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ARTICLE

Urbanisation and economic growth causal nexus: evidence from panel data analyses of selected positively urbanizing countries in Sub-Saharan Africa

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Abstract

The urbanisation process in Sub-Saharan Africa (SSA) has often been highlighted as a puzzle that deviates from the stylized facts in the literature. This study investigates the causal nexus between urbanisation and economic growth from the two dominant viewpoints in the literature viz. urbanisation-led economic growth and economic growth-led urbanisation. We employ the two-step system generalized methods of moments and the Dumitrescu and Hurlin (2012) procedure for Granger-causality test in heterogenous panel on data from 30 countries in SSA with positive annual urbanisation rates between 1970-2019. The study finds evidence of positive bi-directional causality, and non-linear relationship between urbanisation and economic growth in both the short-run and the long-run. These findings which are in line with the 'Africa on the rise' discourse reappraise the popular literature that largely describes urbanisation in SSA as economically dysfunctional. However, the sustainability of the urbanisation process and its full social, political and economic benefits cannot be reaped automatically. This calls for substantial investment in urban planning, public services and infrastructure provisions in major cities across SSA.

Keywords: urbanisation, economic growth, elasticities, system GMM, Granger causality test, Sub-Saharan Africa.

JEL classification: C23; C33; O18; O47; O55

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1. Introduction

Target 11.3 of the Sustainable Development Goal 11 aims to make urbanisation sustainable for all countries worldwide. Among the world's 6 geographic regions, Sub-Saharan Africa (SSA) has the lowest urbanisation level, circa 43.5% in 2020, which is projected to reach 60% by 2050 (UN-Habitat, 2020). Conversely, SSA's urbanisation rates are the highest in the world, estimated to be 1.7% and 0.5% over the periods 1950–2018 and 2018–2050 as compared to 1.0% and 0.3% for the rest of the world over the respective periods (McGranahan Satterthwaite, 2014; UN-DESA, 2019a). With SSA's urban population projected to nearly triple by 2050, there is the urgent need to make urbanisation work not only for development but also for a just development (Lall, 2020; Obeng-Odoom, 2015).

Historically, urbanisation has been an inherent part of the economic growth and development process whereby periods of continued rapid economic growths and developments are accompanied by periods of continued rapid urbanisations (Annez Buckley, 2009; Collier, 2017; Henderson, 2010). For instance, the old urbanisations of Europe and North America and the new urbanisation of Asia which were associated with industrial revolution and agricultural green revolution respectively were also accompanied by rapid economic growths (Glaeser, 2013; Gollin et al., 2016; Henderson Kriticos, 2017). The economic ramifications of these urbanisation experiences were manifestly evident by increasing productivities in agriculture, manufacturing and services sectors; increasing manufacturing and services activities in urban areas; and increasing incomes for a large number of non-urban inhabitants (Beall et al., 2010; UN-Habitat, 2016). However, the urbanisation process in SSA is seen to deviate from these stylized facts. Several major cities in SSA are not able to drive structural transformation, generate productivity growth, job creation, livability and poverty reduction (Collier Venables, 2017; Madden Gutman, 2020). Aside from the insufficient provision of public infrastructure in cities (Lewis, 2013; Madden Gutman, 2020), the coordination of markets and the policy environment have not yielded the desired improvement in working and living conditions required to foster economic development (Lall, 2020).

Particularly, in the 20th century and beyond, positive urbanisation rates continue to occur in SSA alongside sluggish or negative economic growth performances (Fay Opal, 2000; Henderson, 2003a)[1]. These occurrences have led to the urbanisation process in SSA being largely seen to be different from that of other regions. Firstly, SSA is urbanizing at the lowest per-capita income among the world's developing regions. For example, the urbanisation level of around 40% was achieved with per-capita income of $1,860 for Latin America in 1950, $1,806 for Middle East and North Africa in 1968, $3,617 for Asia in 1994, and $1,018 for SSA in 2017 (Lall et al., 2017). Secondly, SSA's current rate of urbanisation is regarded as the most rapid in history such that it will only take about 30 years to reach full urbanisation of 60-85% as compared to the 100-150 years experienced by current developed countries (Henderson, 2010) [2] .

