries over the period 1960-2004 that the finance-growth relationship is more robust in high income countries than in low income countries. When considering both long-run and short-run causality, the authors show significant differences among country groups. While in low and middle income countries there is no supportive evidence of short-run causality between financial development and economic growth, in high income countries economic growth significantly affects financial development.

As far as Africa countries are concerned, panel data studies are quite limited. Allen and Ndikumana (2000) used panel data analysis to assess the financial intermediation and economic growth in Southern Africa. They found that financial development is positively correlated with the growth rate of real per capita GDP. Using panel data for 19 countries in sub-Saharan Africa, Fowewe (2008) analysed the effects of financial liberalization policies on the growth. The results show a significant positive relationship between economic growth and financial liberalization policies. Fowowe (2011) re-examined the causal relationship between financial development and economic growth using data for 17 countries in sub-Saharan Africa. The analysis is conducted using Pedroni panel cointegration and causality tests which take account of heterogeneity between countries. The results show that there is homogenous bi-directional causality between financial development and economic growth. The author also found that, there is no long-run relationship between both variables, using Pedroni cointegration test. Unfortunately as mentioned above a limitation of the Pedroni (1999) test is that it cannot accommodate structural breaks that have been a common place in financial development and economic growth relationship. Furthermore, work by Fowowe (2011) used bivariate panel causality tests and its results suffer from huge bias of omitted variables. Using panel GMM methodology, Assane and Malamud (2010) examine relationship between legal origin, currency union, financial development and economic growth in 24 countries in sub-Saharan Africa from 1960 to 2000. Their results suggest that financial development contributes positively to economic growth in British legal origin SSA, while in French legal origin SSA, the currency union constraints tend to hinder financial development in CFA countries beyond the negative impacts of French legal origin. Abdullahi (2010) also suggest a long-run relationship between financial development and growth from a sample of 15 sub-Sahara African countries over the period of 1976-2005. More recently, Abdullahi and Wahid (2011) investigate the dynamic relationship between financial development and economic growth in a panel of a group of 7 African countries over the period of 1986-2007, using FMOLS estimator. They found that market-based financial system is important for explaining output growth through enhancing efficiency and productivity, while higher levels of banking system are positively associated with capital accumulation growth and lead to faster rates of economic growth. Unfortunately, their study is limited to seven African countries and does not analyze the causal relationship between financial development and economic growth.

To sum up, although the literature on the relationship between financial development and economic growth in Africa is quite vast, it provide mixed results and fails to reach a consensus as to the direction of causality. Besides, to our knowledge, none of the existing studies has considered the problem of structural breaks in a panel framework combined with the possible cross-country dependence, which instead we do in the following analysis.

3. Empirical methodology

Our examination of the relationship between economic growth, financial development, investment as ratio to GDP, government consumption, openness to trade and inflation rate is conducted in three steps. First, we test for the order of integration of the variables. Second, we employ panel cointegration tests to examine whether a long-run relationship exists among the variables and we compare the situation that assumes the existence of no breaks with that accounting for the possibility of multiple heterogeneous and endogenous structural breaks. Then, we estimate long-run coefficients using appropriate methodology (Dynamic OLS, DOLS). And third, we use the Pooled Mean Group (PMG) approach of Pesaran, Shin and Smith (1999) to sort out the long-run versus short-run effects of the different countries respective relationship between financial development and economic growth, and we also evaluate the direction of causality among variables.

3.1. Panel unit root tests

Before proceeding to cointegration techniques, we need to determine the order of integration of each variable. One way to do so is to implement the panel unit root due to Im, Pesaran and Shin (hereafter IPS, 2003) and second generation test of panel unit root of Pesaran (2007). These tests are less restrictive and more powerful than the tests developed by Levin and Lin (2002) and Breitung (2000),[2] which do not allow for heterogeneity in the autoregressive coefficient. The tests proposed by IPS permit to solve Levin and Lin's serial correlation problem by assuming heterogeneity between units in a dynamic panel framework. The basic equation for the panel unit root tests for IPS is as follows:

$$\Delta y_{i,t} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p} \phi_{ij} \Delta y_{i,t-j} + \varepsilon_{i,t} \; ; \; i = 1, 2, ..., N; \; t = 1, 2, ..., T, \qquad (1)$$

where $y_{i,t}$ stands for each variable under consideration in our model, α_i is the individual fixed effect and p is selected to make the residuals uncorrelated over time. The null hypothesis is that $\rho_i = 0$ for all i versus the alternative hypothesis is that $\rho_i < 0$ for some $i = 1, ..., N_1$ and $\rho_i = 0$ for $i = N_1 + 1, ..., N$.

The IPS statistic is based on averaging individual Augmented Dickey-Fuller (ADF, hereinafter) statistics and can be written as follows:

$$\bar{t} = \frac{1}{N} \sum_{i=1}^{N} t_{iT}, \qquad (2)$$

where t_{iT} is the ADF *t-statistic* for country *i* based on the country-specific ADF regression, as in Eq (1). The $\bar{t}$ statistic has been shown to be normally distributed under H_0 and the critical values for given values of N and T are provided in Im et al. (2003).

IPS's test has the drawback of assuming that the cross-sections are independent; the same assumption is made in all first generation of panel unit root tests. However, it has been pointed out in the literature that cross-section dependence can arise due to unobserved common factors, externalities, regional and macroeconomic linkages, and unaccounted residual interdependence. Recently, some new panel unit root tests have emerged that address the question of the dependence and correlation given the prevalence of macroeconomic dynamics and linkages. These tests are called the second generation panel unit root tests. A well-known second generation test that is considered in this paper is Pesaran's (2007) Cross-

[2] For a useful survey on panel unit root tests, see Banerjee (1999) and Hurlin and Mignon (2005).

Sectional Augmented IPS (CIPS) test. To formulate a panel unit root test with cross-sectional dependence, Pesaran (2007) considers the following Cross-Sectional Augmented Dickey-Fuller (CADF) regression, estimating the OLS method for the i^{th} cross-section in the panel:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + c_i \bar{y}_{t-1} + \sum_{j=0}^{k} d_{ij} \Delta \bar{y}_{t-j} + \sum_{j=1}^{k} \delta_{ij} \Delta y_{i,t-j} + \varepsilon_{it}, \quad (3)$$

where, $\bar{y}_{t-1} = \left(\frac{1}{N}\right)\sum_{i=1}^{N} y_{i,t-1}$, and $t_i(N,T)$ is the *t*-statistic of the estimate of ρ_i in the above equation used for computing the individual ADF statistics. More importantly, Pesaran proposed the following test CIPS statistic that is based on the average of individual CADF statistics as follows:

$$CIPS = \left(\frac{1}{N}\right)\sum_{i=1}^{N} t_i(N,T). \quad (4)$$

The critical values for CIPS for various deterministic terms are tabulated by Pesaran (2007).

