FRACTIONAL PERSISTENCE IN INCOME POVERTY IN AFRICA

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ABSTRACT

This paper examines income poverty in Africa by looking at the time series properties of the series corresponding to the household consumer expenditures in 53 African countries. Using fractional integration the results indicate that the series are highly persistent, displaying orders of integration in the interval (0, 1) in some countries or values equal to or higher than 1 in some others. The main implication of the empirical findings is that long term policies aimed at addressing income poverty in the continent such as the policies on expansion of infrastructure and social amenities will have have long-lasting effects on poverty reduction.

Keywords: Income poverty; fractional integration; persistence; Africa

JEL Classification: C22; C32; I32; I38

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1. Introduction

The Sustainable Development Goals (SDGs) include a joint declaration by governments to eliminate extreme poverty across the globe by 2030. However, poverty is still prevalent in several parts of the world, especially in the African continent. There were 50 million more poor people in Africa in 2012 than in 1990. The poverty reduction in the continent was 15% points lower than in other economies over the 1996–2012 period (Beegle et al., 2016). Moreover, the annualized rate of poverty reduction has slipped since 2013 in Africa. From 1% experienced in 1990-2012, the annualized rate of poverty reduction was 0.6% in 2013-2015 and less than 0.5% between 2015-2018 (Watkins and Quattri, 2019). The conversion rate from economic growth to poverty reduction in Africa is the lowest among all the continents. A 1% increase in real Gross Domestic Product (GDP) decreases extreme poverty in Africa by 0.7% whereas a 1% increase in real GDP decreases extreme poverty by 2% in other developing economies. (Watkins and Quattri, 2019). Nigeria (the largest country in the continent) has surpassed India as the country with the largest poor people despite India having more than five times the population in Nigeria.

With about $1.7 trillion of household consumption expenditures in 2018 (2015 prices), Africa has one of the smallest household consumption expenditures, despite being the second most populated continent. About 40% of the 13 countries with the smallest household consumption expenditure are located in the continent. More than a quarter of the hungry in the world live on the African continent. The continent has the highest global rate of malnourished population as about 20% of the total population in Africa are regarded as malnourished. Africa is the region with the highest infant mortality. Twelve countries with the highest infant mortality worldwide are on the African continent (World Bank, 2020).

Poverty in the African continent is caused by a multitude of factors, the leading causes including poor governance and corruption, inadequate employment opportunities, unjust trading structures, insufficient infrastructural facilities, poor resource usage, lack of education and inadequate medical care, recurring conflicts and wars, among others.

Due to the significance of poverty in the continent, several aspects of the subject have been studied by the existing papers. For instance, few authors have focused on the trend of poverty and showed that it is a multi-dimensional concept (Christiaensen et al., 2003; Adjasi and Osei, 2007). The determinants of poverty have been studied by several authors in the past. The drivers of poverty include transport services (Porter, 2014), fossil fuel subsidy (Rentschler, 2016), foreign direct investment inflows (Magombeyi and Odhiambo, 2018), gross domestic product per capita and inflation (Kaidi et al., 2019; Musakwa and Odhiambo 2019), financial development, institutional quality, government expenditure and human capital (Kaidi et al., 2019). There are also studies on the impact of poverty and it has been shown that poverty impairs the ability to control blindness (Naidoo, 2007), hypertension, diabetes, obesity, tobacco use and other risk factors for cardiovascular diseases (Seedat, 2007). Poverty also promotes bureaucratic corruption (Justesen and Bjørnskov, 2014).

However, the persistence of poverty has been largely overlooked by the previous papers. The importance of investigating the persistence of the poverty can be hardly overemphasized. Poverty persistence can be defined as a measure of the degree to which short term shocks (emanating from an innovation or a new poverty reduction policy initiative) create long term changes in poverty. If the poverty series are persistent, the implication is that impacts of shocks, which are assumed to be randomly generated, will have a permanent impact and the poverty level will not move back to its steady long-term growth path. Therefore, this is good in case of shocks reducing significantly poverty since

no strong policy actions should then be required because the shock is expected to be permanent. On the contrary, a negative shock increasing poverty will require strong actions to recover the original trends.

On the other hand, if poverty series are mean reverting, the implication is that poverty reverts to its long-run trend path after a shock, and the effect of the innovation on poverty will be merely temporary. Hence, changes in poverty are related to transient fluctuations such that a shock should have no effect on the long-run poverty. The policies aimed at reducing poverty include government spending, which foster equity; fiscal policy which involves monetary transfers to the poor and investments in social protection, infrastructure and social amenities (Watkins and Quattri, 2019; Kaidi et al., 2019). While some of these are short term in nature, others are meant to have long term impact on poverty (Kaidi et al., 2019).

Moreover, overlooking the unit root properties of the series under investigation or an incorrect examination of these properties can generate inaccurate empirical evidence. In other words, standard methods that are premised on stationary data could yield spurious regression results, when the variable(s) under investigation has a stochastic trend. For instance, conclusions made from regression results that are based on standard Ordinary Least Squares (OLS) estimates are not reliable if an inaccurate assumption of the stationary properties is adopted. Therefore, knowing the statistical properties of the poverty series is of enormous value for policymakers and researchers in creating suitable poverty reduction schemes. If poverty series are not stationary, it is not feasible to project subsequent poverty figures by solely relying on the previous figures. Hence, there is a need to use methods that rely on other inputs rather than merely past figures in order to accurately forecast future figures of poverty.

The few studies on the persistence or nonstationarity of poverty have principally focused on health poverty and have not included African countries in their analyses. For instance, Bishai, (1995), Dreger and Reimers (2005). Silva (2007), Erdoğan et al. (2013), Gil-Alana et al. (2017), Subramaniam et al. (2018) and Yaya et al. (2019) have all focused on the persistence of infant mortality in developed countries or Asian countries. Income poverty and health poverty might not necessarily follow the same directions and the determinants of the two components of poverty might not necessarily be the same (Musakwa and Odhiambo 2019). Moreover, poverty differs across countries and the results on poverty in certain countries might not be tenable for other countries.

The aim of this paper is to examine the statistical properties (e.g., mean reversion, persistence, etc.) in the poverty series of the 53 African countries as well as the aggregate data at the continental level. The first contribution of this study is that we focus on persistence of income poverty. We are not aware of any previous study that has undertaken similar exercise. The second contribution of this study is the use of fractional integration techniques, which are more flexible and general than the classical methods based on integer degrees of differentiation. Thus, while traditional methods (based on stationary (d = 0) and nonstationary (d = 1) we allow for fractional values of d). Another contribution of this study is that we have conducted a time series approach rather than a panel data approach. The importance of doing this is that characteristics of the countries in Africa differ. The region consists of nations at diverse income levels and human development. Macroeconomic conditions differ significantly. For instance, nations such as Kenya and Ethiopia have a convincing profile on reduction of poverty, while several others are not that fortunate (Watkins and Quattri, 2019). All these issues will be investigated in the paper that is structured as follows: Section 2 contains the literature review; Section 3

describes the methodology used in the paper; Section 4 shows the dataset, and Section 5 displays the main empirical results; finally, Section 6 contains some concluding remarks.

2. Literature review

In relation to the first contribution of this study (income poverty), we highlight the contribution of authors such as Fosu (2010, 2017). This author studied whether inequality affected the effectiveness of increasing incomes to reduce poverty. To do this, he used data from the 1990s for a sample of African economies. An analysis-of-covariance model is derived and estimated with the headcount, gap and squared gap poverty ratios serving as the respective dependent variables, and the Gini coefficient and Purchasing power parity (PPP)-adjusted income as explanatory variables. The study concluded that high levels of inequality limit the formulation of efficient policies aimed at raising income to reduce poverty.