These characteristic features of the urbanisation process in SSA provide insights into the inability of the new urban economics and the modern economic geography literature to adequately explain the urbanisation process and its economic ramifications in SSA, since they are primarily based on the old urbanisation experiences of Europe and North America. Consequently, SSA's urbanisation has largely been described as a puzzle and highlighted variously as, 'dysfunctional urbanisation' by Collier and Venables (2017); 'poor country urbanisation' by Glaeser (2013); 'pathological urbanisation' by Annez and Buckley (2009); 'urbanisation of poverty' by Ravallion et al. (2007); and 'urbanisation without growth' by Fay and Opal (2000).

Nevertheless, these descriptions succeed from the fact that an understanding of the urbanisation process and its economic effects in SSA is nascent (Annez Buckley, 2009; Glaeser Henderson, 2017; Turok McGranahan, 2013; World Bank, 2009). Notably, the 'Africa on the rise' discourse and the particularly dissenting findings of studies such as Njoh (2003) at the sub-regional level and Obeng-Odoom (2010, 2012) at the country level challenge this orthodox position. Consequently, a reappraisal of both the urbanisation-economic growth nexus and the role of urbanisation in economic development in SSA, with reference to new evidence and improved methodology is needed to firm up these prior counter viewpoints.

This study contributes to filling the knowledge gap in the literature in several aspects. Firstly, it provides a comprehensive understanding of the urbanisation-economic growth causal nexus in SSA. The empirical analysis is conducted from the perspectives of the two dominant viewpoints in the literature, viz. urbanisation-led economic growth, and economic growth-led urbanisation. Particularly, the study estimates and compares the urbanisation elasticities and economic growth

1. This is at variance with the 'Africa on the rise' discourse. See Obeng-Odoom (2015) and Jerven (2015)
2. The notion of rapid urbanisation in SSA is contested by other studies. See Potts (2009, 2012)

elasticities at both growth rates and levels to ascertain which effect is stronger in the short-run relative to the long-run or both, thereby providing a nuanced understanding of the urbanisation-economic growth nexus in SSA. Secondly, the econometric techniques employed, namely, the two-step system generalized methods of moments (SYS-GMM2) and the Dumitrescu and Hurlin (DH) procedure for Granger causality test provide unbiased, consistent and efficient estimates by controlling for endogeneity and being heteroscedasticity and autocorrelation consistent. Lastly, the results obtained from this study which are largely in line with the prior findings of Obeng-Odoom (2010, 2012) and Njoh (2003) reappraises the popular literature that largely describes the economic effects of the urbanisation process in SSA as dysfunctional.

The rest of the paper is organized as follows. Section 2 presents a review of the literature. Section 3 discusses data sources and definitions, and the empirical strategy. Section 4 presents and discusses the results. Section 5 presents the conclusions and recommendations. Furthermore, Appendix A discusses the results of the DH procedure.

2. Related literature

The extant literature on the urbanisation-economic growth nexus can be summarized into three key observations. One, urbanisation is seen as an engine of economic growth. Through the various micro-foundations of agglomeration economies and scale economies, occasioned by the concentration of people and economic activities in urban areas, urbanisation induces productivity growth and structural transformation by increasing the shares of output from industry and services sectors (Duranton Puga, 2004; Gollin et al., 2016; Jedwab, 2013; Jedwab et al., 2017). This viewpoint is fueled by the new growth theory, new urban economics and new economic geography literature (Gallup et al., 1999; Polese, 2005; World Bank, 2009).

Two, urbanisation is conversely seen as a product of economic growth and development. As the economy transitions from low-income and low productivity rural agriculture to high-income and high productivity industrial- and services-based economy, agricultural productivity increases to release rural farm labor to the urban areas to induce urbanisation (Annez Buckley, 2009; Fay Opal, 2000; Fujita et al., 2003; Henderson, 2003a; Henderson Wang, 2005; Liddle, 2017; Polese, 2005).

Three, the urbanisation-economic growth nexus is largely ambiguous. Factors other than economic growth including demographic, globalization, natural resource endowments and others are seen to cause urbanisation (Gross Ouyang, 2021; Lesthaeghe, 2014). For instance, the demographic perspective ascribes high natural increase in the urban population caused by lower urban mortality relative to urban natality as the predominant cause of urbanisation in the Global South (Jedwab et al., 2017; Potts, 2012).