3.2. Panel cointegration tests without structural breaks

Once the order of integration has been defined, we apply Pedroni's cointegration test methodology. Indeed, like the IPS test, the heterogeneous panel cointegration test advanced by Pedroni (1999, 2004) allows for cross-section dependence with different individual effects.

The empirical model of Pedroni's cointegration test is based on the following equation:

$$Y_{it} = \eta_i + \delta_i t + \beta_{1i} F_{it} + \beta_{2i} X_{it} + \varepsilon_{it}, \quad (5)$$

for $i = 1,...,N$; $t = 1,...,T$, where N refers to the number of individual members in the panel and T refers to the number of observations over time. Y_{it} is real GDP per capita, F_{it} is a measure of financial development, and X_{it} a set of control variables. All variables are expressed in natural logarithms η_i and δ_i are country and time fixed effects, respectively. ε_{it} denote the estimated residuals which represent deviations from the long-run relationship. The structure of estimated residuals is as follows:

$$\hat{\varepsilon}_{it} = \hat{\rho}_i \hat{\varepsilon}_{it-1} + \hat{u}_{it}. \quad (6)$$

Pedroni has proposed seven different statistics to test panel data cointegration. Out of these seven statistics, four are based on pooling, what is referred to as the "Within" dimension and the last three are based on the "Between" dimension. Both kinds of tests focus on the null hypothesis of no cointegration. However, the distinction comes from the specification of the alternative hypothesis. For the tests based on "Within", the alternative hypothesis is $\rho_i = \rho < 1$ for all *i*, while concerning the last three test statistics which are based on the "Between" dimension, the alternative hypothesis is $\rho_i < 1$, for all *i*.

The finite sample distribution for the seven statistics has been tabulated by Pedroni via Monte Carlo simulations. The calculated statistic tests must be smaller than the tabulated critical value to reject the null hypothesis of the absence of cointegration.

A limitation of the tests proposed by Pedroni (1999) is that it based on the hypothesis of common factor restriction and that it does not take possible cross-country dependence into account. This hypothesis suggests that the long-run parameters for the variables in their levels are equal to the short-run parameters for the variables in their first differences. A failure to satisfy the restriction can cause a significant loss of power for residual-based cointegration

tests. In this paper, in addition to applying the Pedroni (1999) tests, we also use the panel cointegration tests proposed by Westerlund (2007) to examine the relationship between economic growth, financial development and auxiliary variables in African countries. The Westerlund (2007) tests avoid the problem of common factor restriction and are designed to test the null hypothesis of no cointegration by inferring whether the error-correction term in a conditional error-correction model is equal to zero. Therefore, a rejection of the null hypothesis of no error-correction can be viewed as a rejection of the null hypothesis of no cointegration. The error-correction tests assume the following data-generating process:

$$\Delta Y_{it} = \delta_i^{'} d_t + \alpha_i \left(Y_{it-1} - \beta_i^{'} X_{it-1} \right) + \sum_{j=1}^{p_i} \alpha_{ij} \Delta Y_{it-j} + \sum_{j=0}^{p_i} \gamma_{ij} \Delta X_{it-j} + \varepsilon_{it} \quad (7)$$

where d_t contains the deterministic components, Y_{it} denotes the natural logarithms of the real GDP and X_{it} denotes a set of exogenous variables, including financial development. Equation (7) can be rewritten as:

$$\Delta Y_{it} = \delta_i^{'} d_t + \alpha_i Y_{it-1} + \lambda_i^{'} X_{it-1} + \sum_{j=1}^{p_i} \alpha_{ij} \Delta Y_{it-j} + \sum_{j=0}^{p_i} \gamma_{ij} \Delta X_{it-j} + \varepsilon_{it} \quad (8)$$

where $\lambda_i = -\alpha_i \beta_i^{'}$. The parameter α_i determines the speed at which the system $Y_{it-1} - \beta_i^{'} X_{it-1}$ corrects back to the equilibrium after a sudden shock. If $\alpha_i < 0$, then the model is error-correcting, implying that Y_{it} and X_{it} are cointegrated. If $\alpha_i = 0$, then there is no error correction and, thus no cointegration. The null hypothesis for all countries of the panel is: $H_0 : \alpha_i = 0$ for all $i = 1,...,N$ versus $H_1 : \alpha_i \neq 0$ for $i = 1,...,N_1$ and $\alpha_i = 0$ for $i = N_1 + 1,...,N$. The alternative hypothesis allows α_i differing across the cross-sectional units.

Westerlund (2007) proposed four different statistics to test panel cointegration, based on least squares estimates of α_i and its $t-$ratio. While two of the four tests are panel tests with the alternative hypothesis that the whole panel is cointegrated ($H_1 : \alpha_i = \alpha < 0$ for all i), the other two tests are group-mean tests which test against the alternative hypothesis that for at least one cross-section unit there is evidence of cointegration ($H_1 : \alpha_i < 0$ for at least one i). The panel statistics denoted P_τ and P_α test the null hypothesis of no cointegration against the simultaneous alternative that the panel is cointegrated, whereas the group mean statistics G_τ and G_α test the null hypothesis of no cointegration against the alternative that at least one element in the panel is cointegrated. The test proposed by Westerlund (2007) does not only allow for various forms of heterogeneity, but also provides *p-values* which are robust against cross-sectional dependencies via bootstrapping.

3.3. Panel cointegration tests with structural breaks

A limitation of the previous cointegration tests is that they cannot accommodate structural breaks. However, using a time series approach such structural breaks have been recently found by Esso (2010) in financial development and economic growth relationship for fifteen ECOWAS countries. Consequently, to deal with this issue, we use the panel cointegration test proposed by Westerlund (2006) that allows for multiple structural breaks to examine the relationship between economic growth, financial development and auxiliary variables in African countries.

Consider the following long-run model:

$$Y_{it} = \lambda_{ij} + \beta_{1i} F_{it} + \beta_{2i} X_{it} + \varepsilon_{it}, \quad (9)$$

$$\varepsilon_{it} = r_{it} + \mu_{it}, \quad (10)$$

$$r_{it} = r_{it-1} + \phi_i \mu_{it}. \quad (11)$$

The index $j = 1,...,M_i + 1$ denotes structural breaks. One can allow for at most M_i breaks or $M_i + 1$ regimes that are located at dates $T_{i1},...,T_{iM_i}$, where $T_{i0} = 1$ and $T_{iM_{i+1}} = T$. α_i is the error-correction parameter measuring the speed of adjustment towards the long-run equilibrium. The location of the breaks are specified as a fixed fraction $\lambda_{ij} \in (0,1)$ of T such that $T_{ij} = \left[\lambda_{ij} T\right]$ and $\lambda_{i,j-1} < \lambda_{ij}$ for $j = 1,...,M_i$. To ensure that the break date estimator works properly we set the minimum length of each sample segment equal to 0.15T and follow the advice of Bai and Perron (2003) and use the Schwartz Bayesian Criterion. The maximum number of allowable breaks is set equal to five.

