the direction of economic progress and policy makers might easily ignore the need for strengthening such an institution (called the 'casino hypothesis') (Kitchen, 1986).

While the scarcity of long-time series on national account data (especially for developing countries) has been a major constraint impeding investigation on a finance-growth possible causal relationship, cross-country studies have dominated the empirical literature in the past (Ang and McKibbin, 2005). Although the results from many studies support the view that financial sector development positively affects growth, it has been argued that evidence from cross-country studies 'generate estimates of the average effects of financial development, while the relationship may vary considerably between countries' (DFID, 2004). Thus the issue of causality among variables may have not been satisfactorily addressed (Ghali, 1999; Demetriades and Hussein, 1996). This has led a number of researchers to re-examine the finance-growth relationship using a time-series approach on individual countries. An important advantage of this time series data is that 'it can distinguish between different causal patterns in the countries studied' (Andersen and Tarp, 2003) while being contingent upon the institutional setting, nature and operation of financial institutions and individual policies pursued.

In the recent years, two factors have also helped the application of time series investigation (Shan et al., 2001). First, developments in the time series modelling framework, especially cointegration methodology and VAR models estimation techniques which are designed to test causality hypothesis, have enhanced the merits of a time series approach. Second, the emergence and development of endogenous models have provided the analytical framework to better study the effect of financial development and financial liberalization on growth (Ghirmay, 2004).

Policy-wise, financial sector development has also been enhanced by reforms across many countries whereby financial liberalization has remained a core element of policy reforms (Andersen and Tarp, 2003). In many transition and developing countries, there has been a significant and gradual reform of financial markets since the 1980s in order to remove distortions and establish an adequate macroeconomic environment for growth. Following an increase in market-related problems and other structural rigidity, the financial system in many sub-Saharan African (SSA) countries has failed to effectively deliver any financial services. As part of the structural adjustment program of late 1980s and early 1990s, financial systems (markets) in Africa were restructured, with a major emphasis on liberalization measures and reduction/removal of controls and state interventions. Prominent features of financial liberalization included abolishment of directed credit mechanisms, removal of ceilings on interest rates, improvements in infrastructure, especially bank supervision and importantly empowering central banks to conduct monetary policy (McDonald and Schumacher, 2007; Aryeetey and Senbet, 2004). The effect of financial liberalization-led financial reforms in SSA is still being debated while the evidence on their importance remains scarce. This paper aims to contribute to this dimension. In general, it is argued that liberalization improves the functioning of the financial system, facilitates cross-country diversification, channels world savings into their most productive uses beyond boundaries, increases the availability of funds and encourages transparency and accountability (Obstfeld, 1998; Mishkin, 2001; Stulz, 1999). Studies have also suggested financial liberalization promotes financial development, and subsequently through deepening of the financial system, facilitates economic development (McDonald and Schumacher, 2007; Andersen and Tarp, 2003; Nissanke and Aryeetey, 1998, p. 67).

This research will contribute to the existing body of economic literature in general, and financial reforms in particular, in a number of ways. First, this study seeks to add to the empirical literature on financial liberalization, financial development and economic growth by taking two favoured measures of financial development and over 20 years of a new financial liberalization index. Additionally, new panel data and time-series techniques are applied while utilizing data from 15 SSA countries. The use of an alternative proxy for financial development will help test the robustness of the findings. Second, the large strand of empirical literature focusing on the relationship between financial development and economic growth concentrates on high-income or middle-income developing countries and there is a relative absence of SSA countries in the sample of countries studied (Ghirmay, 2004). In examining the causal link, most of these studies use either cross-section or panel data techniques which have demonstrated a number of econometric problems (see, for example, Luintel and Khan, 1999; Demetriades and Hussein, 1996). Moreover, in contributing to the literature, this paper provides evidence of causality by adopting the new panel cointegration along with dynamic time series techniques.

2. The econometric methodology

Modern economic theory suggests that by providing various intermediary channels of resource mobilization, allocation diversification and promotion of contractual efficiency, financial market development influences long-term rates of economic growth.

In order to understand the relationship between financial development and growth, various studies have considered this growth causality issue. So far, the empirical evidence establishes that although financial development (mainly in the form of financial integration) does generate some benefit in some emerging countries, the relationship is not always robust (Kose et al., 2003; Luintel and Khan, 1999; Hermes, 1994). While the debate on the direction of the causality between financial development and economic performance (especially in less developed countries) remains, formally the relationship can be expressed as:

$$y_t = \beta_0 + \beta_1 FD_t + \beta_3 C_t + e_t \qquad (1)$$

where y_t is the dependent variable (GDP per capita), FD_t equals financial development, C_t represents vector of other control variables and e_t is an error term with the usual classical properties.

Given equation (1), the panel version can be written as:

$$y_{it} = \beta_{i0} + \beta_{1i} FD_{it} + \beta_3 C_{it} + e_{it} \qquad (2)$$

where *i* and *t* indicate cross-section units and time period respectively. The implied growth equation of equation (1) is:

$$\Delta y_t = \beta_0 + \beta_1 \Delta FD_t + \beta_3 \Delta C_t + e_t \qquad (3)$$

Importantly, differencing the series in (3) above is also useful in terms of deriving a stationary time series process (Granger, 1986; Charemza and Deadman, 1997). Since most of the macroeconomic times series are non-stationary, differencing *d* times is required to make them stationary, that is $y_t \sim I(d)$ if $\Delta^d y_t$ is stationary, where $\Delta y_{t-j} = \sum_{i=0,\ldots,t-j-1} \Delta^d y_{t-j-i}$ and $y_t = \sum_{j=0,\ldots,t-1} \Delta y_{t-j}$.

In general, when a common trend exists among variables, the causal relationship between two or more variables can be investigated using Granger causality methodology. For a bivariate VAR(*p*) model:

$$\begin{pmatrix} X_{1t} \\ X_{2t} \end{pmatrix} = \begin{pmatrix} c1 \\ c2 \end{pmatrix} + \begin{pmatrix} \beta_{11}^1 & 0 \\ \beta_{21}^1 & \beta_{22}^1 \end{pmatrix} \begin{pmatrix} X_{1t-1} \\ X_{2t-1} \end{pmatrix} + \ldots + \begin{pmatrix} \beta_{11}^p & 0 \\ \beta_{21}^p & \beta_{22}^p \end{pmatrix} \begin{pmatrix} X_{1t-p} \\ X_{2t-p} \end{pmatrix} + \begin{pmatrix} \mu_{1t} \\ \mu_{2t} \end{pmatrix} \qquad (4)$$

where $\mu_t \sim$white noise $(0\ \Sigma)$ and 'X_2 does not Granger-cause X_1' when $H_0 = \beta_{12}^j = 0$ for all *j* in the equation of X_1. Causality in this sense implies forecasting abilities where past changes in one variable (say X_2) helps in the prediction of the actual changes in another variable (say X_1) and therefore β_{12}^j'*s* are jointly significantly different from zero (Granger, 1988).