The empirical support for urbanisation-led growth viewpoint often highlights the economic power of cities, whereby the output shares of cities far exceed their shares of national population (Ades Glaeser, 1995; Brookings, 2018; McKinsey Global Institute, 2011). For instance in 2010, about 50% of the world's urban population generated over 80% of the global GDP; and 600 urban areas with 22% of the global population generated over 60% of the world's GDP (McKinsey Global Institute, 2011). Other studies supporting urbanisation-led growth largely show the effect of urbanisation on economic growth amplifies with density (Ciccone, 2002; Henderson et al., 2001) and attenuates with distance (Henderson, 1994; Rice et al., 2006). Particularly, the review study by Rosenthal and Strange (2004) found that doubling the size of a given city will increase productivity by 3 to 8%. Furthermore, Obeng-Odoom (2010, 2012) and Njoh (2003) find positive effect on urbanisation on economic growth in Ghana and SSA respectively.

An equilibrium relationship has also been found between urbanisation and economic growth. The study by Liddle and Messinis (2015) for 100 countries between 1960-2009 found that initial levels of urbanisation stimulated economic growth, however, above an estimated threshold, urbanisation becomes detrimental to economic growth. For SSA, Arouri et al. (2014) estimated an optimal urbanisation level of about 70%. Also, the study by Brülhart and Sbergami (2009) for 16 Western European countries over the period 1960-2000 estimated a per-capita income threshold of USD10,000, beyond which higher urbanisation is associated with declining economic growth.

Other studies rather highlight the negative effect of urbanisation on economic growth. Brückner (2012) studied 41 SSA countries from 1960-2007 and found that rapid urbanisation had an adverse effect on the growth of per-capita income. This is supported by Nathaniel and Bekun (2021)'s study for Nigeria over the period 1971-2014.

On studies supporting growth led-urbanisation, Chen et al. (2017) show how political favoritism fueled the growth of the top four Chinese cities namely Beijing, Tianjin, Shanghai, and Chongqing over the period 1998-2007. Similarly, Davis and Henderson (2003) found evidence of political economy spurring the growth of primate and capital cities like Mexico City, Jakarta, Soul, Paris, and Sao Paulo over various years. Urbanisation has also been found to be uncorrelated with economic growth. In SSA, Fay and Opal (2000) found that over the period 1970-1995, per-capita income declined annually by 0.66% amidst average annual urban growth rate of 5.2%. Similarly, various studies have found no growth promoting effect of urbanisation (Bloom et al., 2008; Henderson, 2003b; Polese, 2005). Additionally, the findings from other studies support the effect of demographic factors on urbanisation (Beauchemin Bocquier, 2004; Gross Ouyang, 2021; Preston, 1979). Particularly, Beauchemin and Bocquier (2004) estimated that 75% of the urban population growth in West Africa over the period 1988-1992 resulted from high natural population increase caused by high urban natality.

The findings from studies on the causal nexus between urbanisation and economic growth are also mixed. Saliminez and Bahramian (2019) employing the Toda-Yamamoto method for data on the United States between 1960-2017 found urbanisation to Granger causes economic growth. Conversely, Odugbesan and Rjoub (2020) found economic growth to Granger causes urbanisation for Nigeria during the period 1993-2017. However, the study by Bloom et al. (2008) over the period 1960-2000 for 163 countries found no Granger-causality between the two variables. Furthermore, Nguyen and Nguyen (2018) study of 7 ASEAN countries from 1993-2014 found that urbanisation Granger causes growth (Thailand, Philippines); growth Granger causes urbanisation (Malaysia, Indonesia); and a bi-directional Granger causality (Vietnam, Cambodia, Brunei). Likewise, Wang et al. (2018) finds a bi-directional Granger causality between urbanisation and economic growth both for a global sample of 170 countries and 28 low income countries during the period 1980-2011.

3. Data and methodology

3.1 The Data

The data for the study is sourced from 3 online databases viz. the United Nation's World Population Prospects; Penn World Tables Version 10.0; and the World Bank's World Development Indicators. This covers 1970-2019 for a balanced panel of 30 countries in SSA with positive annual urbanisation rates over the study period [3]. These countries were purposively sampled across the 4 regions in SSA based on the selection criteria in the literature, namely, urbanisation criteria- only positively urbanizing countries throughout the study period (Henderson, 2003a); population criteria- only countries with 300,000 inhabitants or more in 1970 (Ferre et al., 2012; Henderson et al., 2013; UN-DESA, 2019a); and data availability. Following the standard approach in panel regressions, the data is sub-divided into 5-year intervals to cleanse it from any possible recurring effects and wide variations in the short-term (Brülhart Sbergami, 2009; Fay Opal, 2000; Henderson, 2003a, 2003b)