Among other authors who have identified factors that contribute to reducing poverty and inequality, Dorosh and Sahn (2000) used Computable general equilibrium models (CGE models) for four countries (Cameroon, Gambia, Madagascar and Niger) to examine the impact of macropolicy reforms on real income of poor households in sub-Saharan Africa. They concluded that macro policy reforms alone are not enough, in the short term, to significantly reduce poverty in Africa. Kaidi et al. (2019) showed a detailed analysis of the relationship between financial development, quality of institutions and poverty. They used the least squares method and examined a sample of 132 countries observed during the period 1980-2014. They conclude that there is no causal link between financial development and poverty reduction.

Musakwa and Odhiambo (2019) found a positive relationship between remittances and poverty reduction. They studied the impact of remittances on poverty in

Botswana with time series from 1980 to 2017 through two poverty proxies: household consumption spending and infant mortality rate. Morten (2010) argued that the fundamental cause of poverty is the lack of pro-growth institutions derived from the colonial system, the period of slavery or particular geographical or demographic characteristics. He analysed income estimates in African countries, although it subjects these available data to tests of accuracy, reliability and volatility, so that these countries' incomes should be explained in terms of diversity. According to this author, excluding some island states and South Africa, the income of one African economy is not significantly different from another. It is difficult based on GDP estimates to demonstrate that there is a link between current income and the existence of pro-growth institutions.

Other contributions such as Banerjee and Duflo (2007) conducted household surveys in 13 countries with detailed information on poverty levels. They designed an approach to the fight against poverty based on a scientific understanding of the lives of the poor and their institutions, as well as the consequences of the policies and interventions that have been experienced to help these poor populations. These authors have improved their fundamental understanding of the causes and consequences of poverty, (Rosenzweig, 2012).

In this context, it is worth highlighting the contributions of various authors on other factors that influence the causes of poverty in Africa. Addae-Korankaye (2014) points out important factors such as, at the institutional level, corruption and bad governance, poor use of resources; at the structural level, poor infrastructure; at the social level, cultural factors, wars and conflicts, lack of education and personal development. At the same time, White et al (2001) argue that lack of resources is not sufficient as a reason for poverty. These authors also include the deficient control of productive assets, access to basic public services and the lack of security and vulnerability due to the

inability to take measures for emergencies: natural disasters, human disasters and economic phenomena. Other authors highlight the lack of leadership or the existence of weak leadership. (Dartey-Baah, 2014).

McMillan (2016) presents a set of sixteen essays, edited and synthesized by various authors covering most of the topics related to poverty in Africa and which offer partial explanations, with economic and political arguments, to questions such as why Africa remains poor.

It is clear from the reading of these articles that there are different ways to reduce the magnitude of poverty, that poverty differs between countries, and that poverty instruments in certain countries may not be valid for other countries.

As mentioned in the introduction, the few studies on the persistence or nonstationarity of poverty have principally focused on health poverty and have not included African countries in their analyses. For instance, we can highlight the work by Bishai (1995) who analyzed infant times series mortality rates in Sweden (1800-1989), the UK (1839-1989) and the US (1915-1989) applying ADF (Dickey and Fuller, 1979) unit root tests. The author concluded that these time series were nonstationary. Dreger and Reimers (2005) used panel cointegration technics in a sample of 21 Organization for Economic Cooperation and Development (OECD) countries over the period 1975-2001, to explain the relationship between health care and expenditure and GDP. The negative relationship between per capita real GDP and infant mortality rate is also consonant with other studies such as Subramaniam et al. (2018).

Silva (2007) applied a panel stationarity test to the infant mortality rate in Australia from 1911 to 2002, which allows for disruptions in both the level and trend of the series. The study concludes that not all states and territories show persistent behavior in the infant mortality rate. Subramaniam et al. (2018) analyzed the effects of infant

mortality determinants on the older Association of Southeast Asian Nations (ASEAN), economies Malaysia, Thailand, Indonesia and the Philippines, using a Self-Regressive Distributed Delay Error Correction Model (ARL) framework. Erdogan et al. (2013) applied a panel unit root test to infant mortality rate to demonstrate that there is a negative relationship between the infant mortality rate and real per capita GDP for a sample of 25 high-income OECD countries during the period 1970-2007. Gil-Alana et al. (2017) examined the long-memory properties of infant mortality rates in 37 countries incorporating non-linear deterministic trends. Their results indicate that for several countries we have evidence of both non-linearities and fractional integration. Yaya et al. (2019) analyzed the series of under-5 mortality rates in G7 countries using fractional integration methods, finding evidence of structural breaks and non-linear ruptures in the data.

We must make special mention of the fact that income poverty and health poverty might not necessarily follow the same directions since the determinants of the two components of poverty might not necessarily be the same (Musakwa and Odhiambo, 2019).

This article takes a completely different perspective focussing on the time series properties of the income poverty series in 53 African countries, and looking at the potential existence of time trends and investigating the levels of persistence. As far as we know this is the first empirical paper using this approach.

3. Methodology

This section briefly presents the methodology that we use in the empirical section below. Standard time series frameworks in econometrics consider that the orders of integration of the series are 0 in case of stationary series and 1 if the series is nonstationary. In some

very special circumstances the series may be even integration of order 2, i.e., I(2) (e.g., Burke and Hunger, 2005; Juselius, 2006; etc.). In this paper we depart from these classical assumptions and allow the order of integration to be a fractional value. This allows for a much richer degree of flexibility in the dynamic specification of the model, in the sense that it permits us situation like stationary long memory (if the order of integration lies in the interval (0, 0.5); nonstationary though mean reverting cases (if the order of integration lies in the interval [0.5, 1); unit roots (d = 1), or even situations with orders of integration higher than 1.

4. The dataset

We use the household consumer expenditures to capture the poverty level in the continent in line with the study of Kaidi et al. (2019).[1] It is believed that living standards and the poverty levels are connected. Whenever there is an increase in living standards, consumption of household is likely to fall and therefore the poverty levels of the household will fall. The datasets have been generated from The National Accounts Main Aggregates Database of the United Nations Statistical Division.[2] The datasets-which are defined as real household consumption expenditures (including non-profit institutions serving households) per capita (constant 2015 US$)- are for the time period 1970-2018, annually, for Africa and all its countries. The exceptions are Eritrea, Ethiopia and Zanzibar with datasets for the period 1990-2018.[3] In Table 1, the mean statistics show that Nigeria, South Africa, Egypt, Algeria and Morocco have the largest household

[1] Another measure of poverty is the poverty line indicators (including the World Bank's $1.90 per day poverty line, which captures the level of national poverty lines in some of the poorest nations). However, the data are not available in a consistent manner. Using the household consumption expenditures per capita of household consumption expenditures as a share of GDP does not materially change the results.
[2] This can be obtained at https://unstats.un.org/unsd/snaama/Basic.
[3] Zanzibar is a semi-autonomous territory that is in a political union with Tanzania

consumption on the continent. These identified five countries are also among the countries with the biggest GDP and population in the continent.

TABLE 1 AND FIGURE 1 ABOUT HERE

Figure 1 displays the aggregated series (in millions) for the five regions identified by the United Nations: Northern Africa (which has five countries in the sample), Western Africa (which has sixteen countries in the sample), Eastern Africa (which has eighteen countries in the sample), Central Africa (which has nine countries in the sample) and Southern Africa (which has five countries in the sample). We observe that for Northern Africa and Southern Africa there is a continuous increase across the sample. For Eastern Africa and Western Africa, the increase starts at around 2000, while for Central Africa, there is a decrease in the 1990s, following by a sharp increase after that.