Further, irrespective of the estimation approach, a dynamic version of (3) which includes a lagged dependent variable (to incorporate the theoretical information on levels) can be formulated as:

$$\begin{aligned} \Delta y_t &= \gamma_0 + \sum_{i=1}^{m} \gamma_{1i} \Delta y_{t-i} + \sum_{i=1}^{n} \gamma_{2i} \Delta FD_{t-i} + \sum_{i=1}^{n} \gamma_{3i} \Delta C_{t-i} \\ &- \alpha \left[y_{t-1} - \left(\pi_0 + \pi_1 FD_{t-1} + \pi_2 C_{t-1} \right) \right] + v_t \end{aligned} \qquad (5)$$

where α is the speed of adjustment parameter, v_t is the random disturbance term and *m* and *n* represent the number of lags chosen considering the underlying data generating process (DGP).[1] Importantly, the term in the square bracket is the error correction term which corrects short-run deviations from the equilibrium level (stationary long-run solution). Given that all variables in equation (5) are I(1) processes, any of the standard cointegration techniques such as Johansen maximum likelihood vector error correction (VECM), Engle-Granger two-step (EG) and fully modified OLS (FMOLS) can be applied to estimate the corresponding error correction model (Rao and Rao, 2005; Perterson, 2000; Hendry and Doornik, 1994). If, however, these I(1) variables are not cointegrated (thus they do not trend together towards a long-run equilibrium state) error correction-based causality can be conducted without including the EC term (Ghali, 1999; Granger, 1988). However, fully modified OLS also has other advantages. By allowing researchers to exploit information regarding common long-run relationships: (a) FMOLS technique corrects for potential simultaneity bias among regressors; and (b) it accounts for any serial correlation in the residuals and endogeneity effects (Narayan and Sun, 2007; Mark and Sul, 2002; Pedroni, 1999).

[1] The last term in brackets in equation (4) can be represented as EC_{t-1} and is commonly referred to as the error-correction term representing deviation from long-run equilibrium.

To estimate the long-run equilibrium growth function across the sample countries, the usual verification of the stationary properties of individual variables - a panel based unit root - and testing for cointegration in a panel context can be carried out for all pooled variables in accordance to Pedroni (1999). Among different panel unit roots developed and used in the literature, the Im et al. (2003) method (IPS-t-test) is the most powerful in the sense that it allows for heterogeneity in the panel unit root analysis. Considering a panel version of the augmented Dickey-Fuller (ADF) unit root tests, the IPS-test is of the following form:

$$\Delta y_{it} = A_i + \delta_i t + \theta y_{it-1} + \sum_{j=1}^{m} \pi_{ij} \Delta y_{it-j} + w_{it} \qquad (6)$$

where i=1,2, …N; and t=1,2, …T represent the cross-section dimension and the time length in the ADF regression, and the error term (w_{it}) is assumed to be independent of i's and t's, normally distributed (white noise) but having cross-sectionally hetrogenous variance, σ_i^2. The null and alternative hypothesis are given as: $H_0: \pi = 0$ and $H_1: \pi < 0$ for at least some i's. On the other hand, a panel cointegration test is applied to check whether there exists a long-run equilibrium relationship in the system. Pedroni (1997, 1999, 2004) identifies a number of different statistics for the purpose of testing the null of no cointegration in panel data. These include four 'within dimension' panel tests and three 'between dimension' group mean panel tests which allow for heterogeneity of parameters across countries. Considering that the variables are cointegrated for each member of the panel, the group-mean panel FMOLS estimator is given by:

$$\begin{aligned}
\hat{\beta}_{FD,GFM} &= N^{-1} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} (FD_{it} - \overline{FD}_i)^2 \right)^{-1} \left(\sum_{t=1}^{T} (FD_{it} - FD_i)(y^*_{FD,it} - \hat{\gamma}_i T \right) \\
\hat{\beta}_{C,GFM} &= N^{-1} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} (C_{it} - \overline{C}_i)^2 \right)^{-1} \left(\sum_{t=1}^{T} (C_{it} - C_i)(y^*_{C,it} - \hat{\gamma}_i T \right)
\end{aligned} \qquad (7)$$

where $y^*_{FD,it} = \left(y_{it} - \bar{y}_i \right) - \frac{\hat{\Omega}_{21i}}{\hat{\Omega}_{22i}} (\Delta FD_{it})$; and that

$\hat{\gamma}_i = \hat{\Gamma}_{21i} + \hat{\Omega}^0_{21i} - \frac{\hat{\Omega}_{21i}}{\hat{\Omega}_{22i}} (\hat{\Gamma}_{21i} + \hat{\Omega}^0_{22i})$ is the serial correlation correction. Thus the associated statistics are distributed N(0,1) as $T \to \infty$ and $N \to \infty$ [2].

Data Description

We perform the analysis of financial development, financial liberalization and growth using panel and time series data comprising up to 15 SSA countries with annual observations over the period of 1976-2005.[3] In assessing the relationship between

[2] For more detailed documentation and technical procedures, especially on group panel statistics and long-run covariance of this vector process, see Pedroni (1999).

[3] The countries are Central Africa Republic (CAR), Cameroon, Ghana, Gambia, Kenya, Lesotho, Mauritius, Malawi, Niger, Senegal, Sierra Leone, Togo, South Africa, Rwanda and Zimbabwe.

financial development (deepening) and economic performance, the selection of variables to represent the efficiency and the level of financial development (level of financial services) in an economy has been a major issue. Due to various reasons, from lack of valid and reliable data to diversity of financial services catered for in different financial systems, constructing a comparable measure of financial services for a broad cross-section of countries remains a difficult task (Levine et al., 2000; Neusser and Kugler, 1998).