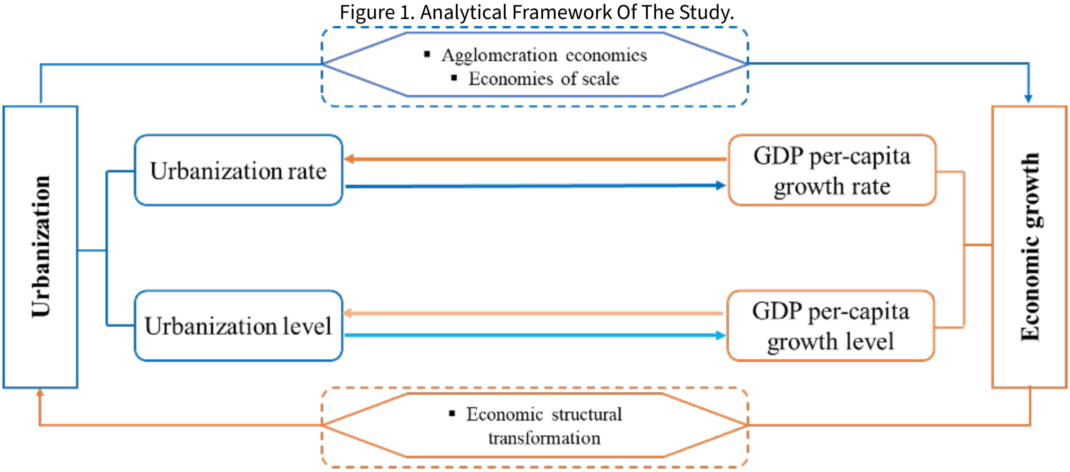
In line with prior studies, the share of a country's population living in cities (urbanisation level) and the growth in the urbanisation level (urbanisation rate) are used exclusively as the proxy measures

3. These are: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Chad, Democratic Republic of Congo, Côte d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mozambique, Nigeria, Republic of Congo, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda.

of urbanisation (Brülhart Sbergami, 2009; Henderson, 2003a; Liddle Messinis, 2015; Rosenthal Strange, 2004). Economic growth is measured exclusively by the output-side real gross domestic product (GDP) per-capita (at chained PPPs in million 2017 USD) and annual percentage growth of real GDP per-capita (Christiaensen Weerdt, 2017; Fay Opal, 2000; Henderson et al., 2013).[4]

The set of control variables namely agglomeration variables (population density, primacy); output shares variables (government, investment and trade) and tertiary education; and demographic factors (population growth, fertility, life expectancy) are used. The expected relationships between economic growth and the control variables are positive for population density, investment share, trade share, tertiary education, life expectancy and negative for primacy, government share, population growth and fertility (Brülhart Sbergami, 2009; Fay Opal, 2000; Glaeser, 2013; Gollin et al., 2016; Jedwab, 2013; Solow, 1957). The analytical framework of the study is presented in Figure 1.

Figure 1. Analytical Framework Of The Study.



4. The Empirical Model

To investigate the urbanisation-led growth viewpoint, the study specifies a Cobb-Douglas production function as:

$$G_{it} = BY_{i0}^{\lambda} U_{it}^{\delta(1+\ln U)} K_{it}^{\pi} \tag{1}$$

Equation (1) hypothesizes that the average annual growth rate (level) of real per-capita GDP of country i over the period t, G_{it}, is a function of the initial real per-capita GDP Y_{i0}; urbanisation rate (level) U_{it}; and a vector of control variables K_{it}.

Conversely, to investigate the growth led-urbanisation viewpoint, a Cobb-Douglas production function is specified as:

$$U_{it} = BY_{it}^{\alpha(1+\ln Y)} (Y_A)_{it}^{\beta} (Y_{ID})_{it}^{\gamma} (Y_S)_{it}^{\theta} C_{it}^{\sigma} \tag{2}$$

Equation (2) hypothesizes that the rate (level) of urbanisation of country i over the period t, U_{it}, is a function of the growth rate (level) of real GDP per-capita Y_{it}; sectoral shares of GDP per-capita of agriculture $(Y_A)_{it}$, industry $(Y_{ID})_{it}$ and services $(Y_S)_{it}$; and a set of control variables C_{it}.

