AFRICAN GOVERNANCE AND DEVELOPMENT INSTITUTE

A G D I Working Paper

WP/12/002

African Development: Beyond Income Convergence

Simplice A. Asongu
African Governance and Development Institute,
P.O. Box 18 SOA/ 1365 Yaoundé, Cameroon.
E-mail: asongusimplice@yahoo.com

 WP/12/002

AGDI Working Paper

Research Department

African Development: Beyond Income Convergence

Simplice A. Asongu[1]

January 2012

Abstract

In examining some big questions on African development, we provide evidence that dynamics of some development indicators could support both endogenous and neoclassical growth theories in the convergence debate. This paper investigates convergence in real per capita GDP and inequality adjusted human development in 38 African countries, disaggregated into 10 homogenous panels based on regions (Sub-Saharan and North Africa), income-levels (low, middle, lower-middle and upper-middle), legal-origins (English common-law and French civil-law) and religious dominations (Christianity and Islam). The main finding is that the income component of the human development index moves slower than others in the convergence process and thus requires a more focused policy intervention. As a policy implication, looking beyond income convergence can provide a concrete agenda for development involving all aspects of economic, institutional and social life.

Keywords: Human development; Growth; Convergence; Panel; Africa
JEL Classification: O11; O20; O47; O55; P52

Acknowledgement

The author is highly indebted to the editor and referees for their useful comments.

[1] Simplice A. Asongu is Lead economist in the Research Department of the AGDI (asongus@afridev.org).

1. Introduction

Is human development among African countries converging or diverging? Do income levels matter in poor countries catching-up with their rich counterparts? Does religious-origin have some bearing on convergence (divergence) in African development? Does legal-origin influence the quality of human development convergence? Do regional dynamics matter in the convergence process? Common to all these questions is the issue of the speed of convergence (divergence). This concern cuts deep into the formulation of theories and policies of economic growth in the African continent. By 2008, according to Konya & Guisan (2008, p. 9) only three papers in the literature had focused on the study of convergence by measuring standards of living with the human development index instead of per capita GDP or labour productivity. What many studies show is that economic and human developments are complex processes with historical, political, economic, geographic and institutional determinants that do not conform to some simple linear model (Mayer-Foulkes, 2010). This fact guides the current paper in disaggregating African countries into 10 homogenous panels based on regions (Sub-Saharan and North Africa), income-levels (low, middle, lower-middle and upper-middle), legal-origins (English common-law and French civil-law) and religious dominations (Christianity and Islam). Hence, the richness of our dataset in investigating this previously missing human development dimension in the convergence literature adds impetus to the study.

Convergence in economic growth and per capita income among nations has been a central theme in neoclassical growth theory and a great bulk of economic literature for decades. Traditionally, the analysis of convergence involved the investigation of whether poor countries are set on a convergence path; that is, if their real per capita incomes will eventually catch-up with those of rich countries. However in recent decades, increased emphasis has been laid on

development strategies based on regional economic integration which has required effectiveness and stability, strengthening of macroeconomic policy credibility; leading to the formulation of specific goals of macroeconomic convergence among regional economic groupings (Tirelli, 2010; Kumo, 2011).

Empirical evidence shows that during the past three decades there have been strong differences among countries in real capita income and economic growth, especially between African economies and emerging Asian countries (Kumo, 2011). Introducing a previously missing human development component into the convergence debate with an in depth analysis from multidimensional spectrums could result in important policy implications. This paper therefore assesses two aspects of intra-regional convergence in ten different panels from the African continent. These include: firstly, the assessment of convergence (divergence) among economies and; secondly, the speed of convergence. An added appeal of this work is the use of a new approach to convergence investigation recently applied by Narayan et al. (2011). Grasping the rate of convergence could have particularly significant policies implications for the African continent given the current debate on economic integration. The rest of the paper is organized in the following manner. Section 2 reviews existing literature. Data and methodology are presented and outlined respectively in Section 3. Empirical analysis, discussion of results, policy implications and future directions are covered in Section 4. We conclude with Section 5.

2. Literature review

2.1 Theoretical framework and intuition

The initial theories of growth that sprouted with the neoclassical revolution and the demise of Keynesianism defined the concept of convergence. As Development Economics was thrown out, together with its appreciation of vicious and virtuous circles, nascent theories of

economic growth grounded simply on extending the concepts of market equilibrium to the inter-temporal dynamic context forecasted absolute convergence (Mayer-Foulkes, 2010). It ensued that economic convergence across countries would result from the implementation of free markets. Therefore findings on convergence were considered to support free market policies. Results from initial empirical studies on income convergence (Barro, 1991) revealed absolute divergence instead, as was later confirmed for the long-run by Pritchett (1997).

The neoclassical (exogenous) growth model predicts that real per capita income converges to each country's steady state or common steady state, irrespective of its initial level (Kumo, 2011). Conversely, the endogenous growth theory by emphasizing differences among countries in their initial endowments and the possibility of multiple equilibria shows that there is no tendency for income levels to converge in the long-term.

The intuition motivating this paper is typically consistent with the evidence of income convergence across countries which has been examined and documented in the context of neoclassical growth models, originally developed by the pioneering works of Baumol (1986), Barro & Sala-i-Martin (1992, 1995) and Mankiw et al. (1992). The theoretical underpinnings of income convergence are flooding the empirical growth literature (Solow, 1956; Swan, 1956) and have recently been applied in other areas of economic development (Narayan et al., 2011; Asongu, 2012). Whereas there is a theory and vast empirical work on per capita income convergence, there is yet not a theory on convergence in other development branches, e.g financial markets, Intellectual Property Rights (IPRs), knowledge economy (KE)...etc. However, there has been growing application of convergence underpinnings to IPRs harmonization (Asongu, 2012), financial markets (Bruno et al., 2011; Narayan et al., 2011; Asongu, 2013a,b) and, optimality of currency areas (Asongu, 2013c,d). Cognizant of these recent empirical

developments, aware of the risks of 'doing measurement without theory'; we argue that reporting facts even without the presence of a formal theoretical model is a useful scientific activity. Therefore, we concur with recent literature (Costantini & Lupi, 2005; Narayan et al., 2011; Asongu, 2012) in the assertion that applied econometrics has other tasks than the mere validation or refutation of economic theories.

2.2 Previous studies on convergence in human development

More than two decades have passed since the 1990 Human Development Report that introduced economic development as human development. Twenty years of change have followed, marked by globalization and events that have improved our understanding of the convergence dimension in human development (Mayer-Foulkes, 2010).

In 2008, Konya & Guisan (2008, p. 9) acknowledged the existence of only three papers in the literature that were dedicated to the study of convergence by measuring living standards. These were Mazumdar (2002), Sutcliffe (2004) and Noorbakhsh (2006). Since the work of Konya & Guisan (2008), to the best of our knowledge only two works have been added to this bulk of existing human development convergence literature: Mayer-Foulkes (2010) and Clark (2011). However, in retrospect we notice that Konya & Guisan (2008) do not give credit to Hobijn & Franses (2001) and Neumayer (2003) who have also focused on human development convergence. We shall examine all these works in the review below.

Mazumdar (2002) investigate if the Human Development Index (HDI) converged across countries over the period 1960-1995 for a full sample of 91 countries, as well as for three groups of countries classified in their levels of human development. Findings of this work indicated divergence for all four considered cases, suggesting that the economies of the world were becoming more dissimilar over the period 1960-1995 with respect to the HDI. Konya & Guisan

(2008) have criticized the basis for data comparability in the work. According to them, Mazumdar (2002) obtained the HDI values for 1960 and 1995 from the 1998 issue of the Human Development Report (HDR). The 1998 HDR however does not report any HDI data for 1960. Konya & Guisan (2008) further emphasis it is well stated on the UNDP website that "*comparable data are not available for many countries for all components of the HDI before 1975, so 1975 is the first year for which the HDI was calculated*" (p. 27).

Sutcliffe (2004) focused on the link between globalization and world inequality and only assessed the issue of convergence in human development by studying the HDI trends of 99 countries in 1975, 1980… 1995 and 2001. Still borrowing from Konya & Guisan (2008), Sutcliffe (2004) rebuffed the whole idea of HDI convergence for two reasons. (1) He posited that developed countries have their HDIs close to unity because in these countries life expectancy has been close to its biological limit, adult literacy and educational (primary) enrolment have been practically hundred percent, and the impact of the only variable without natural upper limit (per capita income) on measuring the variation between the rich and the poor is strongly restricted by taking the logarithm of per capita income. According to Konya & Guisan (2008), this is not a reasonable criticism because in the HDI, life expectancy and education are measured in relative terms compared to the variation between potentially ever changing maximum and minimum values. As concerns per capita income, the logarithm transformation certainly brings the values closer to each other and this is true for the extreme values too. (2) Sutcliffe (2004) is of the opinion that the HDI convergence has been grasped suddenly by the IMF (for instance) to mitigate the acknowledged downside of the long-term economic history of the world economy. We concur with Konya & Guisan (2008) in asserting that this second point might be true, but it

does not eradicate the fact that even with the exception of income, health and education (other components in the HDI) are crucial determinants of the quality of life.