The null hypothesis of cointegration for all countries of the panel is:

$H_0 : \phi_i = 0$ for all $i = 1,...,N$, versus $H_1 : \phi_i \neq 0$ for all $i = 1,...,N_1$ and $\phi_i = 0$ for $i = N_1 + 1,...,N$.

The alternative hypothesis allows ϕ_i differing across the cross-sectional units.

Note that appropriate critical values accommodating possible cross-country dependence are obtained via bootstrap simulations.

3.4. Long-run and short-run parameter estimates of the panel error-correction model

Although Pedroni (1999) and Westerlund (2007) methodologies allow us to test the presence of cointegration among a set of economic variables, they do not provide coefficient estimates either for the long-run or for the short run parameters of a panel error-correction model (PECM). In a panel framework, in presence of cointegration several estimators can be used: OLS, Fully Modified OLS (FMOLS), Dynamic OLS (DOLS) and Pooled Mean Group (PMG). Chen et al., (1999) analyzed the proprieties of the OLS estimator[3] and suggest that alternatives, such as the FMOLS estimator or the DOLS estimators may be more promising in cointegrated panel regressions. However, Kao and Chiang (2000) showed that both the OLS and FMOLS exhibit small sample bias and that the DOLS estimator appears to outperform both estimators.[4] In this paper, we consider two estimators to get the parameter estimates of the PVAR describing the linkage between financial development and economic growth in African countries: DOLS for the long-run parameters and PMG for the short and long-run parameters.

3.4.1. The Dynamic OLS (DOLS) estimator

To obtain an unbiased estimator of the long-run parameters and to achieve the endogeneity correction, DOLS estimator uses parametric adjustment to the errors by including the past and the future values of the differenced I(1) regressors. We obtained the Dynamic OLS estimator from the following equation:

$$Y_{it} = \alpha_i + W_{it}^{'}\beta + \sum_{j=-q}^{j=q} c_{ij} \Delta W_{i,t+j} + v_{it}, \quad (12)$$

where $W = \left[F, X\right]$, c_{ij} is the coefficient of a lead or lag of first differenced explanatory variables. The estimated coefficient of DOLS is given by:

[3] The following proprieties are examined by Chen et al. (1999): the finite sample proprieties of the OLS estimator, the t-statistic, the bias-corrected OLS estimator, and the bias-corrected t-statistic.

[4] See Kao and Chiang (2000) for more discussions on the advantages of these estimators.

$$\hat{\beta}_{DOLS} = \sum_{i=1}^{N}\left(\sum_{t=1}^{T} z_{it} z_{it}'\right)^{-1}\left(\sum_{t=1}^{T} z_{it}\hat{y}_{it}^{+}\right), \quad (13)$$

where $z_{it} = \left[W_{it} - \bar{W}_i, \Delta W_{i,t-q}, ..., \Delta W_{i,t+q}\right]$ is vector of regressors, and $\hat{y}_{it}^{+}$ ($\hat{y}_{it}^{+} = Y_{it} - \bar{Y}_i$) is the transformed variable of Y_{it}.

3.4.2. The Pooled Mean Group (PMG) estimator and the test for causality

Our final step consists in implementing an alternative methodology, the PMG approach of Pesaran et al. (1999), to estimate the short and long-run parameters of the panel error-correction model (PECM), and then to test for causality between economic growth, financial development, investment ratio, government consumption, openness to rate and inflation rate. The PMG is an intermediate estimator between Mean Group (MG) estimator and Dynamic Fixed Effect (DFE) estimator, because it involves both pooling and averaging. One advantage of the PMG over the DOLS model is that it can allow the short-run dynamic specification to differ from country to country while the long-run coefficients are constrained to be the same, a restrictive assumption that we will test in our econometric investigation. Given that the variables are cointegrated, the PMG estimator is used in order to perform Granger-causality tests. First, the long-run model specified in Eq. (5) is estimated in order to obtain the residuals. Next, defining the lagged residuals from Eq. (5) as the error correction term, the following dynamic error correction model is estimated:

$$\Delta Y_{it} = \beta_{1j} + \sum_{k=1}^{p}\beta_{11ik}\Delta Y_{it-k} + \sum_{k=1}^{p}\beta_{12ik}\Delta F_{it-k} + \sum_{k=1}^{p}\beta_{13ik}\Delta X_{it-k} + \lambda_{1i}\varepsilon_{it-1} + \nu_{1it}, \quad (14a)$$

$$\Delta F_{it} = \beta_{2j} + \sum_{k=1}^{p}\beta_{21ik}\Delta F_{it-k} + \sum_{k=1}^{p}\beta_{22ik}\Delta Y_{it-k} + \sum_{k=1}^{p}\beta_{23ik}\Delta X_{it-k} + \lambda_{2i}\varepsilon_{it-1} + \nu_{2it}, \quad (14b)$$

where Y_{it} is real GDP per capita; F_{it} is a measure of financial development and X_{it} is a set of control variables.[5] Δ denotes the first-difference operator and *p* is the optimal lag length determined by the Schwarz Bayesian Criterion.[6] The specification in Eq. (14) allows us to test for both short-run and long-run causality. For example, in the real GDP equation (Eq. 14a), short-run causality from financial development and control variables to real GDP are tested, respectively, based on $H_0 : \beta_{12ik} = 0 \ \forall ik$ and $H_0 : \beta_{13ik} = 0 \ \forall ik$. In the financial development equation Eq. (14b), short-run causality from real GDP and other control variables are tested, respectively, based on $H_0 : \beta_{21ik} = 0 \ \forall ik$ and $H_0 : \beta_{23ik} = 0 \ \forall ik$. More generally, with respect to Eqs. (14a)-(14b), short-run causality is determined by the statistical significance of the partial *F*-statistic associated with the corresponding right hand side variables. The presence (or absence) of long-run causality can be established by examining the significance using a *t-statistic* on the coefficient λ, of the error correction term, ε_{it-1} in Eqs. (14a)-(14b).

[5] All variables are expressed in natural logarithms.

[6] A maximum number of six lags were considered and the optimal number of lags in the VAR system was determined via the Schwarz Bayesian Criterion. In order to avoid some endogeneity problem, the lags of explanatory (other than the lagged of the dependent variable) start at k=1 rather than k=0.