5. Empirical results

Following standard parameterizations in time series modelling, our estimated model is the following one,

$$y_t = \alpha + \beta t + x_t, \quad (1-B)^d x_t = u_t, \quad t = 1, 2, ..., \qquad (1)$$

where y_t is the time series we observe, α and β are unknown coefficients referring respectively to a constant and a linear time trend, and the regression errors, x_t are I(d), so that u_t is a white noise process.

Table 2 displays the estimates of d in equation (1) under three different modelling specifications for the deterministic terms. Thus, in the second column, we present the results supposing that $\alpha = \beta = 0$ a priori, so no deterministic components are included in the model; in the third column, we report the estimated values of d under the assumption that α is unknown and $\beta = 0$ a priori, i.e., including an intercept in the regression model; finally, in the last column, we estimate d with α and β also estimated from the data. We

display in bold in Table 2 the most adequate model for each series. This is based on the t-values on the estimated coefficients. Table 3 displays these estimated coefficients for each series.

TABLES 2 AND 3 ABOUT HERE

The first thing we observe across Tables 2 and 3 is that the time trend coefficient is statistically significant in 43 out of the 53 cases examined, and in all these cases the coefficient is significantly positive implying an increasing trend in the data. The highest values for the time trend coefficients are obtained in the cases of Botswana (0.0714) and Mali (0.0698), followed by Equatorial Guinea (0.0673), Ethiopia (0.0627) and the Kingdom of Eswatini (0.0622). For the global data on Africa, the time trend is also significantly positive and the estimated value is 0.0361. The ten countries where the time trend is not significant are Angola, Cameroon, Dem. Rep. of Congo, Eritrea, Lybia, Liberia, Rwanda, Sierra Leone and Zambia.

We next look at the estimated values of d and the first thing we observe is that the values are significantly positive in all cases, implying long memory behaviour. The values range between 0.34 (Togo) and 1.30 (South Africa). Here the countries can be classified into three categories: 1) those which values of d which are stastistically smaller than 1, and thus showing mean reversion; 2) those where the unit root hypothesis cannot be rejection, i.e., with d = 1; and 3) those with values of d significantly higher than 1. The results are displayed in Table 4.

TABLE 4 ABOUT HERE

We see in Table 4 that there are 16 countries within the first category (d < 1) and thus showing mean reversion. They are Togo, Malawi, Comoros, Kenya, Morocco, Zimbabwe, Gambia, Seychelles, Niger, Benin, Central Africa Republic, Libya, Burkina Faso, Djibouti, Gabon and Namibia. In all these countries, shocks will have transitory

effects, disappearing by themselves in the long run. On the other hand, in the rest of the countries, random shocks will have permanent effects. Thus, for example, if there is an exogenous shock increasing poverty in one of these countries, strong policy actions will be required to recover it original long-term projection.

TABLE 5 AND FIGURE 2 ABOUT HERE

In Table 5 we relate persistence with the actual levels of income for each country, while Figure 2 displays the relationship between the estimates of d and GDP per capita. We do not observe any significant relation between the two apart from the fact that the two countries with the lowest levels of persistence (Togo, d = 0.34, and Malawi, d = 0.41) belong to the group of low income countries.

As a robustness checking of the results presented we also consider the possibility of structural breaks. This is a very relevant issue noting that structural breaks, and nonlinearities in general, are issues which are very much related with fractional integration. In fact, several authors have argued that the latter might be an spurious phenomenon caused by the presence of breaks which have not been taken into account (Diebold and Inoue, 2001; Granger and Hyung, 2004; etc.). However, detecting abrupt changes in the data would produce subsamples with very few observations, invalidating the analysis based on fractional integration. To solve this problem, we implement the approach developed in Cuestas and Gil-Alana (2016) that use the nonlinear Chebyshev's polynomials in time in I(d) contexts. We consider now the following model,

$$y_t = \sum_{i=0}^{m} \theta_i P_{iT}(t) + x_t, \quad (1-L)^d x_t = u_t, \qquad t = 1, 2, ..., \tag{2}$$

where y_t is the observed series and P_{iT} are the Chebyshev time polynomials defined by:

$$P_{0,T}(t) = 1,\ P_{i,T}(t) = \sqrt{2}\cos\left(i\pi(t-0.5)/T\right), \qquad t = 1, 2, \ldots, T; \quad i = 1, 2, \ldots,$$

where m indicates the degree of non-linearity. Bierens (1997) and Tomasevic et al. (2009) showed that highly non-linear trends can be approximated with a low degree polynomial in time. Thus, if m = 0 the model contains an intercept, if m = 1 a linear trend is added, and if m > 1, nonlinear specifications are permitted. We estimate the model given by (2), and to allow for some degree of generality, we set m = 3 in which the data will contain non-linear structures if θ_2 and/or θ_3 are statistically significant. The results are reported in Table 6.

TABLE 6 ABOUT HERE

The most noticeable feature observed in this table is that non-linear structures are present in the majority of the cases. In fact, there are only eleven countries where both θ_2 and θ_3 are insignificantly different from zero. These countries are Botswana, Chad, Cote d'Ivory, Congo, Cabo Verde, Equatorial Guinea, Guinea, Lesotho, Libya, Mauritius, South Africa and Zimbawe. For all the other countries, there is at least one significant non-linear coefficient. Looking at the estimated values of d, we observe that they are very similar to those reported across Table 3 so that the same conclusions as in the linear case apply here.

6. Conclusions

In this article we have examined income poverty in Africa by means of looking at the statistical properties of the household consumer expenditure in 53 African countries using fractional integration methods. In doing so it allows us to determine the degree of persistence in the data in a general and flexible way.

Our results indicate high levels of persistence in all cases and evidence of mean reversion (and thus transitory shocks) is only observed in ten countries: Togo, Malawi, Comoros, Kenya, Morocco, Zimbabwe, Gambia, Seychelles, Niger, Benin, Central

Africa Republic, Libya, Burkina Faso, Djibouti, Gabon and Namibia. For the remaining countries, the estimated values of the differencing parameter are equal to or higher than 1 implying lack of mean reversions and thus permanency of shocks.

The implication of the foregoing results is that tools of supply-side economics are more appropriate to address poverty in most countries in the continent than the tools of demand-side economics. This is because supply-side economics tools are more suited to long term policies. Long term policies aimed at addressing income poverty in the continent will have have long-lasting effects on poverty reduction in the countries having income poverty with permanent shocks. Hence, policies that encourage more investment in infrastructure and social amenities will be effective for poverty reduction in several economies in the continent. Serious infrastructure and social amenities deficiencies in roads, ports, railroads, communications and power generation, still exists in several countries in the region. Improved allocation of public outlays in addition to allowing private investment in these sectors would improve infrastructure while reducing the budgetary burden. For instance, increased power availability will reduce cost of doing business in these countries. The reduction in cost of doing business will improve the business activities of small and medium scales enterprises. Such development will generate employment opportunities in the countries, reduce unemployment among the poor people and increase their income.

Other long-term policies needed include those that facilitate an increase in investment on emerging agriculture technologies as well as the availability of such technologies. These technologies include pest resistant technologies, crop sensors, pervasive automation systems and irrigation systems. This is because a large section of the poor on the continent are farmer. Availability of such technologies are likely to improve the productivity of farmers and consequently their incomes.