Noorbakhsh (2006) used slightly updated data on the HDI from 1975 to 2002 with five year intervals. However his methodology has been criticized from a broad range of dimensions (Konya & Guisan, 2008, p. 28-29). A common criticism to Mazumdar (2002), Sutcliffe (2004) and Noorbakhsh (2006), is that they tested for convergence without correcting for heteroscedasticity. Owing to the wide range of countries in their samples, it is most likely that their estimates could be misleading.

Neumayer (2003) and Hobijn & Franses (2001) investigate convergence in living standards. While the latter conclude on the existence of divergence in living standards, the former argues that convergence in living standards should not be looked-at only in some achievement index. Neumayer (2003) finds strong evidence of convergence in some aspects of living standards like life-expectancy, infant survival, educational enrolment, literacy as well as telephone and television availability. Neumayer (2003) argues that in suggesting divergence rather than convergence in living standards, Hobijn & Franses (2001) unduly deny one of the great success stories of development in the last century. Clark (2011) study the last half of the twentieth century by examining the extent to which welfare outcomes have actually converged and the degree by which economic development is responsible for the observed trends. Drawing from estimates of 195 nations during the period 1955 to 2005, he finds that life expectancy averages converged during this time but the infant mortality rate continuously diverged. Among poor countries, economic development improves life expectancy more than it reduces infant mortality while the situation is reversed among wealthier nations. In this perspective, development has contributed to both convergence in life expectancy and divergence in infant

mortality. There is also evidence that the positive effect of GDP per capita on life expectancy attenuates at higher levels of development whereas the negative effect of GDP per capita growth on infant mortality grows stronger.

2.3 Motivations for convergence in African development

Weak development convergence hinders deeper economic integration in African sub-regions. Thus human development convergence is not an end in itself; instead it is a strategy to economic integration. In the same line of thought, convergence to similar per capita income and human development levels could facilitate trade links and technological spillovers, equalize macroeconomic and institutional policies. On the other hand, macroeconomic strategies should be designed conditional on the actual degree of convergence in the economic structure (Tirelli, 2010). Analysis of human development convergence therefore serves as a signal in the degree of success of integration promotion strategy (Kumo, 2011).

In contrast to Tirelli (2010) and Kumo (2011), we postulate that studies on integration should not limit the concept of convergence to the neoclassical versus endogenous growth controversy in the development of African countries. As highlighted by Konya & Guisan (2008), for undeveloped countries, beyond macro economic convergence, factor endowments, policies and institutions, other important dimensions of human-life like, health, education, working conditions, leisure time, environment, management to escape the grip of famine, social justice…etc have become increasingly important. Lofty ambitions of catching-up with the First World cannot only be limited to analysis between developed and developing countries. A within-assessment of African convergence could be modeled to take stock of the state and direction of living standards. This dimension of convergence has escaped the focus of development literature and certainly deserves attention. Neoclassical growth theory has modeled income-convergence in

such a neat way. Given the absence of strong theoretical foundation for human development convergence, we agree with Costantini & Lupi (2005) that applied econometrics has other tasks than merely validating or refuting economic theories.

2.4 How does the current paper integrate various strands in the literature?

Firstly, we have concurred with Konya & Guisan (2008) in the postulation that a common criticism to Mazumdar (2002), Sutcliffe (2004) and Noorbakhsh (2006), is that they tested for convergence without correcting for heteroscedasticity and owing to the wide range of countries in their samples, it is most likely that their estimates could be misleading. This concern is taken into account in our paper by the Two-Step dynamic GMM estimation technique. It should be recalled that the first-step is based on homoscedasticity of residuals.

Secondly, the Sutcliffe (2004) criticism of the HDI convergence as a means by the IMF to blur the long standing differences between rich and poor countries is only partially valid. We have sided with Konya & Guisan (2008) in asserting that this second point might be true, but it does not eradicate the fact that even with the exception of income, health and education are crucial determinants of the quality of life. To account for this dimension of the debate, we shall distinguish the income component of the HDI in a distinct analysis. Therefore our variables of interest shall be GDP per capita and human development. More so, this decomposition is in line with the basis for the Hobijn & Franses (2001) and Neumayer (2003) debate.

Thirdly, the 2010 Human Development Report has integrated some of the criticisms by Sutcliffe (2004) into the new HDI computation: inequality adjusted HDI. Therefore our work steers clear of past literature by using an index that integrates criticisms from said literature.

Fourthly, the absence of any study that has focused exclusively on Africa is deserving of examination. In the present context of the regional integration debate in the continent, it is

worthwhile investigating the human development appeals of such policies. Beyond this, the richness of our dataset (based on 10 homogenous panels) adds motivation to context of this paper.

3. Data and methodology

3.1 Data

We examine a sample of 38 African countries with data from African Development Indicators (ADI) of the World Bank. Due to constraints in data availability, the dataset spans from 1981 to 2009. The dependent variables are the GDP per capita growth rate and the human development index (HDI). The HDI combines three dimensions of development: a long and healthy life (life expectancy at birth); an education index (mean years of schooling and expected years of schooling) and; a decent standard of living (Gross National Income per capita).

3.1.1 Determination of fundamental characteristics

Many studies show that economic and human developments are complex processes with historical, political, economic, institutional and geographical determinants that do not conform to some simple linear model (Mayer-Foulkes, 2010). To this end, we concur with Narayan et al., (2011) in highlighting that one is unlikely to find convergence within a very heterogeneous set of countries. Hence, the determination of characteristics that are fundamental to human development is crucial.

There are several issues in the determination of fundamental characteristics. Firstly, using non-dummy variables to represent fundamental characteristics is not easy because macroeconomic and institutional characteristics are time-dynamic. Hence, may not be consistent across a long time span (1981-2009). Secondly, using political stability/conflicts as criterion has

two main constraints: on the one hand, since no African country is really free from conflict, it is difficult to arbitrarily appreciate conflicts and; on the other hand, determining a significant threshold of conflicting years to consider also represents an issue. For example, with our sample span of 29 years, it is difficult to establish whether conflict-countries should be those that have experienced political violence/instability for at least 10 years (or less) during the sample period. Thirdly, using oil-exporting countries also poses three issues. (1) We cannot determine what % of GDP (resulting from oil-exports) is significant to qualify a country as 'oil-exporting'. (2) The interval of time required to qualify a country as oil-exporting also represents a qualm. While some countries have only discovered oil in the 21st century, others have experienced a substantial decline in the natural resource. (3) Some countries (such as Botswana in the sample) are not oil-exporting but yet have the same macroeconomic characteristics based on the relevance of natural resources to GDP.

In light of the above, we control for macroeconomic characteristics that are fundamental to development in the estimations (choice of control variables) and take a minimalistic approach in determining fundamental characteristics based on: legal origins, income-levels, regional proximity and religious dominations. These characteristics are broadly consistent with recent convergence literature (Narayan et al., 2011; Asongu, 2013a, b).

3.1.2 Control variables

In the literature on convergence in per capita incomes, countries identical in structural and institutional characteristics such as preferences in technologies, government policies and price stability have the tendency to converge to one another if their initial conditions are dissimilar (Prichett, 1997). Hence we control for trade, inflation, public investment, polity IV,

foreign direct investment, foreign aid, private investment and democracy (Rodriguez & Sachs, 1999; Bruno et al., 2011; Narayan et al., 2011; Arezki & Gyfalson, 2011).

Details about the summary statistics, correlation analysis (showing the basic correlations between key variables used in this paper) and variable definitions (with corresponding data sources) and panels are presented respectively in Appendix 1, Appendix 2, Appendix 3 and Appendix 4. The descriptive statistics of the variables show that there is quite some degree of variation in the data utilized so that one should be comfortable and confident that reasonable estimated relationships would emerge. The purpose of the correlation matrix is to mitigate concerns of overparametization and multicolinearity. Based on the correlation coefficients, there do not appear to be any major issues in terms of the relationships to be estimated.

3.2 Model and estimation approach

Consistent with Islam (2003), dichotomies indicate some of the different ways in which convergence can be understood: convergence within an economy versus (vs) convergence across economies; convergence in terms of growth rate vs. convergence in terms of income, *beta*-convergence vs. *sigma*-convergence; unconditional (absolute) vs. conditional convergence; global-convergence vs. local or club-convergence; income-convergence vs. TFP (total factor productivity)-convergence and; deterministic-convergence vs. stochastic convergence. There is also some correspondence between the convergence definitions and the methodologies used. This correspondence is however not unique because, for instance the informal and formal cross-section approaches, the panel approach and the time series approach (in part) have all studied *beta*-convergence either conditionally or unconditionally. These approaches have generally focused on convergence across economies and in terms of per capita income level. Moreover, the formal cross-section approach and the panel approach have been used to assess club-

convergence and TFP convergence. The cross-section approach has even been employed for *sigma*-convergence. The time series approach has been used to examine convergence both within an economy and across-economies. Finally, the distribution approach has gone beyond assessing *sigma*-convergence and has investigated the entire shape of intra-distribution and distribution dynamics.