In many studies, researchers have used various measures of, or proxies for, the role of financial markets in explaining growth. Some of the most commonly used proxies of financial development are: widely available monetary aggregates such as M2 or M3 to income, ratio of banking deposit liabilities to income, domestic credit to private sectors to GDP, and ratio of domestic credit to income (Beck, 2002; Luintel and Khan, 1999; Demetriades and Hussein, 1996; De Gregorio and Guidotti, 1995; King and Levine, 1993a, 1993b). In this analysis, we will use the ratio of private credit to income (*PCY*) and ratio of domestic credit to income (*DOM*) as proxies for financial development. Ghirmay (2004) iterates that private sector credit (value of credit by financial intermediaries to this sector) is an accurate measure of the functioning of financial development since it captures the quantity and quality of investment.[4] However, in the case of developing economies such as ours, PCY may have some shortcomings since it may exclude financial development that takes place outside the banking sector (Khan and Senhadji, 2003; Ghirmay, 2004; Levine, 1999). Thus, we also take an alternative measure of financial development which represents the domestic assets of the financial sector (*DOM*). The data source for these two variables is the IMF annual publication *International Financial Statistics*.[5]

We use the Chin-Ito (2005) measure of financial openness as a proxy for financial liberalization. This index measures the degree of financial openness for a country at a time period which is constructed using binary variables based upon the IMF's Report on Exchange Arrangements and Exchange Restrictions (AREAER).[6] GDP per capita (GDP) is taken from Penn World Tables (Mark 6.2), while level of monetization (M1) and government spending (GOV) are from secondary data sources of *World Development Indicators* (World Bank). These variables are converted into real terms using GDP deflator. Following the literature (World Bank, 1989; Xu, 2000; Al-Yousif, 2002; Al-awad and Harb, 2005), M1 and GOV are taken to capture the role of macroeconomic polices in stimulating economic growth and stability. With the exception of the index and financial development indicators (*PCY* and *DOM*), all other series are expressed in log form to compress the measurement scale.

3. Estimation results

As discussed in the methodology section, the time series and panel time series techniques we are going to apply in our estimation depend on the stationary condition of the variables involved. Only then can we test for cointegration, apply the panel FMOLS method to estimate long-run financial development-growth relations, and

[4] Similar argument has been given by Levine et al. (2000).

[5] Following Levine et al. (2000), PCY and DOM are calculated as {0.5*[F(/t-1)/P_e(t-1)+F(t-1)/P_e(t-1)]}/[GDP(t)/P-a(t)] where: F is credit by financial institution to the private sector (line 22d+42d) and domestic credit by financial institutions (line 32); GDP is line 99b; P_e is the end of the period CPI (line 64); and P_a is the average CPI for the year.

[6] For detailed calculation and elaboration refer to Chinn-Ito (2005) and Chinn-Ito (2007).

further test for causality using the vector error-correction mechanism (VECM). To explore the panel time series properties, we use Levin, Lin and Chu (2002) (LLC) and Im et al. (2003) (IPS) panel unit root tests. Following Im et al. (2003), we apply demeaning to both LLC and IPS by subtracting the cross section means from the data. Table 1 reports the LLC and IPS unit root tests. With the exception of government spending (*GOV*), the null hypothesis of non-stationarity cannot be rejected for all series both by LLC and IPS tests for the levels. This null hypothesis is rejected at the 5% level for the government spending series by IPS tests with the demeaned data and when the trend is included. On the other hand, the non-stationarity hypothesis is easily rejected at the 1% level by the LLC and IPS tests for all series in their first-differences. Overall, this suggests that income, government spending (*GOV*), monetization (*M1*) and financial development variables (*PCY* and *DOM*) are non-stationary and generated by an I(1) process.

[Insert Table 1 about here]

Next we use the Pedroni (1999) technique to analyse the cointegration relationship among the variables. Table 2 reports hetrogenous panel cointegration test results. This is done for three different income equations. In the *FD1* equation, *pcy gdp, m1* and *gov* variables are considered. In the second equation (*FD2*), *dom* replaces *pcy* and in the third, financial liberalization index (*Flib*) relaces *pcy*. In all the three equations, five out of the seven Pedroni panel and group tests significantly reject the null of no cointegration. Evidence of no cointegration is found from the panel-*rho* tests. However, results from Monte Carlo simulations indicate that panel-*v* and panel-*rho* tend to underestimate the null rejection in the case of small N and T (Pedroni, 1997; Al-awad and Harb, 2005). Thus we conclude that cointegration cannot be ruled out on the whole and therefore proceed to estimate the cointegrating vectors.

[Insert Table 2 about here]

Tables 3(a) to 3(c) give the fully modified (FMOLS) estimates of the three different models specified in the above section. The dependent variable is GDP per capita. The individual country and panel group mean estimators are reported. In the table, individual estimates and t-statistics for $H_0 : \beta_i = 0$ for all the countries and the panel are provided. More specifically, the panel group mean estimator allows for hetrogenous long-run elasticities while permitting the test of the null $H_0 : \beta_i = \beta_0$ versus $H_1 : \beta_i \neq \beta_0$ for all *i* so that the value of β_i are not constrained to be the same under H_1 among different *i* members of the panel.

In the first growth equation where financial development is proxied by private sector credit, seven out of fifteen countries show a positive relationship between the financial development indicator and economic growth. In five cases out of the seven, the null hypothesis is rejected at the 5% significance level and the positive coefficient empirically supported. In Table 3(b) where domestic credit to GDP (dom) is used to proxy financial development, nine out fifteen countries indicate a positive relationship. In seven out of these nine cases (Cameroon, Ghana, Kenya, Niger, South Africa, Rwanda and Zimbabwe) the relationship is statistically significant at least at the 10% level. In this aspect our finding provides support to the theoretical prediction and empirical studies on finance-growth literature (Ghirmay, 2004; Calderon and Liu, 2003; Levine et al., 2000; Benhabib and Spiegel, 2000; Luintel and Khan, 1999;

Demetriades and Hussein, 1996; King and Levine, 1993a; among others). From Table 3(a) we also observe a positive and significant relationship between the monetary aggregate variable (M1) and long-run economic growth.