4. The writers acknowledge the definitional quandaries and other difficulties associated with statistics in SSA and other countries in the Global South. Jerven (2015), Potts (2017) and Alenda-Demoutiez (2022) provide detail expositions on this issue. Consequently, and in line with Obeng-Odoom (2012), the data sources for this study are triangulated to help address this statistical problem.

Taking the natural logarithm on both sides of Equations (1) and (2) and rewriting in a dynamic form gives the respective first order autoregressive-distributed lag [ARDL (1)] models to be estimated as:

$$g_{it} = b_1 + \tau_1 g_{i,t-1} + \lambda y_{i0} + \delta_0 u_{i,t-1} + \delta_1 u_{it} + \delta_2 u_{it}^2 + \pi k_{it} + e_{it} \tag{3}$$

$$u_{it} = b_2 + \tau_2 u_{i,t-1} + \alpha_0 y_{i,t-1} + \alpha_1 y_{it} + \alpha_2 y_{it}^2 + \beta\,(y_A)_{it} + \gamma\,(y_{ID})_{it} + \theta\,(y_S)_{it} + \sigma c_{it} + e_{it} \tag{4}$$

where and $g = \ln G, b = \ln B, y = \ln Y, u = \ln U, k = \ln K, y_A = \ln Y_A, y_{ID} = \ln Y_{ID}, y_S = \ln Y_S, c = \ln \mathrm{C}$. The parameters $b_1, b_2, \tau_1, \tau_2, \lambda, \delta_0, \delta_1, \delta_2, \pi, \alpha_0, \alpha_1, \alpha_2, \beta, \gamma, \theta$ and σ are scalars. The subscript t denotes 5 -year time interval. The squared terms aim to capture non-linear effects. The disturbance term e_{it} in Equations (3) and (4) is assumed to be a one-way error component model given as:

$$e_{it} = \mu_i + \varepsilon_{it} \tag{5}$$

where μ_i represents the country specific and time-invariant effects and ε_{it} the usual random error term. Equation (5) is a random error model, such that $\mu_i \sim IID\left(0, \sigma^2\mu_i\right), \varepsilon_{it} \sim IID(0, \sigma^2\varepsilon_{it})$ and are all independent with $E(\mu_i) = E(\varepsilon_{it}) = E(\mu_i\varepsilon_{it}) = 0$. Further, the explanatory variables $(X_{it}{}^*)$ in Equations (3) and (4) are all assumed to be orthogonal to the error terms μ_i and ε_{it} for all i and t, with $E(\mu_i X_{it}{}^*) = E(\varepsilon_{it} X_{it}{}^*) = E(e_{it} X_{it}{}^*) = 0$.

Following the empirical strategy of Fay and Opal (2000), the lagged terms of the main independent variables namely $u_{i,t-1}$ and $y_{i,t-1}$ are respectively included in Equations (3) and (4) to investigate causality. If $\delta_0 > 0$ and significant, it will imply urbanisation causes economic growth. Conversely, $\alpha_0 > 0$ and significant will indicate that urbanisation is a product of growth. If $\delta_0 > 0$ and $\alpha_0 > 0$ and are both significant it will suggest a bi-directional causality. Furthermore, the coefficients of the respective main independent variables namely δ_0, δ_1 and α_0, α_1 are elasticities. Particularly, δ_0 and δ_1 (α_0 and α_1) are respectively the first lag and contemporaneous urbanisation elasticity of economic growth (economic growth elasticity of urbanisation).

The econometric literature recommends estimating Equations (3) and (4) using the system generalized methods of moments (SYS-GMM) technique (Blundell Bond, 1998; Blundell Bond, 2000; Blundell et al., 2000; Roodman, 2009a). Particularly, several Monte Carlo simulations (Baum et al., 2003; Bowsher, 2002; Judson Owen, 1999) and other studies (Brülhart Sbergami, 2009; Roodman, 2009a) show that the SYS-GMM provides unbiased, consistent and efficient estimates by controlling for endogeneity as well as being heteroscedasticity and autocorrelation consistent (HAC). More so, in the presence of simultaneity bias resulting from the inclusion of both the urbanisation term (u_{it}) and per-capita GDP term (y_{it}) in Equations (3) and (4), the SYS-GMM estimator remains consistent (Bond Windmeijer, 2002).