4. Data and empirical results

4.1. Data

Annual data covering the period 1970 to 2009 were obtained from the World Development indicator (WDI, 2011) CD-ROM for 32 Africa countries.[7] The Gross Domestic Product (GDP) per capita (constant 2000 US dollar) is the real sector's indicator. Financial development is measured by three variables in order to capture the variety of channels through which finance can affect growth: The first one is the ratio of broad money or the money and quasi money to GDP (M2/GDP). A higher M2/GDP ratio implies a larger financial sector and therefore greater financial intermediary development. The second indicator is the ratio of liquid liabilities to GDP, which is calculated as currency plus demand and interest-bearing liabilities of financial intermediaries and nonbank financial intermediaries, divided by GDP (M3/GDP). This is the broadest measure of financial depth used, since it includes all types of financial institutions (central bank, deposit money banks, and other financial institutions). The third one (PRIVATE) equals the value of credits by financial intermediaries to the private sector divided by GDP. Following the works by Beck et al. (2000) and Levine et al. (2000), we also use a set of control variables: investment rate is defined by gross fixed capital formation divided by GDP (INVESTMENT), government expenditure as ratio to GDP (GOVERNMENT), the openness to trade as exports and imports divided by GDP (OPENNESS), and finally inflation rate (INFLATION) is the log difference of Consumer Price Index. Table 1 presents data properties toward descriptive statistics of variables under consideration.

Table 1: Descriptive statistics, cross-section: 1970-2009

Variable	N	Mean	Std. Dev.	Minimum	Maximum
Growth	32	0.915	1.323	-1.241	3.260
M2/gdp	32	25.833	14.264	11.772	69.674
M3/gdp	32	29.035	14.264	11.297	79.327
Private	32	20.590	17.711	4.779	95.705
Investment	32	19.029	5.945	10.561	37.913
Government	32	15.011	3.738	9.931	27.5
Openness	32	63.007	29.357	28.335	160.079
Inflation	32	12.815	9.973	3.746	35.158

On the period 1970-2009, the descriptive statistics show that GDP growth is lower in African countries with regard to the world average (nearly 2%). The level of the financial development indicators is also still low compared to the average of OECD countries (>80%). Except the inflation rate which value remains higher with respect to the convergence criteria (for example, according to the convergence criteria of the ECOWAS, the inflation rate must be lower than 3%), the level of the other control variables is lower compared to the average of the OECD countries. The descriptive statistics indicate that most of the indicators are characterized by great variability across country and motivate the interest to have more homogeneous sub-groups. We present on Table A1 (see Appendix) the statistic on more homogenous sub-groups following legal tradition: civil law countries and common law countries. The comparison of descriptive statistics between country groups reveals in spite of

[7] Algeria, Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Ivory Coast, Egypt, Gabon, Gambia, Ghana, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Morocco, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

the slight high value of financial development variables in common law countries, the statistic tests of means equality do not reject the null hypothesis of financial development level equality across countries. This result contrasts with common findings which suggest that common law countries exhibit significantly higher level of financial development compared to civil law countries. Our results also suggest that common law countries have grown faster than civil law countries. Compared to the common law countries, GDP per capita in civil law countries has grown about 0.66 percentage point slower per year. This outcome is consistent with Mahoney (2001), who found that civil law countries have a delay of growth about 0.6%, with respect to common law countries from 1960 to 2000. Moreover, the recent ranking of Slate Afrique on economic growth in Africa reveals that nine of the ten countries which have better growth perspective are common law, whilst seven of the ten worst African economies are civil law. As soon as the control variables are concerned, both country groups have the same level of government expenditure and investment ratio, while openness to trade and inflation rate are higher in common law countries than civil law countries.

4.2. Results of unit roots and cointegration tests

Panel data integration of "first generation" (as IPS, 2003) assume cross-sectional interdependence among panel units (except for common time effects), whereas panel data unit root tests of the "second generation" (as Pesaran, 2007) allows for more general forms of cross-sectional dependency (not only limited to common time effect). Table 2 presents the results of the IPS (2003) and Pesaran's (2007) panel unit root tests. It shows that the null hypothesis of the unit roots for the panel data for the measures of financial development, economic growth and all control variables cannot be rejected in level. However, this hypothesis is rejected when series are in first differences. These results strongly indicate that the variables in level are non-stationary and stationary in first-differences (at the 1% significance level). Results are qualitatively the same for the two groups of countries of our sample: common law countries and civil law countries. Therefore, we conclude that whether cross-sectional dependence is taken (or not) into account, all our series are non-stationary and integrated of order one.

Table 2: Panel unit root tests

	Level		First Difference	
	IPS	CIPS	IPS	CIPS
All countries (32)				
GDP	-1.474	-1.397	-3.491***	-3.257***
M2/GDP	-1.124	-0.954	-3.048***	-3.034***
M3/GDP	-1.208	-0.921	-3.255***	-3.311***
PRIVATE	-1.300	-1.221	-3.312***	-3.328***
INVESTMENT	-1.516	-1.283	-3.921***	-3.902***
GOVERNMENT	-1.304	-1.893	-3.755***	-3.637***
OPENNESS	-1.334	-1.582	-3.996***	-3.633***
INFLATION	-0.573	-1.484	-2.285***	-2.454***
Common law countries (14)				
GDP	-1.371	-0.997	-3.504***	-3.251***
M2/GDP	-0.782	-0.700	-3.209***	-3.115***
M3/GDP	-1.010	-0.833	-3.498***	-3.553***
PRIVATE	-1.202	-2.045	-3.567***	-3.686***
INVESTMENT	-1.441	-1.379	-3.916***	-4.029***
GOVERNMENT	-1.277	-1.907	-3.810***	-3.645***
OPENNESS	-0.934	-1.141	-3.983***	-3.548***
INFLATION	-0.800	-1.621	-2.905***	-2.824***
Civil law countries (18)				
GDP	-1.189	-1.528	-3.325***	-3.143***
M2/GDP	-1.361	-0.768	-2.952***	-2.867***
M3/GDP	-1.414	-1.052	-2.988***	-2.907***
PRIVATE	-1.093	-1.814	-3.151***	-2.758***
INVESTMENT	-1.801	-1.300	-3.892***	-3.976***
GOVERNMENT	-1.354	-1.455	-3.754***	-3.603***
OPENNESS	-1.412	-1.909	-4.051***	-3.849***
INFLATION	-0.924	-0.690	-1.864**	-2.310***

Notes: **, *** indicate rejection of the null hypothesis of non-stationary at 5 and 1 percent level of significance.

Since all variables are I(1), the next step is to test whether a long-run relationship exists between then. Table 3 shows the results of Pedroni's (1999) tests between GDP, financial development and auxiliary variables. We use four within-group tests (panel statistics based on estimators that pool the autoregressive coefficient across different countries for the unit root tests on the estimated residual) and three between-group tests (group statistics based on estimators that average individually estimated coefficients for each countries). The statistics almost reject the null hypothesis of no cointegration. The same issues are obtained for the two country groups and for the three financial development variables.

Whereas *rho-stat* (panel and group) and *adf-stat* (group) suggest that the long-run relationship is stronger in common law countries than civil law countries, *pp-stat* (panel and group) and *adf-stat* (panel) provide opposite results. Therefore, we cannot conclude using only the panel cointegration tests of Pedroni (1999), whether the long-run relationship between financial development and growth is stronger in one panel country group than other.