[Insert Tables 3(a)-(c) about here]

Considering the limited power of individual tests given the time span of our observation, the panel estimates for both financial development equations are also reported. The two coefficients of financial development are estimated to be 0.57 and 0.59 respectively and the null hypothesis is rejected at the 5% significance level. Accordingly, higher levels of financial development leads to faster current and future rates of GDP per capita in Sub-Saharan African countries.

The relationship between financial liberalization and economic growth is tested and results summarized in Table 3(c). Only in Gambia, Sierra Leone and Zimbabwe do we observe a positive and significant impact on growth. For the panel test, the coefficient is negative and insignificant. From the literature, there are a number of channels through which financial liberalization can influence growth. Financial liberalization may have a direct effect on growth through opening up financial market to enhance across-boundary flow of funds and by encouraging competition and thus increasing the amount of resources available for investment (Nazmi, 2005; Bekaert, 2005; Laeven, 2003; Levine, 1997; Fry, 1997). Ultimately, by generating international competition for funds, thereby rewarding the most productive projects, growth rates may be enhanced. Moreover, being an integral part of financial sector development, financial liberalization may deepen the financial system and stimulate financial intermediation by improving risk management techniques, offering new financial instruments and services, inviting better managed foreign banks and increasing the possibility of risk diversification by financial institutions (Bekaert, 2005). In this aspect, financial liberalization may have an indirect effect through financial development and thus generate higher rates of economic growth (Bonfiglioli, 2005; Klein and Olivei, 1999; Levine, 2001).[7] On the other hand, variables of government expenditure and real money are positive and some times significant, in accordance with the predictions under tables 3(a) and 3(b). The results indicate a very strong long-run connection between variables representing financial development and economic growth.

To further test the causality hypothesis between financial liberalization, financial development and growth, Table 4 reports panel and pairwise Granger causality. For SSA countries: (1) there is evidence of two-way causality from financial development to economic growth; (2) the null hypothesis of Granger no-causality from financial liberalization to growth is not rejected, but the vice versa is rejected at least at the 10% critical level; and (3) the result suggests one-way causality between financial liberalization and financial development since the null hypothesis of no causality from financial liberalization to financial development is rejected at the 5% critical level but not the vice versa. Overall the result supports our previous argument that financial liberalization contributes to growth through its influence on financial market development and enhancement of the role financial intermediation.

[7] On the other hand financial liberalization may actually have a negative impact on growth. Liberalization-led reforms may increase financial fragility of the financial intermediaries institution such as banks and increase information problems and risk-taking activities of financial institutions, leading to financial instability especially in developing countries (Arestis and Caner, 2004; Hellmann et al., 2000; Stiglitz, 2000; Demirguc-Kunt and Detragiache, 1998).

[Insert Table 4 about here]

In recent years, studies have highlighted the dangers of statistical inference based on cross-sectional analysis (Shan and Morris, 2002; Arestis and Demetriades, 1997; Demetriades and Hussein; 1996). In particular the inability of cross-sectional studies to examine causality in the Granger sense has been pointed out. Other advantages of the time series approach to testing causality include allowing the use of a dynamic specification in the sense of considering lagged variables. The literature has argued for the use VAR framework to test causality in that: (a) it permits a multivariable approach that is less prone to model selection uncertainties and functional selection bias; and (b) these techniques in a multivariate model also minimise the risk of simultaneity bias (Shan et al., 2001). This section uses the cointegration and error-correction models (as specified under equation (5)) to test for a causal relationship while applying it in a multivariate framework.

[Insert Tables 5 and 6 about here]

We begin by testing the existence of unit roots. Table 5 reports the country-by-country augmented Dickey-Fuller (ADF) results. The lag lengths on the dependent variable are chosen using the Akaike and Schwarz criterion. The results of ADF unit root tests show that all variables are not stationary in levels (with or without the inclusion of a deterministic trend) but their first difference becomes stationary. Overall, we are unable to reject the null hypothesis that all series are integrated of order one (I(1)) at the 5% level of significance. For consistency with the previous section and economic theory, country-by-country Johansen cointegration tests are also implemented here. The results of this exercise are reported in Table 6. Both the trace and maximum eigenvalue tests almost unanimously point to the same conclusion. The results indicate that the null hypothesis of zero cointegrating vectors is rejected in favour of one cointegrating vector in the case of Gambia, Kenya, Lesotho, Mauritius, Niger, Senegal, South Africa and Rwanda. The evidence also shows existence of at least two co-integrating vectors for Central African Republic, Cameroon, Malawi and Zimbabwe. For Sierra Leone and Togo, the null hypothesis $r = 0$ (no cointegration), $r \leq 1$, $r \leq 2$, and $r \leq 3$ cannot be rejected at any conventional level of significance in favour of alternative hypotheses $r = 1$, $r = 2$, and $r = 3$. These results suggest the presence of a long-run equilibrium relationship among GDP per capita, financial development, M1 and government expenditure in these countries. Thus although the Granger non-causality is ruled out, the direction of Granger causality will be examined next using VECM technique.

We perform ECM-based causality tests for each country and there can be two different sources of causality. The first is the F-test (Wald-test) of explanatory variables (lagged dynamic terms), where non-rejection implies '*x* does not Granger-cause *y*' in the short run. The second is the significance of legged error-term (ECT), which implies a long-run causal relation as it contains long-run information of the variables. Test results of the VECM models are presented in Table 7. To conserve space, this section uses only the private sector credit (*pcy*) proxy to examine the relationship between financial development and growth. The Granger-causality test rejects non-causality from financial development to real income growth in five countries (Central African Republic, Ghana, Malawi, South Africa and Zimbabwe) at least at the 10% significance level. But no feedback relationship from growth to

financial development is observed in these countries. There is evidence of a strong exogeneity test of financial development causing growth, showing overall short-run and long-run causality in Malawi where the sum of the coefficient of the explanatory variable and the corresponding error-correction is significant at the 5% level. Our results also show a feedback relationship (two-way Granger causality) between financial development and real GDP per capita growth from Cameroon, Gambia, Kenya, Niger and Rwanda. This finding lends support to the prediction of Grimmay (2004) for SSA countries who reported that financial development had a long-run causal effect on economic growth in 8 of the 13 sample countries (where six of them were bidirectional). Similar results were reported for other countries by Luintel and Khan (1999) and Ang and McKibbin (2005). Other significant results include unidirectional causality from growth to financial development. For the Senegal and Mauritius, Granger non-causality from economic growth to financial development can be rejected at the 5% significance level, not the reverse. There is, however, no evidence of uni-directional or bi-directional causality between financial development and GDP per capita growth, either in short run or long run in Lesotho, Sierra Leone and Togo.