In the countries having income poverty with transitory shocks, short term policies will be appropriate in these countries. This is because any policies aimed at addressing poverty in these countries might not have permanent effects. The appropriate short-term policies include monetary transfers to the poor. Other short-term policies include reduction in interest rates combined with expansionary government spending programs These policies will stimulate aggregate demand, increased welfare benefits which help increase the income of the poor.

The findings also imply that inferences made from the estimates of standard regression including Ordinary Least Squares (OLS) maybe invalid if the level poverty series as against differenced poverty series of African countries are used in the estimation process. This is because spurious results, which are characteristics of nonstationary series will be present in such estimation. Moreover, as poverty is related to several economic and health series, persistence in poverty is likely be transferred to other variables. Therefore, a negative shock to poverty is likely to reduce the ability to fight several diseases and policy intervention will be clearly needed.

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Table 1: Descriptive statistics

Country	Starting	Ending	Max.	Min.	Mean	Std.
ALGERIA	23.20	25.02	25.02	23.20	24.24	0.44
ANGOLA	23,53	24.91	24.92	22.89	23.87	0.51
BENIN	21.14	22.57	22.57	21.14	21.80	0.44
BURKINA FASO	21.16	23.01	23.01	21.00	21.95	0.56
BOTSWANA	19.62	22.86	22.86	19.62	21.41	0.93
BURUNDI	20.86	21.66	21.70	20.82	21.32	0.24
C. AFRICAN.	20.29	21.27	21.38	20.23	20.90	0.31
CAMEROON	22.36	23.93	23.93	22.36	23.16	0.41
CHAD	21.37	22.73	22.87	21.20	22.10	0.52
COTE D'IVORIE	22.29	24	24.00	22.29	23.03	0.43
COMOROS	18.88	20.71	20.71	18.88	19.81	0.52
CONGO	20.70	21.82	22.55	20.70	21.67	0.51
CABO VERDE	18.91	20.87	20.87	18.80	19.81	0.71
DJIBOUTI	19.72	21.43	21.43	19.62	20.20	0.47
DEM. REP.	23.40	24.07	24.07	23.16	23.52	0.21
EGYPT	24.05	26.39	26.39	24.05	25.30	0.71
EQUAT.	19.15	22.48	22.48	19.15	20.57	1.20
ERITREA	21.26	22.09	22.14	21.26	21.84	0.21
K. OF ESWATINI	18.86	21.79	21.79	18.85	20.65	0.92
ETHIOPIA	22.88	24.62	24.62	22.88	23.66	0.59
GABON	20.96	22.45	22.45	20.96	21.77	0.37
GAMBIA	19.58	21.06	21.06	19.58	20.32	0.40
GUINEA BISSAU	19.09	20.85	20.85	19.09	20.01	0.49
GHANA	22.58	24.34	24.34	22.42	23.16	0.60
GUINEA	21.48	22.87	22.87	21.48	22.17	0.40
KENYA	22.86	24.82	24.82	22.86	23.77	0.55
LESOTHO	19.63	21.39	21.40	19.58	20.74	0.45
LIBYA	22.69	23.10	23.99	22.44	23.32	0.38
LIBERIA	20.59	21.08	21.30	18.71	20.53	0.65
MADAGASCAR	22.22	22.92	22.92	22.15	22.41	0.24
MALAWI	20.79	22.53	22.53	20.79	21.69	0.48
MALI	19.90	23.25	23.25	19.90	21.39	1.00

MAURITANIA	20.18	22.21	22.21	20.14	21.09	0.57
MAURITIUS	20.80	22.98	22.98	20.80	21.96	0.69
MOROCCO	23.01	24.90	24.90	23.01	23.92	0.55
MOZAMBIQUE	21.36	23.16	23.16	21.36	22.07	0.55
NAMIBIA	21.08	22.89	22.90	21.08	21.82	0.52
NIGER	21.40	22.80	22.80	20.95	21.84	0.47
NIGERIA	25.02	26.71	26.71	25.02	25.75	0.56
RWANDA	21.20	22.73	22.73	21.05	21.72	0.45
SOUTH AFRICA	24.55	26.01	26.01	24.55	25.32	0.43
SAO TOME	17.72	19.47	19.48	17.72	18.54	0.48
SENEGAL	21.92	23.44	23.44	21.91	22.57	0.44
SEYCHELLES	18.06	20.67	20.67	17.36	19.12	0.77
SIERRA LEONE	21.22	22.41	22.41	20.90	21.60	0.36
SOMALIA	20.20	20.87	20.87	20.15	20.47	0.18
ZANZIBAR	18.94	20.55	20.55	18.94	19.90	0.43
TONGO	20.68	21.93	21.93	20.62	21.22	0.39
TUNISIA	21.93	24.23	24.23	21.93	23.24	0.64
UGANDA	21.93	23.76	23.76	21.75	22.58	0.68
TANZANIA	21.69	24.25	24.25	21.69	22.97	0.76
ZAMBIA	22.07	23.02	23.11	21.97	22.41	0.35
ZIMBABWE	21.98	23.44	23.61	20.67	22.58	0.54
AFRICA	26.43	28.17	28.17	26.43	27.25	0.50