Table 3: Pedroni (1999) panel cointegration tests

	Panel statistics				**Group statistics**		
	v-stat	rho-stat	pp-stat	adf-stat	rho-stat	pp-stat	adf-stat
All countries (32)							
M2/GDP	1.035	-2.477***	-1.703**	-2.226**	-4.145***	-1.156	-2.652***
M3/GDP	1.139	-1.953**	-2.562***	-2.819***	-3.696***	-2.138**	-2.838***
PRIVATE	0.870	-2.151**	-2.126**	-2.781***	-3.644***	-1.665**	-2.909***
Common law countries (14)							
M2/GDP	0.815	-2.200***	-1.343*	-1.308*	-3.321***	-1.098	-2.021**
M3/GDP	1.049	-1.790**	-1.869**	-1.924**	-3.066***	-1.042	-2.230***
PRIVATE	0.924	-2.473***	-1.651**	-1.340*	-3.364***	-2.490***	-1.318*
Civil law countries (18)							
M2/GDP	0.650	-1.316*	-2.190**	-2.042**	-2.598***	-1.716**	-1.431**
M3/GDP	0.581	-1.297*	-2.660***	-2.508***	-2.223**	-2.474***	-2.138**
PRIVATE	0.934	-1.573**	-3.510***	-3.574***	-1.891**	-2.653***	-2.717***

Notes: The test statistics are normalized so that the asymptotic distribution is standard normal. *, ** and *** indicate rejection of the null hypothesis of non cointegration at the 10, 5 and 1 percent levels of significance based respectively on the following critical values: 1.281, 1.644 and 2.326.

Pedroni cointegration tests have the drawback of requiring the long-run cointegrating vector for the variables in the levels to be equal to the short-run adjustment process for the variables in the differences, and to assume cross-country independence. Failure of this common factor restriction causes significant loss of power in the Pedroni procedures. In order to check the robustness of the previous results, we considered four additional cointegration tests proposed by Westerlund (2007) that allow for cross-sectional dependence. Table 4 summarizes the outcome of Westerlund's cointegration tests. Excepted for the G_α statistic test, the null hypothesis of no cointegration is rejected at the 1% or 5% significance level. When robust *p-values* are computed based on the bootstrapped *p-values* (i.e when allowance is made for cross-sectional dependence), the no cointegration null hypothesis is rejected in all the cases at the 1% significance level. The results with the bootstrapped *p-values* (that take cross-country dependence into account) provide stronger evidence of cointegration relationship between real GDP, financial depth and the additional variables in African countries. When we consider country group, the results provide robust evidence for cointegration relationship between variables under consideration. Therefore, economic growth, financial development and a set of control variables are cointegrated for the panel of all countries and for the panels of country groups.

These results support the empirical assessment of Christopoulos and Tsionas (2004), Apergis et al. (2007), Abdullahi and Wahid (2011) and Bangake and Eggoh (2011) and suggest that in African countries, there is a long run equilibrium relationship between real GDP, financial development, and a set of control variables. However, our outcomes contrast with the work by

Fowewe (2010), who found that there is no long-term relationship between financial development and growth from a sample of African countries, using bivariate framework.

Table 4: Westerlund (2007) panel cointegration tests

		All countries		**Common law countries**		**Civil law countries**	
		Value	P-value	Value	P-value	Value	P-value
G_τ	M2/GDP	-3.908	0.000	-4.353	0.000	-3.563	0.000
	M3/GDP	-3.944	0.000	-4.293	0.000	-3.673	0.000
	PRIVATE	-3.812	0.000	-3.955	0.000	-3.701	0.000
G_α	M2/GDP	-15.916	0.259	-15.400	0.424	-16.317	0.245
	M3/GDP	-16.526	0.144	-15.704	0.370	-17.165	0.130
	PRIVATE	-15.805	0.285	-14.599	0.568	-16.743	0.181
P_τ	M2/GDP	-19.771	0.000	-13.600	0.000	-14.541	0.000
	M3/GDP	-20.438	0.000	-13.644	0.000	-15.272	0.000
	PRIVATE	-18.603	0.000	-10.915	0.008	-15.138	0.000
P_α	M2/GDP	-15.339	0.003	-14.868	0.055	-15.620	0.014
	M3/GDP	-15.841	0.001	-15.245	0.000	-16.153	0.007
	PRIVATE	-14.661	0.012	-13.119	0.209	-15.805	0.011

Notes: Optimal lag/lead length determined by Akaike Information Criterion with a maximum lag/lead length of 2. Width of Bartlett-kernel window set to 2. Number of bootstraps to obtain bootstrapped *p-values* which are robust against cross-sectional dependencies set to 400.

Finally, the case of cointegration with structural breaks is considered (as a robustness check) with the use of the recent Lagrange multiplier (LM) test developed by Westerlund (2006) for the null hypothesis of cointegration, which shows small size distortions and reasonable power.[8] This test allows for multiple structural breaks in both the level and trend of a cointegrated panel regression, being general enough to allow for endogenous regressors, serial correlation and an unknown number of breaks, which may differ among units. The results are reported in Table 5, using M2/GDP as financial development indicator. These outcomes do not change when the other financial variables are considered.

Allowing for multiple possible breaks (Table 5) the Westerlund (2006) test is able to detect 16 breaks in the common law countries panel and 39 breaks in the civil law countries ones, and up to 3 significant breaks for most countries. The asymptotic and bootstrap p-values for the null hypothesis of cointegration are respectively of 0.27 and 0.34, for the common law countries panel, and of 0.23 and 0.31 for the civil law countries panel, indicating non-rejection of the null hypothesis at all conventional level of significance. Hence we can still conclude for the existence of strong evidence that economic growth, financial development and additional variables are cointegrated when multiple structural and endogenous breaks are accommodated, and whether conventional or suitable generated bootstrap values take cross-sectional dependence into account are used.

[8] We thank J. Westerlund for providing us the GAUSS codes.

Table 5: Estimated structural breaks (Westerlund, 2006)

Common law countries	**Number of breaks**	**Years**		
Egypt Arab Rep.	1	1995		
Ghana	1	1991		
Gambia	1	1995		
Kenya	1	1995		
Lesotho	1	1996		
Malawi	2	1986	1995	
Nigeria	2	1986	1995	
Sudan	1	1986		
Sierra Leone	1	1986		
Swaziland	1	1986		
Uganda	1	1986		
South Africa	1	1986		
Zambia	1	1990		
Zimbabwe	1	1994		
Civil law countries	**Number of breaks**	**Years**		
Burundi	2	1980	1989	
Benin	2	1981	1990	
Burkina Faso	3	1976	1982	1990
Central African Republic	3	1976	1983	1989
Ivory Coast	2	1979	1990	
Cameroon	3	1978	1983	1991
Algeria	2	1979	1990	
Gabon	2	1979	1990	
Morocco	2	1979	1989	
Madagascar	2	1979	1990	
Mali	2	1981	1991	
Mauritania	2	1979	1992	
Niger	2	1982	1989	
Rwanda	2	1981	1992	
Senegal	2	1979	1990	
Chad	2	1979	1990	
Togo	2	1983	1992	
Tunisia	2	1978	1989	

Note: The breaks are estimated using the Bai and Perron (2003) procedure with a maximum number of five breaks for each country. The minimum length of each break regime is set to 0.1*T*.