[Insert Table 7 about here]

In general, these results confirm the importance of the role of a well-functioning financial sector and its contribution to the development process. It is well documented in the literature that a robust financial sector is essential in promoting economic development (see, for example King and Levine, 1993a; Luintel and Khan, 1999). Specific channels through which a modern financial sector might facilitate long-run growth include: enhancing the rate of capital accumulation (savings mobilization for investment); increasing the efficiency of investment; reducing information asymmetries and improving risk management; and allowing greater specialization and supporting continuous technological innovation (Levine, 1997). In line with these studies our research finding supports the view that 'finance seems importantly to lead economic growth'. The causality investigation shows that 10 out of the 15 SSA countries exhibited either two-way causality or a unidirectional Granger-causality running from financial development to growth. Our findings tend to agree with those of Andersen and Tarp (2003), Arestis and Demetriades (1997), and Demetriades and Hussein (1996) that may be country-specific, and use of time series, as opposed to cross-sectional data, is important in distinguishing different causal patterns.

Finally we also investigate the effect of financial liberalization on financial development. In order to provide further insight into the dynamic relationship between financial liberalization and economic growth, we also test for a causality relationship between the time series. The result of this exercise is summarized in Table 8. For the individual countries, one-way causality, where the null hypothesis that 'Granger no-causality from financial liberalization to growth' can be rejected at the 95% significance level (mainly through error-correction indicating a long-run causal effect), are observed only in the cases of Senegal and Togo. On contrary, evidence that economic growth leading financial liberalization can be seen for Kenya, Lesotho and South Africa. Importantly, our results clearly indicate that in the cases of Central African Republic, Mauritius, Malawi, Sierra Leone, Rwanda, and Zimbabwe, neither financial liberalization causes growth nor does economic growth cause financial liberalization. In line with our findings earlier, there is little evidence to

suggest that financial liberalization affects economic growth directly. Overall results from the time series data tend to support the view that financial liberalization influences economic development indirectly through fostering financial development.

[Insert Table 8 about here]

4. Conclusion

In order to evaluate and investigate the role of financial development and financial liberalization in the process of economic development, we have presented panel and time series data analyses for Sub-Saharan African countries. Both the theoretical and empirical literature suggests that through playing the critical role in fostering savings mobilization, easing risk management, allocating capital to more productive uses and facilitating transaction financial development stimulates growth. In this regard, financial sector underdevelopment can be a serious obstacle to long-term growth. Thus, a number of comprehensive financial reforms have taken place in Sub-Saharan African countries in the last decade and a half to address the problems of African financial markets and further encourage the financial system to deliver better financial services.

This paper has applied recent developments in non-stationary panel and time-series data analyses to explore the long-run relationship between the financial development, financial liberalization and economic growth for 15 SSA countries. While Pedroni's panel cointegration is employed, the use of cointegration/vector error-correction provides a more realistic dynamic representation of the relationship by incorporating an important feedback relationship that may exist between variables. While using two different proxies for financial development, the results of the panel unit root tests suggest that all of the series are non-stationary integrated variables. Further, evidence from cointegration implies that there is causality between variables considered in the study.

From the group-mean panel FMOLS developed by Pedroni, we obtain a significant positive estimate for the coefficients of financial development. Panel estimates for both coefficients of private sector credit and credit to domestic sectors (the two proxies of financial development) are estimated to be 0.57 and 0.59 respectively and the null hypothesis is rejected at the 5% significance level. Accordingly, higher levels of financial development lead to faster current and future rates of GDP per capita in Sub-Saharan African countries. From the panel estimator, the elasticity of income growth with respect to financial liberalization is negative and insignificant, indicating little evidence of a long-run linkage between financial liberalization and per capita GDP growth. In the second stage country-by-country time series investigations are considered using a multivariate cointegration test and error-correction model. The results from the VECM technique, which incorporated the cointegration effect into the causality analysis, show evidence of causality running from financial development to growth in five countries, a bi-directional causal relationships in five countries and reverse causality from economic growth to financial development in two countries. The analysis yielded evidence of financial liberalization Granger-causing economic growth only in two countries. However, this is not to say that financial liberalization does not promote growth as it could do so indirectly through fostering financial development. These findings appear to reinforce the Granger causality tests for the panel data as well as the fully modified group mean estimator (FMOLS). The policy implication of our results is that governments in

Africa should adopt strategies to enhance the role of the financial sector in promoting economic growth. To deliver effective financial services that boost productivity, structural and institutional constraints should be reduced or eliminated. More importantly, the legal and supervisory framework and supervisory capabilities should continuously be enhanced.

Table 1: Panel unit root tests (IPS and LCC)

Variables			IPS		LCC	
	Data type	Deterministic	Level	1st Difference	Level	1st Difference
PCY	Raw	Constant (C)	1.04	-9.18*	1.06	-9.11*
		C+ Trend	0.55	9.13*	-0.46	8.55*
	Demeaned	C+ Trend	1.77	8.55*	1.93	3.62*
DOM	Raw	Constant (C)	-0.09	-9.46*	-0.41	-9.23*
		C+ Trend	-0.04	-7.56*	-0.55	-7.51*
	Demeaned	C+ Trend	-0.03	-11.62*	-0.45	-12.01*
GDP	Raw	Constant (C)	-2.21	-9.87*	-3.82*	-8.35*
		C+ Trend	-1.38	-14.05*	-1.97	-13.36*
	Demeaned	C+ Trend	-1.56	-8.61*	-1.49	-7.31*
M1	Raw	Constant (C)	1.76	-9.47*	1.85	-7.65*
		C+ Trend	0.31	-8.29*	-0.97	-6.07*
	Demeaned	C+ Trend	-0.64	-14.84*	0.38	-12.63*
GOV	Raw	Constant (C)	-0.77	-12.17*	-0.56	-10.2*
		C+ Trend	-2.08	-9.87*	-0.57	-7.51*
	Demeaned	C+ Trend	-2.87**	-7.87*	-0.67	-13.31*
FLIB	Raw	Constant (C)	-1.57	-15.73	-0.32	-14.49
		C+ Trend	-1.53	-15.33	-2.45	-13.99
	Demeaned	C+ Trend	-1.72	-13.68	-2.15	-16.05

Note: * and ** indicate 1% and 5% rejection level, respectively.