Figure 1: Aggregated time series plots

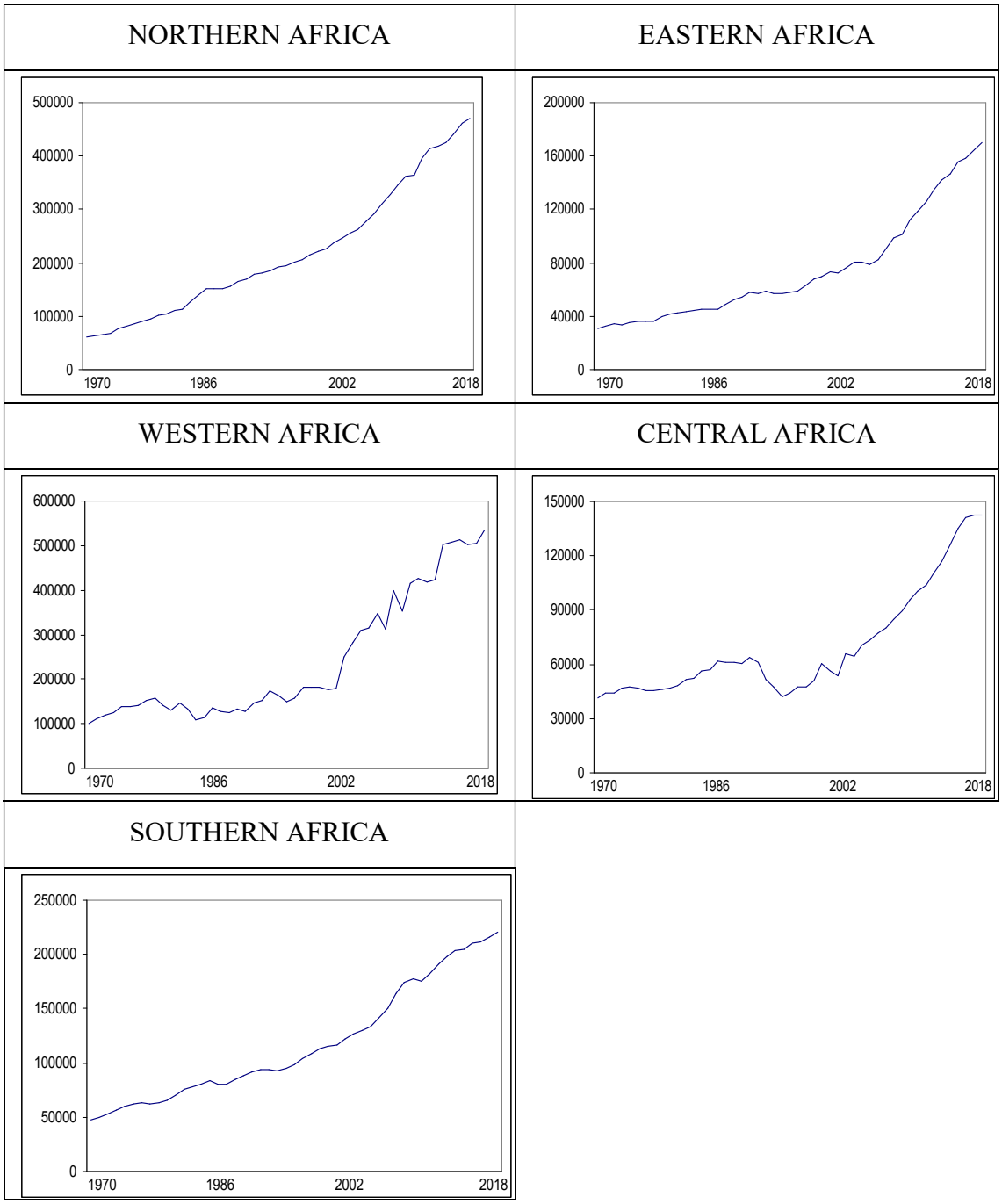


Table 2: Estimates of d (and 95% confidence intervals)

Country	No terms	An intercept	A línear time trend
ALGERIA	0.93 (0.75, 1.19)	1.33 (1.19, 1.52)	**1.29 (1.16, 1.46)**
ANGOLA	0.93 (0.75, 1.19)	**0.99 (0.84, 1.25)**	0.99 (0.83, 1.25)
BENIN	0.92 (0.74, 1.19)	0.83 (0.75, 0.99)	**0.66 (0.48, 0.98)**
BURKINA FASO	0.92 (0.74, 1.19)	0.80 (0.71, 0.92)	**0.70 (0.56, 0.89)**
BOTSWANA	0.93 (0.74, 1.18)	1.35 (0.84, 1.77)	**1.27 (0.95, 1.70)**
BURUNDI	0.92 (0.74, 1.18)	0.96 (0.78, 1.21)	**0.96 (0.79, 1.20)**
CENTRAL AFRICAN. REP.	0.92 (0.74, 1.18)	0.68 (0.57, 0.95)	**0.68 (0.51, 0.95)**
CAMEROON	0.93 (0.75, 1.18)	**1.40 (1.23, 1.63)**	1.39 (1.22, 1.62)
CHAD	0.91 (0.75, 1.19)	0.84 (0.71, 1.14)	**0.73 (0.36, 1.14)**
COTE D'IVORIE	0.93 (0.72, 1.19)	0.97 (0.70, 1.29)	**0.99 (0.74, 1.29)**
COMOROS	0.93 (0.74, 1.19)	0.73 (0.66, 0.85)	**0.51 (0.29, 0.81)**
CONGO	0.91 (0.73, 1.17)	**0.80 (0.54, 1.68)**	0.79 (0.46, 1.69)
CABO VERDE	0.92 (0.73, 1.19)	1.13 (1.01, 1.31)	**1.15 (1.01, 1.34)**
DJIBOUTI	0.93 (0.74, 1.19)	0.74 (0.63, 0.89)	**0.72 (0.60, 0.88)**
DEM. REP. CONGO	0.93 (0.75, 1.19)	**1.10 (0.95, 1.32)**	1.11 (0.96, 1.33)
EGYPT	0.92 (0.74, 1.19)	1.24 (0.96, 1.65)	**1.18 (0.94, 1.61)**
EQUAT.	0.91 (0.72, 1.18)	1.07 (0.90, 1.41)	**1.07 (0.89, 1.42)**
ERITREA	0.88 (0.62, 1.24)	**1.04 (0.22, 1.42)**	1.05 (0.78, 1.37)
K. OF ESWATINI	0.92 (0.74, 1.19)	0.80 (0.71, 1.07)	**0.81 (0.67, 1.04)**
ETHIOPIA	0.86 (0.59, 1.24)	0.96 (0.85, 1.14)	**0.92 (0.73, 1.18)**
GABON	0.93 (0.75, 1.19)	0.69 (0.55, 0.93)	**0.76 (0.62, 0.95)**
GAMBIA	0.93 (0.75, 1.19)	0.68 (0.58, 0.94)	**0.63 (0.40, 0.96)**
GUINEA BISSAU	0.93 (0.74, 1.19)	0.75 (0.63, 1.04)	**0.78 (0.61, 1.04)**
GHANA	0.92 (0.74, 1.19)	0.98 (0.88, 1.15)	**0.96 (0.82, 1.18)**
GUINEA	0.92 (0.74, 1.19)	0.82 (0.72, 1.07)	**0.78 (0.57, 1.08)**
KENYA	0.93 (0.74, 1.19)	0.78 (0.71, 0.91)	**0.59 (0.38, 0.90)**
LESOTHO	0.93 (0.75, 1.19)	1.11 (0.60, 1.45)	**1.08 (0.89, 1.36)**
LIBYA	0.93 (0.74, 1.18)	**0.68 (0.51, 0.97)**	0.69 (0.52, 0.97)
LIBERIA	0.93 (0.75, 1.19)	**1.02 (0.85, 1.29)**	1.02 (0.85, 1.29)
MADAGASCAR	0.93 (0.74, 1.19)	1.00 (0.91, 1.14)	**1.00 (0.89, 1.17)**
MALAWI	0.93 (0.75, 1.20)	0.68 (0.60, 0.77)	**0.41 (0.19, 0.78)**
MALI	0.93 (0.74, 1.19)	1.02 (0.90, 1.24)	**1.03 (0.88, 1.25)**

MAURITANIA	0.92 (0.74, 1.19)	0.82 (0.70, 1.03)	**0.79 (0.62, 1.02)**
MAURITIUS	0.92 (0.74, 1.18)	1.06 (0.84, 1.52)	**1.03 (0.70, 1.49)**
MOROCCO	0.92 (0.74, 1.19)	0.82 (0.76, 0.90)	**0.62 (0.50, 0.79)**
MOZAMBIQUE	0.93 (0.74, 1.19)	1.09 (0.99, 1.26)	**1.11 (0.99, 1.29)**
NAMIBIA	0.92 (0.75, 1.19)	0.83 (0.74, 0.96)	**0.78 (0.67, 0.95)**
NIGER	0.92 (0.74, 1.18)	0.76 (0.67, 0.91)	**0.65 (0.45, 0.88)**
NIGERIA	0.92 (0.75, 1.20)	0.85 (0.73, 1.06)	**0.83 (0.68, 1.06)**
RWANDA	0.93 (0.74, 1.19)	**1.14 (0.97, 1.40)**	1.15 (0.97, 1.41)
SOUTH AFRICA	0.92 (0.74, 1.19)	1.38 (0.89, 1.99)	**1.30 (0.90, 1.92)**
SAO TOME	0.93 (0.75, 1.19)	0.81 (0.66, 1.07)	**0.81 (0.64, 1.07)**
SENEGAL	0.92 (0.74, 1.19)	1.00 (0.88, 1.22)	**1.00 (0.84, 1.25)**
SEYCHELLES	0.93 (0.75, 1.19)	0.67 (0.56, 0.85)	**0.63 (0.49, 0.84)**
SIERRA LEONE	0.92 (0.73, 1.19)	**1.13 (0.96, 1.39)**	1.14 (0.96, 1.39)
SOMALIA	0.93 (0.75, 1.19)	0.83 (0.67, 1.07)	**0.85 (0.70, 1.07)**
ZANZIBAR	0.92 (0.74, 1.19)	1.08 (0.87, 1.43)	**1.08 (0.82, 1.40)**
TONGO	0.92 (0.74, 1.19)	0.73 (0.65, 0.85)	**0.34 (0.08, 0.71)**
TUNISIA	0.93 (0.75, 1.19)	1.37 (1.15, 1.60)	**1.19 (1.06, 1.36)**
UGANDA	0.92 (0.74, 1.19)	1.20 (1.08, 1.41)	**1.23 (1.10, 1.45)**
TANZANIA	0.87 (0.60, 1.23)	0.63 (0.51, 0.74)	**0.91 (0.40, 1.42)**
ZAMBIA	0.92 (0.74, 1.18)	**1.01 (0.81, 1.39)**	1.01 (0.78, 1.39)
ZIMBABWE	0.92 (0.74, 1.18)	0.64 (0.45, 0.99)	**0.62 (0.38, 0.99)**
AFRICA	0.93 (0.74, 1.19)	0.95 (0.86, 1.11)	**0.94 (0.82, 1.13)**