Convergence in terms of both growth rate and income level requires the *beta*-convergence approach. This derives from the assumption of diminishing returns which denote higher marginal productivity of capital in capital-poor countries. Hence, with similar savings rates, poorer economies will therefore grow faster. When this scenario holds, there should be a negative correlation between the initial income-level and subsequent growth rate. This convergence is known as *beta*-convergence. A downside of this approach is that a negative *beta* from the growth-initial level regression does not necessarily imply a reduction in dispersion. This has given rise to the concept of *sigma*-convergence, where *sigma* is the notation for standard deviation of the cross-sectional distribution of either income-level or growth rate. Despite this limitation that *beta*-convergence is a necessary but not a sufficient condition for *sigma*-convergence; researchers have continued to employ it because it provides information regarding structural parameters of growth models, whereas the distribution approach usually does not provide such information.

The estimation approach based on β-convergence is broadly consistent with the methodological underpinnings of recent convergence literature (Asongu, 2012a, 2013a, b). The estimation procedure typically follows the evidence of income convergence across economies which has been investigated in the context of pioneering works in neoclassical growth models

(Baumol, 1986; Barro & Sala-i-Martin, 1992, 1995; Mankiw et al., 1992), as well as in recent finance (Narayan et al., 2011; Asongu, 2013a,b) and IPRs (Asongu, 2012) literature.

Borrowing from Fung (2009) the two equations below are the standard approaches in the literature for testing conditional convergence if $W_{i,t}$ is taken as strictly exogenous.

$$\ln(Y_{i,t}) - \ln(Y_{i,t-\tau}) = \beta \ln(Y_{i,t-\tau}) + \delta W_{i,t-\tau} + \eta_i + \xi_t + \varepsilon_{i,t} \qquad (1)$$

$$\ln(Y_{i,t}) = a \ln(Y_{i,t-\tau}) + \delta W_{i,t-\tau} + \eta_i + \xi_t + \varepsilon_{i,t} \qquad (2)$$

Where $a = 1+ \beta$, $Y_{i,t}$ is the measure of per capita income or human development in country *i* at period *t*. $W_{i,t}$ is a vector of determinants of per capita human development, η_i is a country specific effect, ξ_t is a time specific constant and $\varepsilon_{i,t}$ an error term. Consistent with the neo-classical growth model, a statistically significant negative coefficient on β in Eq. (1) suggests that countries relatively close to their steady state of per capita growth will experience a slowdown in growth of per capita human development, known as conditional convergence (Narayan et al., 2011, p. 2). Also, in line with Fung (2009, p. 3), if $0 < |a| < 1$ in Eq. (2), then $Y_{i,t}$ is dynamically stable around the path with a trend growth rate the same as that of W_t, and with a height relative to the level of W_t. The variables contained in $W_{i,t-\tau}$ and the individual effect η_i are proxies for the long-term level the market is converging to. Thus, the country specific effect η_i appreciates the existence of other determinants of a country's steady state not captured by $W_{i,t-\tau}$.

Conditions for convergence elucidated above are valid if $W_{i,t}$ is strictly exogenous. Unfortunately, this is not the case in the real world because, while inflation, trade, public investment, democracy, foreign aid, Polity IV, private investment and foreign direct investment

(components of $W_{i,t}$) influence per capita development, the reverse effect cannot be ruled-out. Thus we are confronted with the issue of endogeneity where components of $W_{i,t}$ are correlated with the error term ($\varepsilon_{i,t}$). Also country- and time-specific effects could be correlated with other variables in the model, which is often the case when lagged dependent variables apply to the equations. A way of dealing with the problem of the correlation between the individual specific-effect and the lagged dependent variables consists in eliminating the individual effect by first differencing. Thus Eq. (2) becomes:

$$\ln(Y_{i,t}) - \ln(Y_{i,t-\tau}) = a(\ln(Y_{i,t-\tau}) - \ln(Y_{i,t-2\tau})) + \delta(W_{i,t-\tau} - W_{i,t-2\tau}) + (\xi_t - \xi_{t-\tau}) + (\varepsilon_{i,t} - \varepsilon_{i,t-\tau}) \qquad (3)$$

However, Ordinary Least Square (OLS) estimators are still biased because there still remains a correlation between the lagged endogenous independent variable and the disturbance term. Arellano & Bond (1991) has suggested an application of the Generalized Method of Moments (GMM) that exploits all the orthogonality conditions between the lagged dependent variables and the error term. The process employs lagged levels of the regressors as instruments in the difference equation, and lagged differences of the regressors as instruments in the levels equation, therefore exploiting all the orthogonality conditions between the lagged dependent variables and the error term. Between the difference GMM estimator (Arellano & Bond, 1991) and system GMM estimator (Arellano & Bover, 1995; Blundell & Bond, 1998), we choose the latter in accordance with Bond et al. (2001, pp. 3-4)[2].

[2] "*We also demonstrate that more plausible results can be achieved using a system GMM estimator suggested by Arellano & Bover (1995) and Blundell & Bond (1998). The system estimator exploits an assumption about the initial conditions to obtain moment conditions that remain informative even for persistent series, and it has been shown to perform well in simulations. The necessary restrictions on the initial conditions are potentially consistent with standard growth frameworks, and appear to be both valid and highly informative in our empirical application. Hence we recommend this system GMM estimator for consideration in subsequent empirical growth research*". Bond et al. (2001, pp. 3-4).

This GMM approach has been widely used in the convergence literature; and recently applied by Narayan et al. (2011). While Narayan et al. (2011) use Eq. (1) without the presence of fixed effects, this paper applies Eqs. (2) and (3) instead: in line with Fung (2009) and recent African convergence literature (Asongu, 2012). We apply the *two-step* GMM because it corrects the residuals for heteroscedasticity: contrary to Mazumdar (2002), Sutcliffe (2004) and Noorbakhsh (2006) in the human development-convergence literature. The *one-step* supposes that the residuals are homoscedastic. The assumption of no auto-correlation in residuals is paramount as past lagged variables are to be used as instruments for the endogenous variables. However the estimation depends on the assumption that the lagged values of the dependent variable and other independent variables are valid instruments in the regression. We expect the first-order auto-correlation of the differenced residuals to be significant while their second-order auto-correlation in levels should not. The validity of the instruments is also tested with the Sargan over-identifying restrictions test (OIR).

As emphasized by Islam (1995, p. 14), yearly time spans are too short to be appropriate for studying convergence, as short run disturbances may loom large in such brief time spans. Thus considering the data span of 28 years, we borrow from Narayan et al. (2011) in using a 4 year non-overlapping interval such that we have seven time intervals: 1982-1985; 1986-1989 and so on. This implies in our regression, τ is set to 4.

We also compute the implied rate of convergence by calculating (a/4) which is same as the Narayan et al. (2011) computation of (1+β)/4. Thus we divide the estimated coefficient of the lagged-log endogenous difference variable by 4 because we have used a four year interval to mitigate short term disturbances. When the absolute value of the estimated lagged coefficient is greater than zero but less than one ($0 < |a| < 1$), we conclude the existence of convergence. The

broader interpretation suggests, past differences have a less proportionate impact on future differences, implying the variation on the left hand side of Eq. (3) is decreasing overtime as the country is converging to a steady state. To make our point clearer, the estimated lagged value of a standard dynamic GMM approach is a from which 1 is subtracted to obtain β (β= σ-1). In this context the information criterion for *beta*-convergence is $\beta < 0$. In the same vein, in order to limit the arithmetical gymnastics, a could be reported and the $0 < |a| < 1$information criterion used to determine convergence. This interpretation is consistent with recent convergence literature (Prochniak & Witkowski, 2012a, p. 20; Prochniak & Witkowski, 2012b, p. 23; Asongu, 2012, Asongu, 2013a, b, c).

4. Empirical analysis

4.1 Empirical results

This section investigates two main issues: (1) assessment of the presence of convergence an (2) determination of the speed of convergence. Table 1 presents a summary of overall findings while Table 2 and Tables 3-4 respectively present results for unconditional and conditional convergence.

Unconditional (absolute) convergence is estimated when only the lagged difference of the endogenous variable is used as the exogenous variable while conditional convergence is in respect of Eq. (3). Therefore unconditional convergence is estimated without $W_{i,t}$: vector of determinants (trade, democracy, foreign direct investment, inflation, public investment, foreign aid, private investment and polity IV) of per capita growth (human development). To assess the validity of the model and indeed the convergence hypothesis, we carry-out two tests, notably the Sargan test which examines the over-identification restrictions, and the Arellano and Bond test

for autocorrelation which assesses the null hypothesis of no autocorrelation. The Sargan test assesses whether the instruments are uncorrelated with the error term in the estimated equation. The null hypothesis is the view that the instruments as a group are strictly exogenous (absence of endogeneity), which is essential for the validity of the GMM estimates. We also report the Wald statistics for the combined significance of estimated coefficients. The p-values of estimated coefficients are reported in brackets in the line following the reported values of the estimated coefficients. The autocorrelation, Wald and Sargan tests statistics with associated p-values for each of the panels are reported in the tables. The Sargan test statistics often appear with a p-value greater than 0.10, hence its alternative hypothesis is rejected for the most part. We only report the second-order autocorrelation: *AR(2)* test because it is more relevant than AR(1) as it detects autocorrelation in levels. For most estimated models we fail to reject the null hypothesis of no autocorrelation. There is therefore robust evidence that most of the models are free from autocorrelation.