Compared to the existing studies, the estimated date of our structural breaks is roughly consistent with Teng and Liang (2010) who found two structural breaks in 11 emerging countries. Our results also are broadly in accordance with consistent with Esso (2010) that used the Gregory and Hansen (1996a; 1996b) testing approach to threshold cointegration for 15 African countries.

As far as the civil law countries are concerned, our study shows that the first structural breaks occurred in the 1970s or 1980s, while the second and the third structural breaks in the 1990s or 2000s. Roughly, our structural breaks are associated globally and with great shocks. They may reflect the energy crises triggered by the 1973 Arab oil embargo; the 1978 Iranian revolution, accompanied by escalating oil prices and a period of high inflation during the

1970s decade; the deep world-wide recession in the early 1980s; the 1987 wall Street stock market crash; the commodities crises of the 1980s due to the second oil shocks and to the start period of the economic liberalization within the context of structural adjustment in most of the Sub-Saharan African countries (Esso, 2010). Indeed, Africa countries faced to a serious economic crisis in the 1980s which is culminated in pronounced disequilibria in both the domestic and external sector. Moreover, for Algeria, Burkina Faso, Cameroon, Central African Republic, Chad, Ivory Coast, Morocco, Madagascar, Mauritania, Senegal and Tunisia, the first structural breaks appeared between 1976 and 1979 before the commodity crisis around the time of the second oil price shock in 1979 and the Iran-Iraq war in 1980. In Benin, Burundi, Mali, Niger, Rwanda, and Togo the first structural breaks occurred in early 1980 period of deep world-wide recession.

Concerning the common law countries, the results of the estimated date of structural breaks are almost different to those obtained in civil. For instance, for Malawi, Nigeria, Sudan, Sierra Leone, Swaziland, South Africa and Uganda, the first structural appeared in the 1980s during the commodity crisis of the 1980s. Except for South Africa, Nigeria and Sudan, most of these countries are largely monoculture and rely on one or two commodity exports. In this regard, a perennial balance of payment deficit, brought about largely by commodity price fluctuation and adverse terms of trade led these countries to be heavily indebted.

4.3. Results of DOLS and panel causality results

As mentioned above, we use two techniques to obtain the parameter estimates of the panel error-correction model for the relationship between financial development and economic growth and a set of control variables: DOLS for the long-run parameters and PMG for the short and long-run parameters. Table 6 presents the DOLS results. The estimated coefficients of the three indicators of financial development (M2/PIB, M3/PIB, and PRIVATE) are all positive and statistically significant for all countries at 1% level. Since the variables are expressed in natural logarithms, the coefficients can be interpreted as elasticities. Overall, the outcomes of this study show that there is strong long-run relationship between real GDP, financial development and the other control variables. The results on the global sample indicate that a 1% increase in financial development variables (M2/GDP, M3/GDP and PRIVATE) increases economic growth respectively, by 0.085%, 0.063% and 0.072%. Accordingly, these findings suggest that high levels of financial depth are positively associated with faster economic growth in African countries. There is difference in results when country groups are considered. For instance, in common law countries, a 1% increase in financial development variables (M2/GDP, M3/GDP and PRIVATE) increases economic growth respectively by 0.158%, 0.072% and 0.086%. As far as civil law countries are concerned, a 1% increase of financial development increases economic growth respectively, by 0.067%, 0.049% and 0.068%.

Compared to the results of other DOLS and FMOLS estimates using panel data in developing countries, the elasticity of financial development in African countries is within the range of these studies. For example, the financial development coefficients are larger than the 0.032, 0.027 and 0.024 (for liquid liability, bank credit and private credit, respectively) reported by Apergis et al. (2007) for a sample of non-OECD countries. However, the elasticity estimates associated with financial depth are smaller than the 0.108, 0.107 and 0.115 (for liquid liability, deposit money bank asset and private credit, respectively) reported by Bangake and Eggoh (2011) for a sample of low income countries. Using FMOLS estimator for a panel of

15 sub-Sahara African countries from 1976-2005, Abdullahi (2010) also reported the estimate coefficients of 0.031 and 0.579 for private credit and domestic credit, respectively.

In addition, the coefficients of control variables have expected sign. The investment rate and the openness to trade are positively associated with economic growth, while government expenditure as ratio to GDP has negative impact and inflation rate is insignificant, for the global sample. However, government expenditure exhibits non significant coefficient in common law countries, but a statistically negative impact in civil law countries. This outcome shows that government expenditures are more inefficiency in African civil law countries, which also record the most negative impact of inflation rate.

Table 6: Panel DOLS long-run estimates

	M2/GDP	**M3/GDP**	**PRIVATE**
All countries (32)			
Finance (F)	0.085 (3.07)***	0.063 (2.97)***	0.072 (6.15)***
Investment (I)	0.188 (8.00)***	0.187 (9.96)***	0.183 (9.89)***
Government (G)	-0.040 (-1.65)*	-0.047 (-2.37)**	-0.014 (-1.72)*
Openness (O)	0.058 (1.98)**	0.064 (2.51)**	0.054 (2.17)**
Inflation (P)	0.005 (0.10)	-0.022 (-0.44)	0.002 (0.05)
R2	0.558	0.546	0.642
Common law countries (14)			
Finance (F)	0.158 (3.21)***	0.072 (3.01)***	0.086 (3.94)***
Investment (I)	0.274 (8.91)***	0.279 (9.00)***	0.262 (8.73)***
Government (G)	-0.024 (-1.73)*	-0.021 (-1.65)*	-0.048 (-1.43)
Openness (O)	0.073 (2.11)**	0.082 (2.08)**	0.060 (1.84)*
Inflation (P)	-0.105 (-1.78)*	-0.121 (-1.84)*	-0.070 (1.06)
R2	0.651	0.617	0.679
Civil law countries (18)			
Finance (F)	0.067 (2.22)**	0.049 (1.63)*	0.060 (5.00)***
Investment (I)	0.094 (3.74)***	0.092 (3.62)***	0.085 (3.38)***
Government (G)	-0.085 (-3.19)***	-0.095 (-3.53)***	-0.068 (-2.50)**
Openness (O)	0.187 (3.96)***	0.201 (4.22)***	0.209 (4.30)***
Inflation (P)	-0.281 (-2.23)**	-0.233 (-1.83)*	-0.179 (-1.47)
R2	0.606	0.601	0.583

Notes: t-statistics are in parentheses. *, ** and *** significant at 10, 5 and 1 percent.