The values in bold refer to the selected models according to the deterministic terms. The values in parenthesis refer to the 95% confidence bands for the values of d.

Table 3: Estimated coefficients of the selected models in Table 2 (intercept and a time trend)

Country	No terms	An intercept	A línear time trend
ALGERIA	1.29 (1.16, 1.46)	23.147 (550.16)	0.0438 (2.36)
ANGOLA	0.99 (0.84, 1.25)	23.526 (150.23)	---
BENIN	0.66 (0.48, 0.98)	21.089 (549.98)	0.0298 (15.19)
BURKINA FASO	0.70 (0.56, 0.89)	21.081 (287.35)	0.0383 (9.26)
BOTSWANA	1.27 (0.95, 1.70)	19.434 (287.84)	0.0714 (2.84)
BURUNDI	0.96 (0.79, 1.20)	20.844 (346.42)	0.0166 (2.21)
CENTRAL AFR. REP.	0.68 (0.51, 0.95)	20.277 (256.89)	0.0210 (4.96)
CAMEROON	1.40 (1.23, 1.63)	22.337 (536.86)	---
CHAD	0.73 (0.36, 1.14)	21.316 (207.92)	0.0312 (5.00)
COTE D'IVORIE	0.99 (0.74, 1.29)	22.250 (311.16)	0.0356 (3.61)
COMOROS	0.51 (0.29, 0.81)	18.857 (87.11)	0.0374 (20.90)
CONGO	0.80 (0.54, 1.68)	20.790 (90.00)	---
CABO VERDE	1.15 (1.01, 1.34)	18.869 (402.57)	0.0389 (3.42)
DJIBOUTI	0.72 (0.60, 0.88)	19.670 (127.87)	0.0316 (3.46)
DEM. REP. CONGO	1.10 (0.95, 1.32)	23.391 (345.49)	---
EGYPT	1.18 (0.94, 1.61)	24.004 (653.02)	0.0480 (4.83)
EQUAT.	1.07 (0.89, 1.42)	19.039 (345.49)	0.0673 (2.12)
ERITREA	1.04 (0.22, 1.42)	21.248 (191.32)	---
K. OF ESWATINI	0.81 (0.67, 1.04)	18.824 (185.04)	0.0622 (7.98)
ETHIOPIA	0.92 (0.73, 1.18)	22.808 (310.40)	0.0627 (5.79)
GABON	0.76 (0.62, 0.95)	20.964 (223.77)	0.0294 (4.75)
GAMBIA	0.63 (0.40, 0.96)	19.567 (261.30)	0.0294 (8.19)
GUINEA BISSAU	0.78 (0.61, 1.04)	19.064 (219.99)	0.0356 (5.88)
GHANA	0.96 (0.82, 1.18)	22.541 (276.99)	0.0367 (3.63)
GUINEA	0.78 (0.57, 1.08)	21.458 (518.93)	0.0284 (9.80)
KENYA	0.59 (0.38, 0.90)	22.818 (504.45)	0.0394 (19.62)
LESOTHO	1.08 (0.89, 1.36)	19.591 (290.47)	0.0373 (2.92)
LIBYA	0.68 (0.51, 0.97)	22.812 (103.27)	---
LIBERIA	1.02 (0.85, 1.29)	20.592 (70.91)	---
MADAGASCAR	1.00 (0.89, 1.17)	22.207 (610.47)	0.0145 (2.79)
MALAWI	0.41 (0.19, 0.78)	20.840 (457.42)	0.0338 (21.01)
MALI	1.03 (0.88, 1.25)	19.827 (232.54)	0.0698 (5.16)

MAURITANIA	0.79 (0.62, 1.02)	20.125 (20.85)	0.0416 (5.98)
MAURITIUS	1.03 (0.70, 1.49)	20.755 (381.04)	0.0453 (5.24)
MOROCCO	0.62 (0.50, 0.79)	22.964 (708.04)	0.0391 (25.65)
MOZAMBIQUE	1.11 (0.99, 1.29)	21.318 (386.98)	0.0379 (3.26)
NAMIBIA	0.78 (0.67, 0.95)	21.039 (271.90)	0.0368 (6.79)
NIGER	0.65 (0.45, 0.88)	21.278 (205.43)	0.0292 (5.62)
NIGERIA	0.83 (0.68, 1.06)	25.004 (197.63)	0.0345 (3.35)
RWANDA	1.14 (0.97, 1.40)	21.192 (244.86)	---
SOUTH AFRICA	1.30 (0.90, 1.92)	24.510 (1030.19)	0.0319 (3.27)
SAO TOME	0.81 (0.64, 1.07)	17.700 (148.55)	0.0352 (3.86)
SENEGAL	1.00 (0.84, 1.25)	21.883 (713.87)	0.0318 (7.20)
SEYCHELLES	0.63 (0.49, 0.84)	18.023 (74.76)	0.0500 (4.32)
SIERRA LEONE	1.13 (0.96, 1.39)	21.207 (200.86)	---
SOMALIA	0.85 (0.70, 1.07)	20.201 (265.50)	0.0127 (1.92)
ZANZIBAR	1.08 (0.82, 1.40)	21.638 (383.37)	0.0532 (4.98)
TONGO	0.34 (0.08, 0.71)	20.565 (554.33)	0.0266 (21.08)
TUNISIA	1.19 (1.06, 1.36)	21.898 (881.33)	0.0496 (7.14)
UGANDA	1.23 (1.10, 1.45)	21.904 (438.20)	0.0339 (2.10)
TANZANIA	0.91 (0.40, 1.42)	18.904 (366.31)	0.0564 (7.63)
ZAMBIA	1.01 (0.81, 1.39)	22.074 (225.59)	---
ZIMBABWE	0.62 (0.38, 0.99)	21.968 (73.27)	0.0282 (1.99)
AFRICA	0.94 (0.82, 1.13)	26.395 (787.54)	0.0361 (9.26)