Table 1 below presents a summary of the results. This synthesis of results is based on details presented in Tables 2-4. AC, CC, SAC, SCC denote Absolute Convergence, Conditional Convergence, Speed of Absolute Convergence and Speed of Conditional Convergence respectively. In contrast to GDP per capita growth, we notice substantial evidence of CC in Human Development. Both development dynamics show evidence of AC.

Table 1: Summary of results on convergence

	Legal Origins		Religions		Regions		Income Levels				Africa
	English	French	Christ	Islam	N.Africa	SSAfrica	Low.I	Middle I	LMI	UMI	
Panel A: Absolute Convergence with Specifications in Table 2											
Absolute Convergence for GDP per capita											
AC	Yes	No	Yes	No	Yes	Yes	Yes	No	No	No	Yes
S AC	2.87%	---	3.60%	---	8.45%	1.95%	2.32%	---	---	---	1.9%
Absolute Convergence for Human Development											
AC	No	No	Yes	No	Yes	No	No	No	No	No	No
S AC	---	---	21.80%	---	23.15%	---	---	---	---	---	---
Panel B: Conditional Convergence with Specifications in Table 3											
Conditional Convergence for GDP per capita											
CC	No	No	No	No	No	No	No	No	No	No	No
SCC	---	---	---	---	---	---	---	---	---	---	---
Conditional Convergence for Human Development											
CC	No	Yes	Yes	No	No	No	Yes	No	Yes	No	No
SCC	---	24.77%	21.67%	---	---	---	23.27%	---	24.05%	---	---
Panel C: Conditional Convergence with Specifications in Table 4											
Conditional Convergence for GDP per capita											
CC	No	No	No	No	Yes	No	No	No	No	No	No
SCC	---	---	---	---	11.70%	---	---	---	---	---	---
Conditional Convergence for Human Development											
CC	No	No	Yes	Yes	No	No	Yes	No	Yes	No	No
SCC	---	---	19.50%	22.25%	---	---	19.12%	---	23.47%	---	---

AC: Absolute Convergence. CC: Conditional Convergence. SAC : Speed of Absolute Convergence. SCC: Speed of Conditional Convergence. English: Common-Law. French: Civil-Law. Christ: Christians. N.Africa: North Africa. SSAfrica: Sub-Saharan Africa. Low I: Low Income. Middle I: Middle Income. LMI: Lower Middle Income. UMI: Upper Middle Income.

In Table 2 below, we report results of absolute convergence. Firstly, we notice that for most of the models the instruments are valid as the alternative hypotheses of the Sargan OIR tests are rejected. We also observe the absence of autocorrelation with overwhelming failure to reject to the null hypothesis of the second-order autocorrelation test: AR(2). In all cases where the lagged endogenous estimated coefficient is significant, the Wald statistics is also significant: which is not unexpected since only one explaining variable is used for the absolute convergence regressions. We find evidence of AC in per capita income only in Africa, SSA, Low-income-countries, English common-law, Christian dominated and North African countries. There is also AC in human development in Christian dominated and North African countries. From a comparative standpoint, it could be concluded that the convergence in human development is faster than per capita income convergence. For instance, for North African countries while the

AC rate is 8.45% in per annum (pa) in per capita income, it is 23.15% in human development. The corresponding time for full (100%) is 47.33 years (yrs) and 17.27 yrs for per capita income and human development respectively. To calculate the rates and corresponding years, with the initial value of 0.926, the rate of convergence is 23.15% ((0.926/4)*100) and the time needed to achieve full convergence is 17.27 years (400%/23.15%). Hence, 17.27 years is required to achieve a 100% convergence for an estimated lagged value of 0.926.

For CC results in Tables 3-4, whereas we find some convergence patterns across specifications and panels for human development, but for a thin exception (North African countries in Table 4) there is overwhelming absence of CC in per capita income.

Table 2: Absolute convergence in development

Panel A: GDP per Capita Growth

	English	French	Christ	Islam	N.Africa	SSAfrica	Low.I	Middle I	LMI	UMI	Africa
Initial	**-0.11*** **	0.054	**-0.14*** **	-0.023	**-0.338***	**-0.078***	**-0.093** **	-0.040	-0.027	-0.404	**-0.076***
	(0.000)	(0.603)	**(0.000)**	(0.795)	**(0.063)**	**(0.083)**	**(0.033)**	(0.767)	(0.886)	(0.613)	**(0.094)**
AR(2)	**-1.002**	**-0.481**	**-1.060**	**-0.701**	-1.719*	**-1.112**	**-1.162**	**0.575**	**0.040**	**0.137**	**-1.120**
	(0.316)	**(0.630)**	**(0.288)**	**(0.483)**	(0.085)	**(0.265)**	**(0.244)**	**(0.564)**	**(0.967)**	**(0.890)**	**(0.262)**
OIR	**14.994**	**20.082**	**19.465**	**12.974**	4.788	**27.006**	**22.999**	**14.799**	**9.967**	**4.743**	**29.704**
	(0.957)	**(0.787)**	**(0.491)**	**(0.984)**	(0.999)	**(0.409)**	**(0.633)**	**(0.960)**	**(0.998)**	**(1.000)**	**(0.280)**
Wald	**107*** **	0.269	**60577*** **	0.067	**3.446***	**2.996***	**4.541** **	0.087	0.020	0.255	**2.805***
	(0.000)	(0.603)	**(0.000)**	(0.795)	**(0.063)**	**(0.083)**	**(0.033)**	(0.767)	(0.886)	(0.613)	**(0.094)**
Countries	15	23	25	13	5	33	23	15	10	6	38
Obser	102	152	146	83	25	224	154	100	70	30	254

Panel B: Human Development

	English	French	Christ	Islam	N.Africa	SSAfrica	Low.I	Middle I	LMI	UMI	Africa
Initial	**1.00*** **	**1.059*** **	**0.87*** **	**1.049*** **	**0.926*** **	**1.00*** **	**1.08*** **	**1.00*** **	**1.04*** **	**1.00*** **	**1.00*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
AR(2)	**-1.054**	**-0.250**	**-1.055**	**0.667**	**-1.001**	**-1.057**	**-1.187**	**-1.006**	-1.876*	**-1.001**	**-1.057**
	(0.291)	**(0.802)**	**(0.291)**	**(0.504)**	**(0.316)**	**(0.290)**	**(0.234)**	**(0.314)**	(0.060)	**(0.316)**	**(0.290)**
OIR	**13.369**	**22.748**	**22.238**	**12.982**	**4.989**	**31.254**	**20.626**	**14.615**	**9.833**	**4.408**	35.75*
	(0.980)	**(0.647)**	**(0.327)**	**(0.984)**	**(0.999)**	**(0.218)**	**(0.761)**	**(0.964)**	**(0.998)**	**(1.000)**	(0.096)
Wald	**2.1e^7*** **	**10570*** **	**3e^7*** **	**2e^4*** **	**2059*** **	**1e^7*** **	**2850*** **	**2e^8*** **	**2 e^4*** **	**1e^7*** **	**1e^7*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Countries	14	23	25	13	5	32	22	15	10	5	37
Obser	96	161	146	91	30	222	154	103	70	33	257

***,**,*: significance levels of 1%, 5% and 10% respectively. English: Common-Law. French: Civil-Law. Christ: Christians. N.Africa: North Africa. SSAfrica: Sub-Saharan Africa. Low I: Low Income. Middle I: Middle Income. LMI: Lower Middle Income. UMI: Upper Middle Income. AR(2): Second Order Autocorrelation test. OIR: Overidentifying Restrictions test. Obser: Observations. Wald: Statistics for joint significance of estimated coefficients. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(2) tests and; b) the validity of the instruments in the Sargan OIR test. Initial: lagged endogenous estimated coefficient (*a*). P-values in parentheses.