There are interesting results when considering panels of country groups. For instance, in common law countries, a 1% increase in financial development indicators (M2/GDP, M3/GDP and PRIVATE) increases economic growth by 0.158%, 0.072% and 0.086%, respectively. As far as civil law countries are concerned, a 1% increase in financial development variables (M2/GDP, M3/GDP and PRIVATE) increases economic growth by 0.067%, 0.049% and 0.069%, respectively. We carefully investigate whether the (long-run) coefficients can be considered as being the same in both country groups, using a Fisher

statistics.[9] Our results indicate that the null hypothesis of coefficients equality between common law and civil law countries is strongly rejected at 1% significance level. These outcomes provide overwhelming evidence in support the view that the positive long-run effects of financial development on growth is higher in African common law than in civil law countries.

What does difference in the finance-growth relationship, between common law and civil law countries in Africa? La Porta et al. (2008, p. 298) formally established that: "compared to French civil law, common law is associated with (a) better investor protection, which in turn is associated with improved financial development, better access to finance, and higher ownership dispersion, (b) lighter government ownership and regulation, which are in turn associated with less corruption, better functioning labor markets, and smaller unofficial economies, and (c) less formalized and more independent judicial systems, which are in turn associated with more secure property rights and better contract enforcement". Moreover, Djankov et al. (2007) show that private credit rises after improvements in creditor rights and in information sharing in a sample of 129 countries. Using firm perceptions on how helpful the government is to provide an alternative test of the theory of legal origin, Amin (2009) also finds from a sample of 48 countries, that the English common law is associated with a more helpful government than the French civil law.

These results imply that in the countries with strong legal protection of investors, the long-run relationship between finance and growth is higher than in the countries with worst protection. These findings may be due to the fact that in common law countries with less-formal judicial procedures many reforms have been taken in the early 1980s (privatization, rationalization of the public sector, liberalization of exchange rate, and financial systems).

Thus, the flexibility of common law system has facilitated the development of financial intermediaries and the establishment of new financial institutions. On the other hand, civil law juridical proceedings and centralized administration have impeded financial development in African French legal origin countries. Furthermore, African civil law countries are characterized by a weak institutional framework which is not favorable to financial development.

After establishing that economic growth has a long-run relationship with financial development, we need to examine the causality between both variables. Table 7 reports (Panels A, B and C) the results of the short-run and long-run Granger-causality tests for each panel data set, using M2/GDP as financial development variable.[10] The optimal lag structure of two years is chosen using the Schwarz Bayesian Criterion. In panel A which includes all countries of our sample, Eq. (14a) shows that financial development and investment ratio have a positive and statistically significant impact in the short-run on economic growth, whereas government ratio has negative impact. On the other hand, openness to trade and price level have insignificant impact on economic growth. The sum of the lagged coefficients is 0.081 and 0.052 for financial development variable and investment ratio respectively. This outcome highlights the importance of financial development in the economic growth process

[9] Fisher statistics for coefficients equality between common law and civil law countries are 15.395, 14.342 and 9.910 respectively for M2/GDP, M3/GDP and PRIVATE. The critical value at 1 percent significance level is $F(6, 1076) = 2.82$.

[10] In order to check for robustness we present in the Appendix (see Tables A2 and A3) the results, based on the other financial development variables. Notice that the results are robust to various financial development indicators.

in African countries and supports the supply leading hypothesis. Moreover, the error correction term is statistically significant at 1% and denotes the speed of adjustment to long-run equilibrium. In term of Eq. (14b), it appears that economic growth, investment ratio and government consumption have positive and significant impact on financial development in short-run at 5% significant level. The sum of lagged values of economic growth, investment ratio and government expenditure is 0.306, 0.061 and 0.144, respectively. This shows that economic activity is the main factor in financial development process and provides a strong support to demand following hypothesis. The statistically significance at 1% of the error correction term suggests that financial development responds to deviations from long-run equilibrium. Overall, our investigation provides a strong support to feedback relationship between financial development and economic growth: decreasing in financial development decreases growth and vice versa, and that increasing in financial development increases growth, and vice versa. Our results are in line with Apergis et al. (2007), Luintel and Khan (1999), Demetriades and Hussein (1996) who also show a bi-directional relationship between financial development and growth.

As far as the short-run dynamics is concerned, the Eq. (14a) shows that financial development and investment ratio have a positive and statistically significant impact on economic growth in common law countries, whilst financial development, government consumption and trade openness are significant in civil law countries. Thus, financial development policies can impulse growth in common law as well as civil law countries. With respect to Eq. (14b) economic growth and openness to trade have positive and significant impact in both country groups, whereas government ratio is only significant in civil law countries, and price level in common law countries. Concerning the long-run relationship, the error correction terms are statistically significant, but the speed of adjustment can vary according to the country groups. For example, the adjustment dynamic of economic growth is faster in common law than in civil law countries.

More importantly, our empirical results bring further evidence: the bi-directional causality is observed in all country groups, giving credence to both the supply-leading and the demand-following hypothesis. However, a strong support for short-run and long-run causality is found for common law countries. Due to their juridical system that offers better investor protection and government effectiveness, improvements in the financial system will have more impact on economic growth than in civil law countries. Finally, our results suggest that financial development may be a good lever to enhance economic growth in African countries.

Similar results are often obtained in the literature and suggest a low effect of financial development on economic growth in developed countries. For example, Apergis et al. (2007) find that the bi-directional causality between financial development and economic growth is higher in non-OECD countries, than OECD countries.

Table 7: Panel causality tests using m2/gdp as financial development variable

Dependant variables	Sources of causality						
	Short-run						**Long-run**
	ΔY	ΔF	ΔI	ΔG	ΔO	ΔP	ECT
Panel A – All countries							
(14a) ΔY	-	7.72*** [0.081]	3.97** [0.052]	2.65* [-0.038]	1.59 [0.023]	0.48 [-0.028]	-0.048*** (-4.77)
(14b) ΔF	5.93** [0.306]	-	2.87* [0.061]	10.41*** [0.144]	3.07* [0.152]	2.31 [0.104]	-0.089*** (-5.63)
Panel B – Common law countries							
(14a) ΔY	-	9.78*** [0.107]	4.82** [0.069]	1.08 [-0.015]	0.98 [0.029]	2.91* [-0.089]	-0.073*** (-4.69)
(14b) ΔF	4.98** [0.373]	-	1.36 [0.091]	1.81 [0.061]	10.54*** [0.201]	5.42** [0.221]	-0.124*** (-4.13)
Panel C – Civil law countries							
(14a) ΔY	-	3.86** [0.094]	2.79* [0.054]	3.07* [-0.065]	1.81 [0.051]	1.57 [-0.060]	-0.042*** (-2.78)
(14b) ΔF	8.85*** [0.268]	-	1.16 [-0.018]	11.81*** [0.209]	5.36** [0.127]	2.71* [0.182]	-0.084*** (-5.26)

Notes: Partial *F-statistics* are reported with respect to short-run changes in the independent variables. ECT represents the coefficient of the error correction term. *t-statistics* are reported in parentheses. The sum of the lagged coefficients for the respective short-run changes is denotes in brackets *** Significant at 1 percent and ** significant at 5 percent.