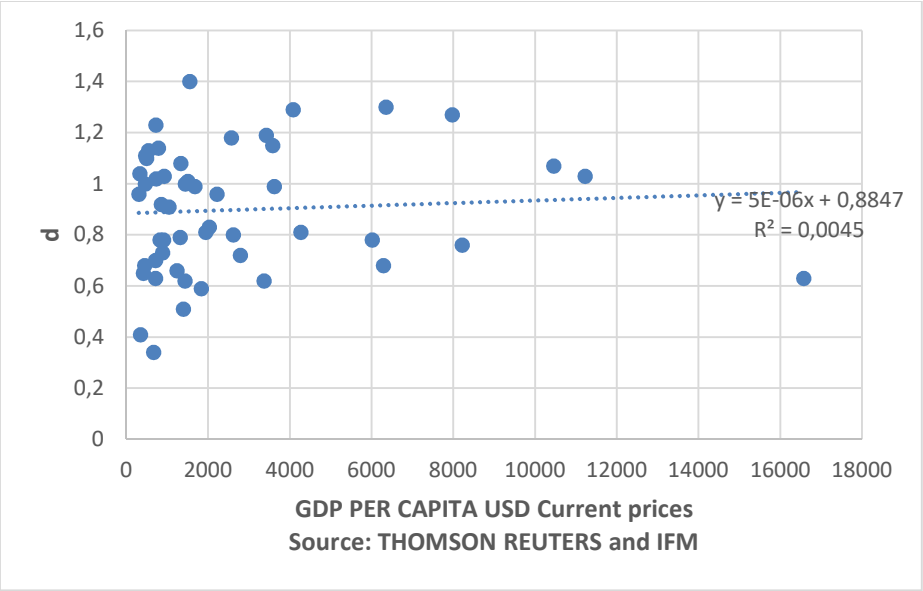
The values in parenthesis in the third and fourth columns are t-values.

Table 4: Classification of countries according to the level of persistence

0 < d < 1	d = 1	d > 1
TOGO (0.34)	CHAD (0.73)	CABO VERDE (1.15)
MALAWI (0.41)	GUINEA BISSAU (0.78)	TUNISIA (1.19)
COMOROS (0.51)	GUINEA (0.78)	UGANDA (1.23)
KENYA (0.59)	MAURITANIA (0.79)	ALGERIA (1.29)
MOROCCO (0.62)	CONGO (0.80)	CAMEROON (1.40)
ZIMBABWE (0.62)	K. OF ESWATINI (0.81)	
GAMBIA (0.63)	SAO TOME (0.81)	
SEYCHELLES (0.63)	NIGERIA (0.83)	
NIGER (0.65)	SOMALIA (0.85)	
BENIN (0.66)	TANZANIA (0.91)	
CENT. AFR. REP. (0.68)	ETHIOPIA (0.92)	
LIBYA (0.68)	AFRICA (0.94)	
BURKINA FASO (0.70)	BURUNDI (0.96)	
DJIBOUTI (0.72)	GHANA (0.96)	
GABON (0.76)	COTE D'IVORIE (0.99)	
NAMIBIA (0.78)	ANGOLA (0.99)	
	MADAGASCAR (1.00)	
	SENEGAL (1.00)	
	ZAMBIA (1.01)	
	LIBERIA (1.02)	
	MALI (1.03)	
	MAURITIUS (1.03)	
	ERITREA (1.04)	
	EQUAT. GUINEA (1.07)	
	LESOTHO (1.08)	
	ZANZIBAR (1.08)	
	DEM. R. CONGO (1.10)	
	MOZAMBIQUE (1.11)	
	SIERRA LEONE (1.13)	
	RWANDA (1.14)	
	EGYPT (1.18)	
	BOTSWANA (1.27)	
	SOUTH AFRICA (1.30)	

Table 5: Summary results on persistence

	0 < d < 1	d = 1	d > 1
High Income 1	GABON (0.76) MOROCCO (0.62) NAMIBIA (0.78) LIBYA (0.68) SEYCHELLES (0.63)	EQ. GUINEA (1.07) MAURITIUS (1.03) BOTSWANA (1.27) S. AFRICA (1.30) ANGOLA (0.99)	CABO VERDE (1.15) ALGERIA (1.29) TUNISIA (1.19)
Upper-Middle Income 2	KENYA (0.59) DJIBOUTI (0.72)	SENEGAL (1.00) SAO TOME (0.81) NIGERIA (0.83) ZAMBIA (1.01) CONGO (0.79) COT. D'IVORIE (0.99) GHANA (0.96) LESOTHO (1.08) K. ESWATINI (0.81) EGYPT (1.18)	CAMEROON (1.40)
Lower-Middler Income 3	COMOROS (0.51) ZIMBABWE (0.62) GAMBIA (0.63)	MALI (1.03) ZANZIBAR (1.08) ERITREA (1.04) ETHIOPIA (0.92) TANZANIA (0.91) CHAD (0.73) GUIN. BISSAU (0.78) MAURITANIA (0.79) GUINEA (0.78) RWANDA (1.14)	
Low-Income 4	BURKINA FASO (0.70) CT. AFR. REP. (0.68) BENIN (0.66) NIGER (0.65) TOGO (0.34) MALAWI (0.41)	MADAGASCAR (1.00) LIBERIA (1.02) BURUNDI (0.96) SOMALIA (0.85) MOZAMBIQUE (1.11) S. LEONE (1.13) DEM R CONGO (1.10)	UGANDA (1.23)



r= 0.06736323; p-value= 0.6386,

Figure 2: Persistence and GDP per capita

Table 6: Estimated coefficient in a nonlinear I(d) model

Country	d	θ_0	θ_1	θ_2	θ_3
ALGERIA	1.06 (0.88, 1.29)	24.0096 (131.64)	-0.3829 (-3.52)	0.0004 (0.008)	**-0.1952** **(-5.91)**
ANGOLA	0.76 (0.47, 1.13)	23.8267 (89.93)	-0.3557 (-2.40)	**0.2880** **(2.99)**	**-0.1313** **(-1.84)**
BENIN	0.52 (0.21, 0.99)	21.7853 (629.03)	-0.4364 (-21.37)	**0.0365** **(2.27)**	**-0.0434** **(-3.25)**
BURKINA FASO	0.54 (0.31, 0.83)	21.9246 (325.81)	-0.5519 (-14.06)	**0.0938** **(3.07)**	**-0.0671** **(-2.67)**
BOTSWANA	1.36 (1.05, 1.78)	20.7987 (25.72)	-0.7420 (-1.42)	-0.0219 (-0.12)	-0.0975 (-0.95)
BURUNDI	0.61 (0.32, 0.97)	21.3353 (359-13)	-0.1922 (-5.69)	**-0.0489** **(-1.96)**	**-0.1089** **(-5.48)**
CENT. AFR. REP.	0.55 (0.31, 0.90)	20.8796 (276-18)	-0.2927 (-6.66)	**-0.0745** **(-2.19)**	-0.0443 (-1.60)
CAMEROON	1.30 (1.09, 1.57)	22.9569 (54.60)	-0.3026 (-1.13)	0.0165 (0.17)	**-0.1457** **(-2.56)**
CHAD	0.58 (0.19, 1.05)	22.1236 (211.62)	-0.4864 (-8.11)	-0.0228 (-0.50)	-0.0456 (-1.24)
COTE D'IVORIE	1.05 (0.79, 1.32)	22.8459 (20.24)	-0.3948 (-2.04)	0.0573 (0.62)	-0.0617 (-1.03)
COMOROS	0.58 (0.29, 0.91)	19.7966 (325.06)	-0.5216 (-14.93)	-0.0215 (-0.81)	**-0.0855** **(-4.01)**
CONGO	0.68 (0.20, 1.61)	21.5888 (64.90)	-0.4166 (-2.21)	-0.1665 (-1.27)	-0.0197 (-0.19)
CABO VERDE	0.75 (0.44, 1.10)	19.8245 (271.25)	-0.7049 (-17.27)	-0.0339 (-1.26)	0.0257 (1.29)
DJIBOUTI	-0.03 (-0.32, 0.38)	20.1982 (1222.69)	-0.3669 (-21.41)	**0.2208** **(12.72)**	**-0.1550** **(-8.84)**
DEM. REP. CONGO	0.88 (0.65, 1.19)	23.5528 (140.56)	-0.0997 (-1.04)	**0.1179** **(2.16)**	**-0.1194** **(-3.11)**
EGYPT	0.95 (0.48, 1.50)	25.2857 (218.56)	-0.6981 (-10.45)	**-0.0673** **(-1.90)**	**-0.1058** **(-4.38)**
EQUAT.	0.91 (0.54, 1.40)	20.3970 (42.31)	-1.1740 (-4.26)	0.2206 (1.44)	0.0781 (0.73)
ERITREA	0.86 (0.15, 1.30)	21.7362 /97.44)	-0.1181 (-0.95)	-0.0976 (-1.34)	**-0.1045** **(-2.03)**
K. OF ESWATINI	0.58 (0.32, 0.94)	20.5831 (206.85)	-0.9254 (-16.21)	**-0.1551** **(-3.59)**	**-0.0648** **(-1.86)**
ETHIOPIA	0.45 (0.09, 0.86)	23.6477 (555.10)	-0.5912 (-22.54)	**0.0776** **(3.61)**	0.0057 (0.31)
GABON	0.16 (-0.09, 0.51)	21.7712 (1097.51)	-0.3133 (-19.18)	0.0500 (0.32)	**-0.1755** **(-12.11)**
GAMBIA	0.61 (0.30, 0.98)	20.2652 (214.71)	-0.3975 (-7.42)	0.0275 (0.69)	**-0.0821** **(-2.60)**
GUINEA BISSAU	0.69 (0.43, 1.02)	20.0278 (158.63)	-0.4814 (-6.81)	**-0.0878** **(-1.79)**	**-0.0828** **(-2.20)**
GHANA	0.58 (0.32, 0.95)	23.1756 (317.24)	-0.5658 (-13.50)	**0.1829** **(5.76)**	**-0.0426** **(-1.66)**