Table 3: Conditional convergence (First specification)

Panel A: GDP per Capita Growth

	English	French	Christ	Islam	N.Africa	SSAfrica	Low.I	Middle I	LMI	UMI	Africa
Initial	-0.427	-0.034	0.014	-0.161	**-7.248***	-0.004	-0.039	-0.238	-0.274	-1.524	-0.010
	(0.273)	(0.766)	(0.748)	(0.344)	**(0.090)**	(0.961)	(0.733)	(0.256)	(0.291)	(0.176)	(0.920)
Intercept	8.067	**-3.296***	**-0.31*****	0.316	**-29.98***	-0.139	0.094	1.454	-4.447	-31.27	-0.201
	(0.130)	**(0.096)**	**(0.000)**	(0.959)	**(0.096)**	(0.884)	(0.957)	(0.746)	(0.205)	(0.536)	(0.816)
Trade	-0.034	**0.044****	**0.065*****	0.019	1.072	**0.015***	0.010	-0.0001	0.030	0.332	0.014*
	(0.251)	**(0.026)**	**(0.000)**	(0.764)	(0.103)	**(0.066)**	(0.542)	(0.995)	(0.189)	(0.441)	(0.060)
Inflation	-0.020	**-0.006*****	**-0.005*****	0.044	0.223	**-0.007*****	**-0.007*****	0.016	**0.054****	0.750	**-0.007*****
	(0.222)	**(0.000)**	**(0.000)**	(0.501)	(0.611)	**(0.000)**	**(0.000)**	(0.474)	**(0.013)**	(0.626)	**(0.000)**
PubIvt	-0.145	**0.255****	0.030	0.034	---	0.083	0.141	0.067	**0.314****	---	**0.105***
	(0.293)	**(0.037)**	(0.481)	(0.884)		(0.339)	(0.358)	(0.542)	**(0.012)**		**(0.099)**
Polity IV	0.019	0.017	-0.061	0.025	---	-0.037	0.006	0.007	---	---	-0.007
	(0.781)	(0.803)	(0.222)	(0.855)		(0.550)	(0.912)	(0.929)			(0.886)
AR(2)	**-1.412**	**-0.994**	**0.180**	**-1.372**	2.348**	**-0.942**	**-1.067**	**-0.774**	-1.786*	**-0.798**	**-0.976**
	(0.157)	**(0.320)**	**(0.856)**	**(0.169)**	(0.018)	**(0.346)**	**(0.285)**	**(0.438)**	(0.074)	**(0.424)**	**(0.328)**
OIR	**5.422**	**17.961**	**18.807**	**5.258**	8e^15***	**29.979**	**16.858**	**6.754**	**3.424**	**0.000**	**30.681**
	(1.000)	**(0.877)**	**(0.534)**	**(1.000)**	(0.000)	**(0.268)**	**(0.913)**	**(0.999)**	**(1.000)**	**(1.000)**	**(0.240)**
Wald	1.745	**399*****	**3529*****	3.862	**7.705***	**266*****	**147*****	2.166	**29.5*****	**22.1*****	**213*****
	(0.883)	**(0.000)**	**(0.000)**	(0.569)	**(0.052)**	**(0.000)**	**(0.000)**	(0.825)	**(0.000)**	**(0.000)**	**(0.000)**
Countries	13	22	24	11	4	31	22	86	9	4	35
Obser	82	133	127	64	24	190	129	13	58	28	215

Panel B: Human Development

	English	French	Christ	Islam	N.Africa	SSAfrica	Low.I	Middle I	LMI	UMI	Africa
Initial	**1.00*****	**0.991*****	**0.867*****	**1.04*****	0.492	**1.00*****	**0.931*****	**1.00*****	**0.96*****	**1.00*****	**1.00*****
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	(0.135)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Intercept	0.036	0.003	0.0004	0.002	0.011	0.013	0.022	0.032	0.037	0.023	**0.016***
	(0.175)	(0.817)	(0.469)	(0.838)	(0.221)	(0.157)	(0.475)	(0.203)	(0.352)	(0.528)	**(0.099)**
Trade	-0.0001	-0.000	-0.000	-0.000	-0.0001	**-0.0001***	-0.000	-0.0002	**-0.00*****	-0.000	**-0.0001****
	(0.142)	(0.742)	(0.202)	(0.738)	(0.422)	**(0.067)**	(0.860)	(0.168)	**(0.000)**	(0.806)	**(0.014)**
Inflation	-0.0001	**-0.00*****	**-0.00*****	-0.000	-0.0004	**-0.00*****	**-0.00*****	-0.000	-0.000	-0.0003	**-0.00*****
	(0.232)	**(0.000)**	**(0.000)**	(0.615)	(0.194)	**(0.000)**	**(0.002)**	(0.621)	(0.473)	(0.729)	**(0.000)**
PubIvt	-0.001	**0.001*****	**0.0005*****	0.0008	---	0.0008	**0.001***	0.0006	**0.001*****	---	0.0009
	(0.610)	**(0.000)**	**(0.000)**	(0.125)		(0.213)	**(0.053)**	(0.481)	**(0.000)**		(0.101)
Polity IV	0.001	**0.0008*****	**0.0009*****	0.0004	---	0.001	**0.001*****	0.001	---	---	0.001
	(0.273)	**(0.000)**	**(0.000)**	(0.245)		(0.164)	**(0.000)**	(0.402)			(0.172)
AR(2)	**-1.006**	**-0.639**	**-1.019**	**0.207**	**-0.959**	**-1.015**	**-0.657**	**-1.005**	-1.958*	**-1.001**	**-1.016**
	(0.314)	**(0.522)**	**(0.307)**	**(0.835)**	**(0.337)**	**(0.310)**	**(0.511)**	**(0.314)**	(0.050)	**(0.316)**	**(0.309)**
OIR	**9.370**	**20.274**	**13.676**	**9.499**	**2.418**	**26.795**	**18.784**	**9.266**	**5.530**	**1.001**	**31.689**
	(0.998)	**(0.778)**	**(0.846)**	**(0.998)**	**(1.000)**	**(0.420)**	**(0.845)**	**(0.999)**	**(1.000)**	**(1.000)**	**(0.203)**
Wald	**1.9e^6*****	**2186*****	**1e^6*****	**2410*****	**10.55****	**3e^7*****	**997*****	**2e^7*****	**324*****	**7e^5*****	**3e^7*****
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.014)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Countries	12	22	23	11	5	30	21	13	9	5	34
Obser	76	133	122	64	27	184	125	84	58	30	209

***,**,*: significance levels of 1%, 5% and 10% respectively. English: Common-Law. French: Civil-Law. Christ: Christians. N.Africa: North Africa. SSAfrica: Sub-Saharan Africa. Low I: Low Income. Middle I: Middle Income. LMI: Lower Middle Income. UMI: Upper Middle Income. AR(2): Second Order Autocorrelation test. OIR: Overidentifying Restrictions test. Obser: Observations. PubIvt: Public Investment. Wald: Statistics for joint significance of estimated coefficients. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(2) tests and; b) the validity of the instruments in the Sargan OIR test. Initial: lagged endogenous estimated coefficient (*a*). P-values in parentheses.

The significant control variables overwhelmingly have the expected signs. From intuition, inflation has a negative nexus with development (both in human and per capita income terms) whereas; trade, public investment, democracy, foreign aid, foreign direct investment and private investments broadly have a positive incidence on development.

Table 4: Conditional Convergence (Second specification)

Panel A: GDP per Capita Growth

	English	French	Christ	Islam	N.Africa	SSAfrica	Low.I	Middle I	LMI	UMI	Africa
Initial	0.070	-0.026	0.021	-0.108	**-0.46****	0.041	0.110	-0.212	-0.563	-1.239	0.036
	(0.858)	(0.869)	(0.461)	(0.793)	**(0.015)**	(0.782)	(0.502)	(0.289)	(0.436)	(0.216)	(0.822)
Intercept	-1.089	-1.939	-0.001	9.165	-0.340	-0.346	-2.130	-0.324	0.557	4.257	-0.007
	(0.764)	(0.248)	(0.982)	(0.736)	(0.734)	(0.659)	(0.535)	(0.813)	(0.823)	(0.115)	(0.992)
FDI	0.025	**0.683*****	**0.115***	0.306	-0.196	0.146	0.407	0.007	-0.004	-0.377	0.145
	(0.672)	**(0.001)**	**(0.073)**	(0.754)	(0.664)	(0.396)	(0.134)	(0.945)	(0.967)	(0.240)	(0.265)
NODA	0.045	**0.094****	**0.021***	-0.415	-0.721	0.037	0.065	0.024	-0.034	**1.080***	0.038
	(0.741)	**(0.027)**	**(0.052)**	(0.708)	(0.489)	(0.364)	(0.511)	(0.703)	(0.831)	**(0.076)**	(0.339)
PrivIvt	0.102	0.099	0.029	-0.336	---	0.075	0.165	0.114	0.1182	---	0.058
	(0.437)	(0.510)	(0.250)	(0.760)		(0.160)	(0.310)	(0.205)	(0.230)		(0.285)
Demo.	0.077	-0.007	**-0.130*****	**0.451***	---	0.003	-0.080	0.022	0.018	---	-0.004
	(0.640)	(0.950)	**(0.000)**	**(0.093)**		(0.961)	(0.640)	(0.749)	(0.931)		(0.945)
AR(2)	**-0.105**	**0.399**	**0.361**	**-0.425**	**-1.207**	**0.340**	**0.698**	**-1.023**	-1.645*	**-0.636**	**0.289**
	(0.915)	**(0.689)**	**(0.717)**	**(0.670)**	**(0.227)**	**(0.733)**	**(0.484)**	**(0.306)**	(0.099)	**(0.524)**	**(0.772)**
OIR	**9.698**	**15.148**	**19.758**	**6.468**	**1.399**	**26.175**	**11.505**	**4.646**	**2.360**	**0.261**	**28.726**
	(0.998)	**(0.954)**	**(0.473)**	**(0.999)**	**(1.000)**	**(0.453)**	**(0.993)**	**(1.000)**	**(1.000)**	**(1.000)**	**(0.323)**
Wald	0.842	**21.7*****	**602*****	**34.6*****	**6.870***	5.308	5.038	**12.46****	6.498	---	3.904
	(0.974)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.076)**	(0.379)	(0.411)	**(0.028)**	(0.260)		(0.563)
Countries	13	21	23	11	5	30	21	13	9	5	34
Obser	78	112	111	56	20	168	110	80	59	23	190