Table 2: Panel cointegartion test statistics

Test	FD1	FD2	Flib
Panel v-stat	2.366*	2.015*	-2.864*
Panel rho-stat	1.243	-1.930*	0.313
Panel pp-stat	-3.117*	-0.933	-2.632*
Panel adf-stat	-1.789**	-1.895**	-1.775**
Group rho-stat	4.424*	2.228*	1.958*
Group pp-stat	-1.007	-3.307*	-2.001*
Group adf-stat	-1.877**	-0.695	-0.422

Note: *(**) indicate 1% (5%) rejection level of the null hypothesis. FD1 and FD2 are growth-private credit and growth-domestic credit equations respectively while Flib indicates the growth-financial liberalization equation.

Table 3(a): FMOLS regression for FD (private credit) and growth tests

Country	PCY	M1	GOV
CAR	-4.865* (-2.971)	-0.001 (-0.003)	0.256 (0.698)
Cameroon	-0.508 (-0.135)	-0.151 (-0.469)	1.349* (5.525)
Ghana	4.351* (6.327)	-0.651* (-4.478)	0.544* (6.495)
Gambia	-0.022 (-1.121)	0.282** (2.264)	-0.437** (-2.198)
Kenya	1.661* (3.549)	0.328*** (1.837)	0.479** (2.084)
Lesotho	-0.593 (-1.451)	0.796* (3.769)	0.366 (1.594)
Mauritius	-0.896** (-2.703)	-0.223 (-1.188)	2.121* (9.609)
Malawi	-0.536 (-0.375)	0.438 (1.809)	0.782* (3.389)
Niger	5.576** (2.306)	-0.239 (-1.301)	0.909* (4.130)
Senegal	-3.888* (-4.741)	0.075 (0.414)	1.749* (6.237)
S/Leone	-9.008* (-3.444)	0.221** (2.148)	-0.161 (-1.123)
Togo	1.488 (1.324)	-0.171 (-1.127)	-0.245 (-1.084)
S/Africa	0.058 (1.133)	0.088 (1.053)	1.025* (8.548)
Rwanda	4.182** (2.701)	0.179 (0.302)	0.399 (1.526)
Zimbabwe	0.574** (2.006)	-0.021 (-1.121)	0.632* (3.974)
Panel	0.031** (2.295)	0.105* (3.599)	0.213* (8.252)

Note 1: Figures in the parenthesis are t-statistics. *, ** and *** correspond to being significant at 1%, 5% and 10% respectively.

Table 3(b): FMOLS regression for FD (domestic credit) and growth tests

Country	DOM	M1	GOV
CAR	-2.215 (-1.625)	0.337 (0.932)	0.282 (0.611)
Cameroon	3.978* (5.408)	0.421** (2.566)	0.830* (6.322)
Ghana	1.427* (2.854)	-0.625** (-2.341)	0.709* (4.624)
Gambia	-0.731*** (-1.928)	0.402* (3.484)	-0.095 (-0.439)
Kenya	1.029** (2.192)	0.250 (1.117)	0.524 (1.666)
Lesotho	-0.351 (-1.474)	0.875* (4.080)	0.151 (0.596)
Mauritius	-0.468* (-2.841)	-0.256 (-1.594)	1.921* (11.352)
Malawi	-0.565 (-1.187)	0.287 (1.175)	0.795* (3.576)
Niger	4.371* (11.067)	-0.027 (-0.541)	0.346* (6.129)
Senegal	-1.953* (-3.143)	-0.319 (-1.499)	1.712* (4.798)
S/Leone	0.350 (1.404)	0.160 (1.1025)	-0.088 (-0.431)
Togo	0.375 (0.531)	-0.177 (-1.105)	-0.324 (-1.435)
S/Africa	0.129*** (1.737)	0.080 (1.157)	1.058* (10.704)
Rwanda	2.703* (3.252)	0.531 (1.232)	0.574** (2.355)
Zimbabwe	0.599** (2.216)	-0.021 (-1.165)	0.503* (3.083)
Panel	0.579* (4.741)	0.1 (2.221)	0.593* (13.817)

Note: See Note 1 of Table 3 (a).

Table 3(c): FMOLS regression for financial liberalization and growth tests

Country	FLIB	M1	GOV
CAR	-0.173 (-1.397)	0.347 (0.907)	0.328 (0.671)
Cameroon	-0.093 (-0.695)	-0.144 (-0.586)	1.198* (3.984)
Ghana	0.005 (0.043)	0.043 (0.206)	0.449** (2.643)
Gambia	0.077*** (1.833)	0.093 (0.644)	-0.098 (-0.501)
Kenya	0.003 (0.052)	0.085 (0.312)	0.939** (2.567)
Lesotho	-0.024 (-0.145)	0.871* (3.801)	0.275 (0.914)
Mauritius	-0.084 (-1.471)	-0.412*** (-1.970)	2.001* (7.368)
Malawi	-0.136 (-0.582)	0.449 *** (1.922)	0.830* (3.501)
Niger	0.032 (0.428)	0.032 (0.198)	0.571* (3.099)
Senegal	-0.284** (-2.338)	-0.569** (-2.056)	1.573* (3.622)
S/Leone	0.245* (3.407)	-0.003 (-0.034)	0.083 (0.567)
Togo	-0.304* (-3.981)	-0.246** (-2.518)	-0.060 (-0.423)
S/Africa	0.004 (0.125)	0.155*** (1.872)	1.052* (8.729)
Rwanda	0.066 (0.177)	1.613** (2.656)	0.058 (0.133)
Zimbabwe	0.227*** (1.976)	-0.025 (-1.208)	0.776* (4.312)
Panel	-0.029 (-0.714)	0.152 (1.071)	0.665* (10.635)

Note: See Note 1 of Table 3 (a).