5. Conclusion

The aim of this study was to shed light on relationship between financial development, economic growth and auxiliaries' variables for 32 African countries over the period from 1970 to 2009. We have made use of recent panel unit root tests, Pedroni (1999) and Westerlund (2006, 2007) panel cointegration and causality tests to analyse the nexus between financial development and growth. Since African countries differ in their level of financial development due to differences in policies and institutions, the sample is divided into two groups: civil law countries and common law countries. Our results reveal that there is a long-run equilibrium relationship between financial development, economic growth, and auxiliaries' variables. Moreover, we find that decreasing in financial development decreases growth and vice versa, and that increasing in financial development increases growth, and vice versa, and that this applies for both civil law countries and common law countries. In other words, both the financial and real sectors are complementary to each other. This result is robust to possible cross-country dependence and still holds when allowing for multiple endogenous structural breaks, which can differ among countries.

From a policy perspective, the results mean that adopting an apparently simple solution of improving financial development is not going to help with economic growth. What is necessary is to alter the relationship between financial development and economic growth. In this regard, one solution consists in focusing on financial development efficiency, that is, to promote faster economic growth. African countries might undertake financial reforms through financial liberalization, the promotion of saving for the modest households. Of course, this would require a mentality change and an access to the banking sector for the households with low income, this might be a choice that is necessary to make. It would also be interesting to

improve access to credit for moderate income households through credits and microcredit loans to stimulate domestic consumption and investment in order to promote economic growth. Furthermore, our results also show that estimated structural break tests are associated globally and with great shocks i.e. mainly occurred during commodities crisis. It implies that commodities crisis have a significant impact on the finance development-growth nexus.

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Appendix

Table A1: Descriptive statistics, cross-section: 1970-2009; Sub-samples

Variable	N	Mean	Std. Dev.	Minimum	Maximum
Common law countries					
Growth	14	1.289	1.147	-0.806	3.260
M2/gdp	14	27.915	12.555	14.0699	69.674
M3/gdp	14	32.526	11.864	16.081	79.327
Private	14	20.852	23.153	4.779	95.705
Investment	14	19.058	4.381	10.561	37.913
Government	14	15.685	3.505	10.241	20.636
Openness	14	70.065	36.911	29.298	158.976
Inflation	14	20.578	10.663	9.778	35.158
Civil law countries					
Growth	18	0.624	1.065	-1.241	3.225
M2/gdp	18	24.214	10.403	11.772	55.572
M3/gdp	18	26.319	10.273	12.297	61.846
Private	18	20.387	12.727	7.795	57.234
Investment	18	19.007	4.773	11.272	31.479
Government	18	14.487	3.926	9.931	27.535
Openness	18	59.173	21.291	33.090	102.448
Inflation	18	6.776	2.487	3.746	13.579
Equality tests: H_0: mean difference=0					
Growth	1.434 [0.080]				
M2/gdp	0.722 [0.237]				
M3/gdp	1.089 [0.142]				
Private	0.072 [0.471]				

Table A2: Panel causality tests using m3/gdp as financial development variable

Dependant variables	Sources of causality						
	Short-run						**Long-run**
	ΔY	ΔF	ΔI	ΔG	ΔO	ΔP	ECT
Panel A – All countries							
(14a) ΔY	-	3.86** [0.075]	4.07** [0.052]	3.22* [-0.048]	1.07 [0.032]	1.23 [-0.021]	-0.049*** (-4.81)
(14b) ΔF	7.34*** [0.372]	-	1.17 [0.042]	14.65*** [0.159]	3.98** [0.123]	2.67 [0.278]	-0.141*** (-8.06)
Panel B – Common law countries							
(14a) ΔY	-	3.90** [0.097]	3.02* [0.055]	0.86 [-0.029]	1.48 [-0.021]	1.14 [-0.022]	-0.066*** (-2.88)
(14b) ΔF	4.34** [0.451]	-	1.25 [0.049]	2.02 [0.093]	2.68* [0.087]	6.08** [-0.185]	-0.176*** (-4.14)
Panel C – Civil law countries							
(14a) ΔY	-	3.74** [0.052]	3.88** [0.053]	1.71 [-0.053]	1.38 [-0.037]	1.23 [-0.032]	-0.041*** (-3.71)
(14b) ΔF	4.30** [0.390]	-	1.31 [-0.064]	1.51 [0.076]	8.79*** [0.149]	2.67* [0.028]	-0.138*** (-2.61)

Notes: Partial *F-statistics* are reported with respect to short-run changes in the independent variables. ECT represents the coefficient of the error correction term. *t-statistics* are reported in parentheses. The sum of the lagged coefficients for the respective short-run changes is denotes in brackets *** Significant at 1 percent and ** significant at 5 percent.

Table A3: Panel causality tests using private/gdp as financial development variable

Dependant variables	Sources of causality						
	Short-run						**Long-run**
	ΔY	ΔF	ΔI	ΔG	ΔO	ΔP	ECT
Panel A – All countries							
(14a) ΔY	-	8.21*** [0.081]	11.85*** [0.092]	5.84** [-0.064]	0.46 [0.022]	0.81 [-0.038]	-0.055*** (-4.99)
(14b) ΔF	2.96* [0.279]	-	3.72** [0.065]	8.20*** [0.152]	1.21 [-0.047]	1.29 [-0.188]	-0.108*** (-6.09)
Panel B – Common law countries							
(14a) ΔY	-	3.78** [0.087]	4.24** [0.133]	1.30 [-0.019]	1.33 [0.025]	1.35 [-0.094]	0.081*** (-2.54)
(14b) ΔF	3.81** [0.225]	-	4.27** [0.088]	4.02** [-0.059]	5.69** [0.223]	2.02 [-0.237]	-0.178*** (-5.45)
Panel C – Civil law countries							
(14a) ΔY	-	3.52** [0.046]	6.05** [0.090]	3.64** [-0.088]	1.09 [-0.014]	2.52 [-0.042]	-0.072*** (-3.75)
(14b) ΔF	3.20* [0.147]	-	3.67** [0.098]	7.94*** [0.227]	1.36 [0.021]	1.65 [-0.239]	-0.069*** (-4.05)

Notes: Partial *F-statistics* are reported with respect to short-run changes in the independent variables. ECT represents the coefficient of the error correction term. *t-statistics* are reported in parentheses. The sum of the lagged coefficients for the respective short-run changes is denotes in brackets *** Significant at 1 percent and ** significant at 5 percent.