Panel B: Human Development

	English	French	Christ	Islam	N.Africa	SSAfrica	Low.I	Middle I	LMI	UMI	Africa
Initial	**1.01*****	**1.00*****	**0.780*****	**0.890*****	0.558	**1.01*****	**0.765*****	**1.01*****	**0.93*****	**1.02*****	**1.011*****
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	(0.119)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Intercept	-0.010	0.001	0.0007	0.078	0.010	-0.003	0.083	0.003	0.045	-0.104	0.0008
	(0.530)	(0.952)	(0.310)	(0.124)	(0.327)	(0.618)	(0.277)	(0.739)	(0.642)	(0.564)	(0.899)
FDI	-0.001	**0.001***	-0.000	**0.001***	-0.0005	-0.001	0.003	-0.001	-0.0003	-0.008	-0.001
	(0.482)	**(0.070)**	(0.373)	**(0.054)**	(0.366)	(0.411)	(0.137)	(0.301)	(0.330)	(0.434)	(0.447)
NODA	0.0006	0.0001	-0.000	-0.002	-0.0002	**0.0004****	-0.0003	0.0007	-0.0001	0.025	0.0001
	(0.298)	(0.655)	(0.682)	(0.140)	(0.823)	**(0.034)**	(0.430)	(0.331)	(0.943)	(0.450)	(0.180)
PrivIvt	0.0002	0.0007	**0.0006*****	0.0002	---	0.0003	0.0009	0.0001	0.0002	---	0.0004
	(0.712)	(0.246)	**(0.000)**	(0.614)		(0.423)	(0.561)	(0.794)	(0.603)		(0.274)
Demo.	0.002	0.001	**0.004*****	0.0005	---	**0.002***	0.001	0.002	0.0004	---	0.002
	(0.205)	(0.128)	**(0.000)**	(0.549)		**(0.078)**	(0.194)	(0.169)	(0.404)		(0.138)
AR(2)	-2.34**	**0.799**	**-0.435**	**-0.633**	**-1.374**	**-0.658**	**0.536**	-1.762*	**-1.524**	**0.589**	**-0.669**
	(0.019)	**(0.424)**	**(0.662)**	**(0.526)**	**(0.169)**	**(0.510)**	**(0.591)**	(0.078)	**(0.127)**	**(0.555)**	**(0.503)**
OIR	**7.750**	**16.682**	**16.064**	**9.200**	**2.792**	**21.877**	**16.485**	**11.574**	**4.088**	**0.991**	**25.651**
	(0.999)	**(0.918)**	**(0.712)**	**(0.997)**	**(0.999)**	**(0.695)**	**(0.923)**	**(0.993)**	**(1.000)**	**(1.000)**	**(0.482)**
Wald	**1e^6*****	**2889*****	**8e^5*****	**9642*****	4.322	**1e^7*****	**303*****	**3e^7*****	**1439*****	---	**1e^7*****
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	(0.228)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**		**(0.000)**
Countries	12	21	22	11	5	29	20	13	9	5	33
Obser	72	112	106	56	22	162	106	78	59	23	184

***,**,*: significance levels of 1%, 5% and 10% respectively. English: Common-Law. French: Civil-Law. Christ: Christians. N.Africa: North Africa. SSAfrica: Sub-Saharan Africa. Low I: Low Income. Middle I: Middle Income. LMI: Lower Middle Income. UMI: Upper Middle Income. AR(2): Second Order Autocorrelation test. OIR: Overidentifying Restrictions test. Obser: Observations. FDI: Foreign Direct Investment. NODA: Net Official Development Assistance. PrivIvt: Private Investment. Demo: Democracy. Wald: Statistics for joint significance of estimated coefficients. The significance of bold values is twofold. 1) The significance of estimated coefficients and the Wald statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(2) tests and; b) the validity of the instruments in the Sargan OIR test. Initial: lagged endogenous estimated coefficient (*a*). P-values in parentheses.

4. 2 Discussion and policy implications

Before delving into discussion of the findings, it is imperative to reconcile our results with economic growth theories. Based on the investigated conditional catch-up processes, the findings have broadly rejected the neoclassical (exogenous) growth model prediction that real

per capita income converges to each country's steady state or common steady state regardless of its initial level. Thus, confirming the endogenous theory which emphasizes that variation among countries in their initial endowments and, the possibility of multiple equilibria shows that there is no tendency for income levels to converge in the long run. Conversely, conditional convergence results for human development are in line with the neoclassical growth hypothesis and run counter to the endogenous theory. Therefore from a theoretical standpoint, it could broadly be concluded that while GDP per capita (human development) findings, reject (confirm) the exogenous growth model theory, human development (GDP per capita) results reject (confirm) the endogenous theory. Put in plainer terms, the main finding reveals while human development supports the exogenous growth model and rejects the endogenous theory; its income component suggests the contrary. However the above interpretation is valid only with respect to conditional convergence. For absolute catch-up processes, we have noticed support for the exogenous theory in both capita income catch-up and human development convergence, with the catch-up rate in the latter broadly higher than that witnessed in the former.

4.2.1 Absolute Convergence (AC)

Absolute convergence is the result from factors such as monetary unions and the adoption of a single currency, among others (Nayaran et al., 2011). In the context of our paper it stretches beyond monetary policies to include homogenous characteristics of human development like religions, income-levels, regions, institutional qualities, legal origins…etc. Therefore AC implies that countries share the same fundamental characteristics with respect to development, such that the only difference between countries is in the initial level of development. The absence of AC in some panels suggests that, holding other things constant (such as political instability, market isolation and macroeconomic conditions) financial liberalization has not: reduced barriers to

trade, increased investment, mitigated capital controls and stifled the control on exchange rate transactions. Openness (globalization) in trade and capital has not had some positive redistributive impact on income between rich and poor African countries. Simply put, structural adjustment programs implemented by African countries may not have had the desired absolute effect on equalizing per capita income growth. If we were to assume that cross border capital flows have increased with financial liberalization, then the cross-country development equalizing impact has been negative in some panels. Evidence from recent inequality-growth literature point to the negative income redistributive impact of foreign direct investment in the African continent (Asongu, 2013e). This interpretation should be treated with caution because a great chunk of foreign private capital flows often emanate from developed countries and not from other African countries within the same panel. All these factors have resulted in the absence of absolute convergence.

Conversely, AC in some panels has occurred. Per capita income AC is due to factors already highlighted above. As for human development convergence, it is due to factors like increase in life expectancy, literacy and gross enrolment ratios due to development policies by the United Nations Development Program, World Bank, World Health Organization, World Trade Organization, Food and Agricultural Organization…etc. Therefore, it maybe said that irrespective of cross-country differences in structural and institutional characteristics, the impact of policies by multilateral donor organizations is equalizing in human development in some panels. Hence, in spite of dissimilar initial conditions of human development across countries, global human development initiatives are being applied in all countries without distinction: leading to poor countries catching-up with their rich neighbors.

4.2.2 Conditional Convergence (CC)

Borrowing from Barro (1991), in the economic growth literature conditional convergence depicts convergence whereby one's own long-term steady state (equilibrium) is contingent on the different structural characteristics or fundamentals of each economy or market (Nayaran et al., 2011). When countries with the same fundamental characteristics (in the same homogenous panel) differ in terms of factors relating to the performance of their economies, there is likely to be conditional convergence. This convergence is contingent on the variables we select and empirically test; implying findings depend on macro economic variables used. With constraints in data availability and degrees of freedom required for the overidentifying restrictions (OIR) test, we have conditioned the analysis on two pairs of four macroeconomic variables (trade, inflation, democracy and public investment; foreign direct investment, foreign aid, polity IV and private investment): consistent with the convergence literature (Prichett, 1997; Bruno et al., 2011; Narayan et al., 2011). Thus based on our conditioning information set, it could be established that differences in factors related to social and health performance across countries are blurring. Hence, leading to conditional convergence in human development for some panels. It follows that countries with lower living standards in terms of life expectancy, literacy and gross enrolment ratios are catching-up with their higher-level counterparts. Conversely, we fail to find any evidence for per capita income CC. This absence could result from persisting cross-country differences in long run economic performance patterns. Inflation, globalization (trade and foreign direct investment), domestic investments (public and private) and foreign aid on which the analysis is conditioned are crucial determinants of GDP per capita growth (see significance of the control variables). Beyond structural disparities, based on the significance in democracy and Polity IV results, cross-country differences in government quality

determinants like corruption-control, government effectiveness, regulation quality, rule of law and political instability could also constitute important institutional patterns that explain this absence of convergence.