Table 4: Panel data Granger causality results

Null hypothesis	F-test	(p-value)	ECT_{t-1}	(p-value)
PCY does not Granger cause GDP	3.846	0.010	0.003	0.496
GDP does not Granger cause PCY	0.673	0.511	-0.565	0.000
DOM does not Granger cause GDP	4.190	0.016	-0.044	0.453
GDP does not Granger cause DOM	1.598	0.204	0.036	0.429
FLIB does not Granger cause GDP	0.189	0.706	-0.036	0.467
GDP does not Granger cause FLIB	1.620	0.199	-0.057	0.008

(b) Pairwise Granger Causality Tests

Null hypothesis:	Obs	F-Statistic	p-value
GDP does not Granger cause FLIB	420	2.47062	0.0858
FLIB does not Granger cause GDP		0.12606	0.8816
PCY does not Granger cause FLIB	315	1.53906	0.1335
FLIB does not Granger cause PCY		1.93470	0.0469
DOM does not Granger cause FLIB	315	1.54459	0.1317
FLIB does not Granger cause DOM		1.99780	0.0393
PCY does not Granger cause GDP	420	2.38470	0.0934
GDP does not Granger cause PCY		3.94173	0.0201
DOM does not Granger cause GDP	420	4.29426	0.0143
GDP does not Granger cause DOM		7.26184	0.0008

Note: We have also tried the test at various lags and the relationship remains robust.

Table 5: ADF tests results for individual countries

Country	Variable	Levels	1st Difference	Country	Variable	Levels	1st Difference
CAR	GDP	-2.549	-5.804	Niger	GDP	-2.275	-4.775
	Pcy	0.734	-3.809		Pcy	-2.246	-3.850
	Dom	0.024	-4.147		Dom^{C}	-1.727	-3.143
	M1	-2.414	-3.866		M1^{C}	-2.082	-3.024
	GOV	-1.945	-3.503		GOV	-2.771	-4.328
	Flib	-1.828	-3.683		Flib	-1.497	-4.037
Cameroon	GDP^{C}	-1.891	-3.014	Senegal	GDP^{C}	-1.069	-3.150
	Pcy	-2.054	-3.718		Pcy	-1.564	-3.709
	Dom^{C}	-1.697	-3.083		Dom^{C}	-2.143	-3.001
	M1	-2.269	-2.508		M1	0.500	-4.844
	GOV	-1.828	-3.834		GOV	-1.822	-3.637
	Flib	-2.847	-3.873		Flib	-2.005	-3.658
Ghana	GDP	-2.324	-5.665	S/Leone	GDP	-1.768	-3.788
	Pcy	-1.928	-3.638		Pcy	-1.383	-3.601
	Dom	-0.492	-2.991		Dom	-2.636	-5.108
	M1	-2.054	-4.089		M1	-1.198	-3.076
	GOV	-1.884	-4.428		GOV	-2.198	-3.665
	Flib	-2.317	-5.369		Flib	-1.834	-3.962
Gambia	GDP	-1.539	-3.788	Togo	GDP	-1.216	-3.305*
	Pcy	-2.923	-3.836		Pcy	-2.223	-4.082
	Dom^{C}	-1.303	-3.016		Dom^{C}	-1.817	-3.318
	M1	-0.496	-3.727		M1	-2.805	-6.342
	GOV	-1.490	-5.724		GOV	-3.727	-
	Flib^{C}	-0.305	-3.023		Flib	-2.987	-4.383
Kenya	GDP	-2.512	-5.060	S. Africa	GDP	-3.128	-3.778
	Pcy	-2.411	-3.737		Pcy	-2.064	-3.908
	Dom	-2.214	-4.364		Dom	-2.040	-4.644
	M1	-2.177	-3.695		M1	-2.951	-4.507
	GOV	-2.908	-3.645		GOV^{C}	0.012	-3.197
	Flib	-2.015	-3.859		Flib	-2.883	-4.103
Lesotho	GDP	-1.811	-5.989	Rwanda	GDP	-2.644	-4.074
	Pcy	-0.044	-3.688		Pcy	-1.372	-5.571
	Dom^{C}	-0.958	-3.131		Dom	-1.596	-4.068
	M1	-2.881	-4.713		M1^{C}	-0.905	-3.032
	GOV	-2.709	-3.939		GOV	-1.586	-3.989
	Flib	-2.955	-4.144		Flib	-2.308	-5.892
Mauritius	GDP	-0.489	-4.035	Zimbabwe	GDP	-1.930	-4.204
	Pcy	-1.326	-3.741		Pcy	-0.420	-6.374
	Dom	-0.392	-3.188*		Dom	-1.677	-3.914
	M1	-1.165	-3.282*		M1	-1.975	-5.593
	GOV	-2.932	-3.978		GOV	-2.191	-4.096
	Flib	-2.479	-5.561		Flib	-1.749	-3.603
Malawi	GDP	-2.421	-4.044				
	Pcy	-2.092	-3.338				
	Dom	-1.217	-3.021*				
	M1	-2.816	-4.565				
	GOV	-3.200*	-3.838				
	Flib	-2.518	-3.801				

Note: * denotes statistical significance at 10% level. (C) Denotes test includes a constant, all others take into account a constant and a trend.

Table 6: Johansen's maximum likelihood test for multiple cointegrating relationships