GUINEA	0.92 (0.66, 1.18)	22.0949 (166.17)	-0.4080 (-5.35)	-0.0531 (-0.12)	-0.0155 (-0.53)
KENYA	0.64 (0.30, 1.01)	23.7620 (352.05)	-0.5576 (-14.66)	0.0254 (0.92)	**-0.0814** **(-3.77)**
LESOTHO	1.15 (0.93, 1.45)	20.3041 (48.84)	-0.3814 (-1.50)	-0.0230 (-0.21)	-0.0794 (-1.18)
LIBYA	0.60 (0.37, 0.92)	23.1762 (88.21)	-0.1861 (-1.24)	-0.1674 (-1.50)	0.0813 (0.91)
LIBERIA	0.93 (0.72, 1.23)	20.2136 (23.31)	-0.0913 (-0.10)	**0.4552** **(1.67)**	-0.0833 (-0.44)
MADAGASCAR	0.07 (-0.33, 0.60)	22.4089 (4417.16)	-0.2119 (-45.52)	**0.1092** **(24.17)**	-0.0061 (-1.39)
MALAWI	0.43 (-0.01, 0.91)	21.6667 (489.97)	-0.4861 (-17.57)	0.0189 (0.82)	**-0.0459** **(-2.33)**
MALI	1.02 (0.80, 1.25)	21.0420 (60.46)	-0.9666 (-4.71)	**0.1900** **(1.89)**	-0.0354 (-0.53)
MAURITANIA	0.32 (0.00, 0.73)	21.0850 (570.36)	-0.5316 (-20.84)	**-0.0812** **(3.64)**	**-0.1757** **(-8.79)**
MAURITIUS	1.04 (0.66, 1.48)	21.8610 (93.48)	-0.6784 (-4.90)	-0.299 (-0.45)	-0.0432 (-0.99)
MOROCCO	0.45 (0.26, 0.69)	23.9207 (1031.80)	-0.5482 (-38.38)	0.0159 (1.35)	**-0.0906** **(-9.06)**
MOZAMBIQUE	0.83 (0.55, 1.11)	21.9433 (192.37)	-0.5202 (-8.10)	**0.1924** **(4.95)**	**-0.0668** **(-2.39)**
NAMIBIA	0.24 (-0.04, 0.61)	21.8214 (991.31)	-0.4838 (-29.27)	**0.1287** **(8.61)**	**-0.1185** **(-8.59)**
NIGER	0.51 (0.24, 0.79)	21.8920 (249.92)	-0.4258 (-8.20)	**0.0842** **(2.04)**	**-0.0731** **(-2.13)**
NIGERIA	0.52 (0.17, 0.92)	25.6808 (256.41)	-0.5256 (-8.90)	**0.1885** **(4.05)**	-0.0050 (-0.13)
RWANDA	0.82 (0.51, 1.21)	21.7681 (125.29)	-0.3547 (-3.63)	**0.1420** **(2.38)**	**-0.2024** **(-4.69)**
SOUTH AFRICA	1.38 (0.93, 1.97)	25.0694 (83.13)	-0.3653 (-1.87)	0.0308 (0.47)	-0.0467 (-1.24)
SAO TOME	0.63 (0.33, 0.97)	18.4603 (134.04)	-0.4430 (-5.69)	**0.1133** **(1.99)**	**-0.1422** **(-3.18)**
SENEGAL	0.92 (0.61, 1.25)	22.5454 (250.34)	-0.4368 (-8.46)	**0.0593** **(2.09)**	**-0.0679** **(-3.47)**
SEYCHELLES	0.30 (0.04, 0.66)	19.0984 (191.49)	-0.6542 (-9.31)	**0.2693** **(4.34)**	**-0.1759** **(-3.14)**
SIERRA LEONE	0.81 (0.47, 1.22)	21.6001 (104.23)	-0.1972 (-1.69)	**0.1489** **(2.07)**	**-0.2226** **(4.27)**
SOMALIA	0.42 (0.18, 0.79)	20.4668 (507.07)	-0.1038 (-4.08)	**0.0637** **(3.01)**	**-0.1130** **(-6.18)**
ZANZIBAR	1.02 (0.69, 1.37)	22.9107 (101.65)	-0.7457 (-5.62)	0.0502 (0.07)	**-0.1239** **(-2.88)**
TONGO	0.35 (0.09, 0.68)	21.2266 (739.50)	-0.3824 (-19.88)	0.0634 (0.38)	**-0.0361** **(-2.45)**

TUNISIA	1.35 (1.18, 1.57)	22.7959 75.99)	-0.5254 (-2.73)	-0.0206 -0.30)	**-0.1869** **(-2.26)**

UGANDA	0.75 (0.47, 1.16)	22.5896 (291.92)	-0.6623 (-15.33)	**0.1576** **(5.56)**	**0.0436** **(2.06)**
TANZANIA	0.24 (-0.17 1.62)	19.8875 (963.78)	-0.4232 (-27.27)	**-0.0327** **(-2.33)**	**-0.0794** **(-6.13)**
ZAMBIA	0.71 (0.26, 1.23)	22.4330 (160.41)	-0.2582 (-3.30)	**0.1184** **(2.22)**	**-0.1308** **(-3.23)**
ZIMBABWE	0.52 (0.21, 0.95)	23.5944 (82.12)	-0.3243 (-2.00)	0.1059 (0.82)	-0.1491 (-1.83)
AFRICA	0.74 (0.31, 1.07)	27.1837 (491.88)	-0.5070 (-16.44)	**0.0731** **(3.57)**	**-0.0739** **(-4.82)**

In bold, the nonlinear coefficients which are significant at the 5% level.