4.2.3 Retrospect to testable hypotheses

In the introduction of this paper, we highlighted certain concerns common to all panels that cut deep into the formulation of theories and policies of economic growth in the African continent. For clarity in interpretation of results we reformulate the issues. (1) *Is human development among African countries converging or diverging?* Based on distinct homogenous settings, while human development in per capita income terms is not significantly converging, non-income aspects of human development like health care, education, life expectancy and gross enrolment ratios could be converging conditional on structural and institutional macroeconomic characteristics. (2) *Do income levels matter in poor countries catching-up with their rich counterparts?* In terms of both AC and CC, income levels matter in convergence, with low income panels experiencing some patterns of convergence while their middle income counter parts revealing no catch-up. This fact still holds when convergence dynamics of upper- and lower-middle income countries are compared. Whereas, there are convergence patterns in lower-middle income countries, none is found in their upper-middle income counterparts. (3) *Do religious-domination, legal origin and regional-belonging have some bearing on human development convergence (divergence) in Africa?* Firstly, while catch-ups based on legal origins does not show any clear-cut patterns, those based on religion domination show that Christian-oriented countries are experiencing convergence in development to a greater extent than Muslim dominated countries. Secondly, we have found more evidence of catch-up in North African than in sub-Saharan Africa.

4.2.4 Contribution to addressing exiting puzzle in the literature

Our findings have partially confirmed the Sutcliffe (2004) hypothesis on the validity of the HDI convergence (as preached by the IMF). Konya & Guisan (2008) concurred with the criticism by Sutcliffe (2004) only with respect to the income dimension of the HDI and went forth to use the HDI in its integrality. By distinguishing the income effect from the integral HDI effect, our findings have confirmed the Konya & Guisan (2008) criticism on this partial validity of the Sutcliffe (2004) hypothesis. It follows that with respect to various homogenous strands in the African continent, the HDI is converging faster than GDP per capita growth.

Our results have broadly shown that while human development supports the exogenous theory of convergence, its income component is for the endogenous theory. It is worthwhile to provide the intuition motivating this inference. Human development could support the exogenous theory because of common factors like general improvements in life expectancy, literacy and gross school enrolments ratios tailored by development policies of multinational organizations (The African Development Bank, United Nations Development Program, World Bank, World Health Organization, World Trade Organization, Food and Agricultural Organization…etc). Conversely, in addition to the reasons already discussed above, GDP per capita growth convergence could be tilting towards the endogenous growth theory because the population in low-growth countries is increasing relatively faster than corresponding GDP growth. This second intuition is based on the hypothesis that, their higher-growth counterparts prefer quality of children to quantity of children.

4.2.5 Policy implications: beyond income convergence

The debate on convergence has tended to be linked with a radical defense of the neoclassical growth model. Proponents supporting this thesis have mostly focused on income convergence. However there is need to focus beyond income convergence and objectively assess other components beside income that can wheel the transitions that are essential in the development process. The convergence decomposition must extend well beyond GDP growth mechanisms. Our analysis enables us to infer that different human development variables like life expectancy and literacy levels have been converging in the African continent. The weak case for income convergence in our findings suggests in substance that convergence in factors affecting life-expectancy, literacy and democracy are also crucial in the formulation and implementation of policies aimed at reducing cross-country human development variations. A corollary of above explanation is that certain human development variables may naturally converge and do not require much policy intervention. At this point, it could be established that the income component of the human development index moves slower than others in the convergence process and thus requires a more focused policy intervention.

4.3 Caveats and future directions

Consistent with Apergis et al. (2010), critics of *beta*-convergence argue that if countries converge to a common equilibrium with identical internal structures, then the dispersion of the variable under consideration should disappear in the long-term as all countries converge to the same long-run path. More so, if countries converge to 'convergence clubs' or to their own unique equilibrium, the dispersion of this measure will not approach zero (Miller & Upadhyay, 2002). Hence, in the latter case of country-specific equilibrium, the movements of the dispersion will be contingent on the initial distribution of the variable under investigation with regard to their final

long-term outcomes. For the above reasons, we have concurred with a referee by not emphasizing too much on full convergence because of the existence of shocks (e.g in foreign aid) can change the long-run state and therefore invalidate the time of convergence. Such approximation of full convergence is however feasible in the absence of any shock.

Given significant convergence findings in human development across homogenous strands in the African continent, future research aimed at further elucidating this human development-convergence nexus could be directed at assessing which variables have most intervened in improving human development. In other words, what roles have income improvement, life expectancy, literacy and gross enrolment ratios played in human development-convergence? Mayer-Foulkes (2010) has documented an analysis of this kind with a broad and global appeal. However a replicate for the African continent could result in interesting policy implications. Further research can also investigate the validity of the intuitions in Section 4.2.4.

5. Conclusion

In examining some big questions on African development, we have provided evidence that dynamics of some development indicators could support both endogenous and neoclassical growth theories in the convergence debate. This paper has investigated convergence in real per capita GDP and inequality adjusted human development in 38 African countries, disaggregated into 10 homogenous panels based on regions (Sub-Saharan and North Africa), income-levels (low, middle, lower-middle and upper-middle), legal-origins (English common-law and French civil-law) and religious dominations (Christianity and Islam). The main finding is that the income component of the human development index moves slower than others in the convergence process and thus requires a more focused policy intervention. As a policy

implication, looking beyond income convergence can provide a concrete agenda for development involving all aspects of economic, institutional and social life.

Appendices

Appendix 1: Summary statistics

		Mean	S.D	Minimum	Maximum	Observations
Development	GDP pc growth	1.071	7.447	-30.430	90.140	292
	Human development	1.763	7.590	0.163	47.475	297
Control	Openness (Trade)	65.889	34.606	10.079	192.29	285
Variables	Inflation	22.145	123.54	-100.00	1986.9	281
	Public Investment	7.527	4.393	0.000	27.523	248
	Polity IV	-1.796	5.914	-10.000	10.000	304
	Foreign Direct investment	1.853	3.564	-7.646	32.011	252
	NODA	10.035	9.744	0.009	76.266	294
	Democracy	1.769	3.735	-8.000	10.000	304
	Private Investment	11.538	6.986	-1.771	47.829	251

S.D: Standard D. GDPpc : Gross Domestic Product per capita. NODA: Net Official Development Assistance.

Appendix 2: Correlation analysis

GDPpcg	HDI	Trade	Inflation	PubIvt.	Polity	FDI	NODA	Demo	PrivIvt.	
1.000	-0.020	0.118	-0.256	0.149	0.061	0.180	-0.010	0.141	0.168	GDPpcg
	1.000	-0.067	-0.011	-0.137	0.139	-0.009	-0.092	0.095	0.088	HDI
		1.000	-0.122	0.272	0.123	0.340	-0.078	0.203	0.464	Trade
			1.000	-0.162	0.0002	-0.237	-0.056	-0.196	-0.161	Inflation
				1.000	0.0002	0.151	0.208	0.167	0.151	PubIvt.
					1.000	0.174	0.079	0.691	0.211	Polity
						1.000	0.162	0.046	0.355	FDI
							1.000	-0.058	-0.178	NODA
								1.000	0.258	Demo
									1.000	PrivIvt.

GDPpcg : GDP per capita growth rate. HDI: Inequality Adjusted Human Development Index. PubIvt: Public Investment. Polity: Polity IV. FDI: Foreign Direct Investment. NODA: Net Official Development Assistance. Demo: Democracy. PrivIvt: Private Investment.

Appendix 3: Variable definitions

Variables	Sign	Variable Definitions	Sources
GDP Per Capita	GDPpcg	GDP Per Capita Growth (Annual %)	World Bank (WDI)
Human Development	HDI	Inequality Adjusted Human Development Index	World Bank (WDI)
Openness	Trade	Imports (of goods and services) plus Exports (of goods and services) on GDP	World Bank (WDI)
Inflation	Infl.	Consumer Prices (Annual %)	World Bank (WDI)
Public Investment	PubIvt.	Gross Public Investment (% of GDP)	World Bank (WDI)
Polity IV	Polity	Polity captures regime authority spectrum on a 21 point scale ranging from -10 (hereditary monarchy) to +10 (consolidated democracy)	World Bank (WDI)
Foreign Investment	FDI	Foreign Direct Investment (% of GDP)	World Bank (WDI)
Foreign Aid	NODA	Net Official Development Assistance (% of GDP)	World Bank (WDI)
Democracy	Demo.	Institutionalized Democracy	World Bank (WDI)
Private Investment	PrivIvt.	Gross Private Investment (% of GDP)	World Bank (WDI)

WDI: World Development Indicators. GDP: Gross Domestic Product.