Country	Null vs Alternative	Eigevalue	Trace	maximum eigenvalue
CAR	r = 0 r =1	0.689	60.764*	32.742*
	r ≤ 1 r =2	0.392	28.022**	13.925
	r ≤ 2 r =3	0.349	14.097	12.007
Cameroon	r = 0 r =1	0.591	58.597*	28.999*
	r ≤ 1 r =2	0.553	33.598*	22.562*
	r ≤ 2 r =3	0.249	11.036	8.008
Ghana	r = 0 r =1	0.682	75.013*	32.050*
	r ≤ 1 r =2	0.635	42.963*	28.232*
	r ≤ 2 r =3	0.366	14.731	12.779
Gambia	r = 0 r =1	0.686	70.143*	32.420*
	r ≤ 1 r =2	0.513	37.723	20.119
	r ≤ 2 r =3	0.419	17.604	15.224
Kenya	r = 0 r =1	0.667	51.072*	30.788*
	r ≤ 1 r =2	0.312	20.284	10.471
	r ≤ 2 r =3	0.222	9.813	7.027
Lesotho	r = 0 r =1	0.630	65.636*	27.826
	r ≤ 1 r =2	0.555	37.810	22.684
	r ≤ 2 r =3	0.316	15.127	10.629
Mauritius	r = 0 r =1	0.483	45.393*	18.447
	r ≤ 1 r =2	0.369	22.947	12.903
	r ≤ 2 r =3	0.301	10.044	10.019
Malawi	r = 0 r =1	0.658	60.364*	30.020*
	r ≤ 1 r =2	0.563	30.344*	23.177*
	r ≤ 2 r =3	0.223	7.167	7.061
Niger	r = 0 r =1	0.549	47.595*	22.266
	r ≤ 1 r =2	0.444	23.329	16.460
	r ≤ 2 r =3	0.126	6.869	3.776
Senegal	r = 0 r =1	0.564	49.164*	23.250
	r ≤ 1 r =2	0.388	25.914	13.740
	r ≤ 2 r =3	0.274	12.174	8.951
S/Leone	r = 0 r =1	0.490	41.701	18.860
	r ≤ 1 r =2	0.347	22.841	11.934
	r ≤ 2 r =3	0.258	10.907	8.342
Togo	r = 0 r =1	0.522	44.641	20.642
	r ≤ 1 r =2	0.379	23.999	13.335
	r ≤ 2 r =3	0.227	10.664	7.203
S.Africa	r = 0 r =1	0.629	49.766*	27.745*
	r ≤ 1 r =2	0.443	22.022	16.378
	r ≤ 2 r =3	0.180	5.644	5.558
Rwanda	r = 0 r =1	0.661	60.231*	30.282*
	r ≤ 1 r =2	0.436	29.949	16.032
	r ≤ 2 r =3	0.282	13.917	9.286
Zimbabwe	r = 0 r =1	0.657	60.235*	29.968*
	r ≤ 1 r =2	0.541	30.267*	21.832*
	r ≤ 2 r =3	0.212	8.435	6.674

Note: * denotes significance at the 5% level and ** denotes significance at the 10% level.

Table 7: Granger causality results based on error-correction model

Country	Null hypothesis	F-test	(p-value)	ECT-1	(p-value)
CAR	PCY →GDP	0.871	0.435	-0.746	0.043
	GDP → PCY	1.090	0.358	-0.183	0.186
Cameroon	PCY →GDP	0.048	0.854	-1.008	0.025
	GDP → PCY	1.510	0.248	-0.994	0.000
Ghana	PCY →GDP	0.749	0.487	-0.367	0.052
	GDP → PCY	0.102	0.903	-0.251	0.287
Gambia	PCY →GDP	0.924	0.415	-0.270	0.074
	GDP → PCY	1.071	0.364	-1.167	0.000
Kenya	PCY →GDP	3.984	0.052	-0.993	0.013
	GDP → PCY	0.725	0.498	-0.399	0.034
Lesotho	PCY →GDP	0.314	0.569	-0.070	0.617
	GDP → PCY	0.057	0.673	-0.090	0.734
Mauritius	PCY →GDP	0.161	0.853	0.031	0.802
	GDP → PCY	1.375	0.285	-0.488	0.025
Malawi	PCY →GDP	2.911	0.067	-0.165	0.047
	GDP → PCY	2.162	0.144	-0.317	0.118
Niger	PCY →GDP	2.910	0.081	-0.279	0.052
	GDP → PCY	0.751	0.486	-0.599	0.050
Senegal	PCY →GDP	0.762	0.481	-0.110	0.317
	GDP → PCY	0.069	0.934	-0.523	0.049
S/Leone	PCY →GDP	1.967	0.166	-	-
	GDP → PCY	0.252	0.780	-	-
Togo	PCY →GDP	0.290	0.751	-	-
	GDP → PCY	1.129	0.230	-	-
S. Africa	PCY →GDP	7.117	0.009	-0.232	0.186
	GDP → PCY	0.698	0.533	-0.116	0.331
Rwanda	PCY →GDP	1.044	0.372	-0.717	0.002
	GDP → PCY	3.066	0.066	0.034	0.708
Zimbabwe	PCY →GDP	0.102	0.904	-0.547	0.003
	GDP → PCY	1.465	0.257	-0.185	0.139

Note: ECT_{t-1} denotes the error correction term. The F-test is the joint significance of the lagged coefficients of the independent variables. → means 'does not Granger-cause'.

Table 8: Granger causality tests between financial liberalization and growth

Country	Null hypothesis	F-test	(p-value)	ECT-1	(p-value)
CAR	FLIB → GDP	2.268	0.132	-0.082	0.208
	GDP →FLIB	3.417	0.055	-0.488	0.011
Cameroon	FLIB → GDP	1.232	0.315	-0.111	0.229
	GDP →FLIB	1.160	0.336	-0.669	0.102
Ghana	FLIB → GDP	2.772	0.089	-0.035	0.685
	GDP →FLIB	1.736	0.205	-0.567	0.014
Gambia	FLIB → GDP	0.250	0.782	-0.313	0.095
	GDP →FLIB	0.534	0.595	-0.222	0.032
Kenya	FLIB → GDP	0.356	0.705	-0.099	0.401
	GDP →FLIB	5.044	0.013	-0.230	0.186
Lesotho	FLIB → GDP	1.672	0.216	0.075	0.612
	GDP →FLIB	1.144	0.341	-0.861	0.018
Mauritius	FLIB → GDP	1.415	0.267	-	-
	GDP →FLIB	1.217	0.407	-	-
Malawi	FLIB → GDP	1.274	0.263	-0.158	0.147
	GDP →FLIB	0.266	0.770	-0.469	0.167
Niger	FLIB → GDP	1.553	0.185	-0.243	0.041
	GDP →FLIB	2.046	0.158	-0.338	0.045
Senegal	FLIB → GDP	5.170	0.004	-0.276	0.008
	GDP →FLIB	0.989	0.391	-0.057	0.732
S/Leone	FLIB → GDP	1.796	0.193	-	-
	GDP →FLIB	1.231	0.314	-	-
Togo	FLIB → GDP	1.617	0.226	-0.524	0.036
	GDP →FLIB	0.317	0.733	-0.769	0.117
S. Africa	FLIB → GDP	0.412	0.668	-0.055	0.748
	GDP →FLIB	0.276	0.762	-0.404	0.026
Rwanda	FLIB → GDP	1.710	0.209	-0.094	0.806
	GDP →FLIB	0.311	0.737	-0.462	0.138
Zimbabwe	FLIB → GDP	0.263	0.774	-0.419	0.144
	GDP →FLIB	0.324	0.730	-0.381	0.165

Note: See note to Table 7 above.

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