Appendix 4: Presentation of countries (38)

Group	Group category	Countries	Num
Legal origin	English Common-Law	Botswana, Ghana, Kenya, Lesotho, Liberia, Malawi, Mauritius, Nigeria, South Africa, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.	15
	French Civil-Law	Algeria, Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo Democratic Republic, Congo Republic, Ivory Coast, Djibouti, Egypt, Ethiopia, Libya, Madagascar, Mali, Morocco, Mozambique, Niger, Rwanda, Senegal, Togo, Tunisia.	23
Religions	Christianity	Benin, Botswana, Burundi, Cameroon, Central African Republic, Congo Democratic Republic, Congo Republic, Ivory Coast, Ethiopia, Ghana, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.	25
	Islam	Algeria, Burkina Faso, Chad, Djibouti, Egypt, Libya, Mali, Morocco, Niger, Nigeria, Senegal, Sudan, Tunisia.	13
Regions	Sub-Saharan Africa	Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo Democratic Republic, Congo Republic, Ivory Coast, Djibouti, Ethiopia, Ghana, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.	33
	North Africa	Algeria, Egypt, Libya, Morocco, Tunisia.	5

Income Levels	Low Income	Benin, Burkina Faso, Burundi, Central African Republic, Chad, Congo Democratic Republic, Congo Republic, Djibouti, Ethiopia, Ghana, Kenya, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Tanzania, Togo, Uganda, Zambia, Zimbabwe.	23
	Middle Income	Algeria, Botswana, Cameroon, Ivory Coast, Egypt, Lesotho, Libya, Mauritius, Morocco, Nigeria, Senegal, South Africa, Sudan, Swaziland, Tunisia.	15
	Lower Middle Income	Cameroon, Ivory Coast, Egypt, Lesotho, Morocco, Nigeria, Senegal, Sudan, Swaziland, Tunisia.	10
	Upper Middle Income	Algeria, Botswana, Libya, Mauritius, South Africa.	5

Num: Number of cross sections(countries)

References

Apergis, N., Christou, C., & Miller, S. M., (2010). "Country and Industry Convergence in Equity Markets: International Evidence from Club Convergence and Clustering", Department of Banking and Financial Management, University of Piraeus, Greece.

Asongu, S. A., (2012). "Harmonizing IPRs on Software Piracy: Empirics of Trajectories in Africa", *Journal of Business Ethics*: Forthcoming. http://link.springer.com/article/10.1007%2Fs10551-012-1552-7?LI=true#page-1 (accessed: 19/12/2012).

Asongu, S. A., (2013a). "African Stock Market Performance Dynamics: A Multidimensional Convergence Assessment", *Journal of African Business*: Forthcoming. http://econpapers.repec.org/paper/pramprapa/36055.htm (accessed: 19/12/2012).

Asongu, S. A., (2013b). "African Financial Development Dynamics: Big Time Convergence", *African Journal of Economic and Management Studies*: Forthcoming. http://econpapers.repec.org/paper/pramprapa/36053.htm (accessed: 19/12/2012).

Asongu, S. A., (2013c). "Are Proposed African Monetary Unions Optimal Currency Areas? Real, Monetary and Fiscal Policy Convergence Analysis", *African Journal of Economic and Management Studies*: Forthcoming.
http://econpapers.repec.org/paper/pramprapa/41552.htm (accessed: 19/12/2012).

Asongu, S. A., (2013d). "Real and Monetary Policy Convergence: EMU Crisis to the CFA Zone", *Journal of Financial Economic Policy*, 5(1), pp. 20-38.

Asongu, S. A., (2013e). "Investment and inequality: which financial channels are good for the poor?" *African Journal of Finance*: Forthcoming .
http://econpapers.repec.org/paper/pramprapa/34990.htm (accessed: 19/12/2012).

Arellano, M., & Bond, S., (1991). "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations". *The Review of Economic Studies*, 58, pp. 277-297.

Arellano, M., & Bover, O., (1995). "Another look at the instrumental variable estimation of error-components models", *Journal of Econometrics*, 68, pp. 29-52.

Arezki, R., & Gyfalson, T., (2011). Resource rents, Democracy and Corruption: Evidence from Sub-Saharan Africa. *CESifo Working Paper* No. 3575.

Barro, R., (1991). "Economic Growth in a Cross Section of Countries". *Quarterly Journal of Economics* 196 (2/May): 407–443.

Barro, R. J., & Sala-i-Martin, X., (1992). "Convergence", *Journal of Political Economy*, 100, pp. 223-251.

Barro, R. J., & Sala-i-Martin, X., (1995). *Economic Growth*. The MIT Press, Cambridge, MA.

Baumol, W. J., (1986). "Productivity, growth, convergence and welfare: what the long run data show", *American Economic Review*, 76, pp. 1072-1085.

Blundell, R., & Bond, S., (1998). "Initial conditions and moment restrictions in dynamic panel data models", *Journal of Econometrics*, 87(1), pp. 115-143.

Bond, S., Hoeffler, A., & Tample, J., (2001). "GMM Estimation of Empirical Growth Models", University of Oxford.

Bruno, G., De Bonis, R., & Silvestrini, A., (2011). "Do financial systems converge? New evidence from financial assets in OECD countries". *Journal of Comparative Economics*; Forthcoming.

Clark, R., (2011). "World health inequality: Convergence, divergence and development", *Social Science and Medicine*. 72, pp.617-624.

Costantini, M., & Lupi, C., (2005). "Stochastic Convergence among European Economies". *Economics Bulletin*, 3(38), pp.1-17.

Fung, M. K., (2009). "Financial development and economic growth: convergence or divergence?". *Journal of International Money and Finance*, 28, pp.56-67.

Hobijn, B., & Franses, P.H.,(2001). "Are living standards converging?". *Structural Change and Economic Dynamics*, 12, pp. 171-200.

Islam, N., (2003). "What have we learnt from the convergence debate?", *Journal of Economic Surveys*, 17(3), pp. 309-362.

Islam, N., (1995). "Growth Empirics: A Panel Data Approach". *The Quarterly Journal of Economics*, 110, (4), pp. 1127-1170.

Konya, L., & Guisan, M-C., (2008). "What does the human development index tell us about convergence ? ". *Applied Econometrics and International Development*, 8-1.

Kumo, W. L.,(2011). "Growth and Macroeconomic Convergence in Southern Africa". *African Development Banking Working Paper 130*, Tunis, Tunisia.

Mankiw, N. G., Romer, D., & Weil, D. N., (1992). "A contribution to the empirics of economic growth", *Quarterly Journal of Economics*, 107, pp. 407–437.

Mayer-Foulkes, D., (2010). "Divergences and Convergences in Human Development". *UNDP Human Development Research Paper 2010/20*.

Mazumdar, K., (2002). "A Note on Cross-Country Divergence in Standard of Living". *Applied Economic Letters*, 9, pp.87-90.

Miller, S. M., & Upadhyay, M. P., (2002). "Total factor productivity and the convergence hypothesis", *Journal of Macroeconomics* 24, 267-286.

Narayan, P.K., Mishra, S., & Narayan, S., (2011). "Do market capitalization and stocks traded converge? New global evidence". *Journal of Banking and Finance*, 35, pp.2771-2781.

Neumayer, E., (2003). "Beyond income: convergence in living standards, big time". *Structural Change and Economic Dynamics*, 14, pp.275-296.

Noorbakhsh, F., (2006). "International Convergence or Higher Inequality in Human Development? Evidence from 1975 to 2002", *World Institute of Development Economics Research Paper 2006/15*, United Nations University.

Pritchett, L., (1997). "Divergence, Big Time". *Journal of Economic Perspectives*, 11(3), pp. 3-17.

Prochniak, M., & Witkowski, B., (2012a). "Beta convergence stability among "Old" and "New" EU countries: The Bayesian Model Averaging Perspective", Warsaw School of Economics.

Prochniak, M., & Witkowski, B., (2012b). "Real economic convergence and the impact of monetary policy on economic growth of the EU countries: The analysis of time stability and the identification of major turning points based on the Bayesian methods", Warsaw School of Economics.

Rodriguez, F., & Sachs, D. J., (1999). "Why Do Resource-Abundant Economies Grow More Slowly?", *Journal of Economic Growth*, 4, 277-303.

Solow, R. M., (1956). “A contribution to the theory of economic growth”, *Quarterly Journal of Economics*, 70, pp. 65-94.

Swan, T., (1956). “Economic growth and capital accumulation”. *Economic Record*, 32, pp. 334–361.

Sutcliffe, B., (2004). “World Inequality and Globalization”. *Oxford Review of Economic Policy*, 20, pp. 15-37.

Tirelli, P.,(2010, May). “Growth and Macroeconomic Convergence in West-Africa: Factor Endowments, Policies and Institutions”, Economic Commission for Africa.