This study estimates and interprets the results of Equation (3) and (4) using the two-step system-GMM (SYS-GMM2). The used of the SYS-GMM2 estimator is shown to have additional efficiency gains including controlling for heteroskedasticity and cross correlation (Bond Windmeijer, 2002; Roodman, 2009a, 2009b; Windmeijer, 2005). The robustness checks for the SYS-GMM2 estimation follows the standard two specification tests, namely, the first and second order serial correlation tests [AR(1) and AR(2)]; and the test of instruments validity and the structural specification of the model using both the Sargan test and the Hansen test (Baltagi, 2005; Bowsher, 2002; Brülhart Sbergami, 2009; Roodman, 2009a).

5. Results and Discussions

5.1 Descriptive Statistics

Table 1 shows considerable variations for the key variables of the study. The urbanisation rate (level) ranges from a minimum of about 0.03% (3%) to a maximum of 12% (89%) and a mean of 2% (31%).

Similarly, GDP per-capita growth rate (level) also ranges from a least figure of about -14% ($491) to as high as 14% ($14,843) and a mean of 1% ($2,620).

Table 1: Summary Statistics Of Key Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Urbanisation rate	2.12	1.66	0.03	11.94
Urbanisation level	30.66	16.89	3.11	88.95
GDP growth per-capita	0.96	0.04	−14.25	14.08
GDP per-capita	2620.26	2711.33	490.98	14842.71
Agriculture share	28.95	15.05	2.06	70.93
Industry share	23.74	13.66	4.79	73.83
Services share	42.46	10.00	13.93	66.47
Agriculture value-added growth	3.36	3.38	−7.96	18.28
Industry value-added growth	5.77	18.34	−17.06	300.00
Services value-added growth	4.43	3.70	−10.78	19.90
Rural-Urban wage differentials	26.85	20.64	0.23	110.10

Source: Author's estimation using study data

In line with the literature, Figures 2 and 3 and Table 2 depict positive relationships between urbanisation level and GDP per-capita and urbanisation rate and GDP per-capita growth rate.

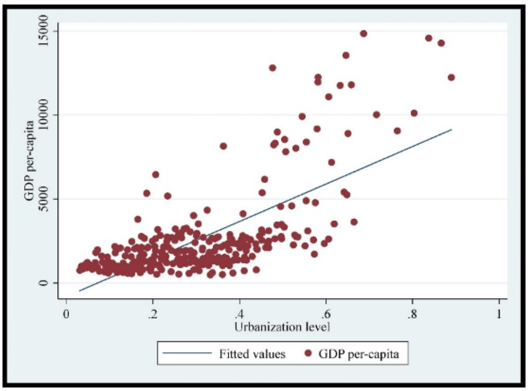


Figure 2:Scatterplot Relationship: GDP per-capita vs. Urbanisation Level

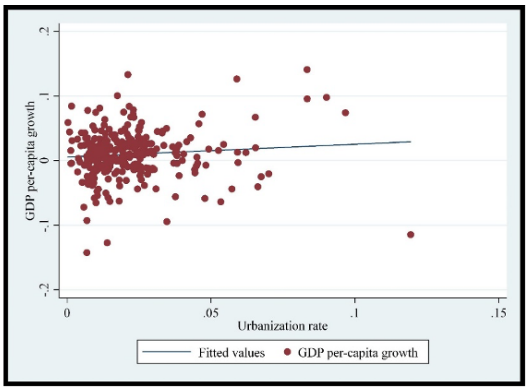


Figure 3: Scatterplot relationship: GDP per-capita growth vs. Urbanisation rate

Source: Based on study data.

Additionally, as depicted in Table 2, the correlations among the urbanisation variables and the variables representing the structure of the economy (sectoral shares and value-added growths) and rural urban-wage differentials are mainly as expected.

5.2 Econometric Results

The results for the SYS-GMM2 estimations of urbanisation as an engine of economic growth [Equation 3] and urbanisation as a product of economic growth [Equation 4] for urbanisation rates (levels) are presented in Tables 3 (4) and Tables 5 (6) respectively. All estimations are conducted at 95% confidence interval. The standard specifications and diagnostic tests are all in order. The AR (1) and AR (2) are not significant in all estimations. The latter implies that the lag terms of the respective dependent variables are exogenous and valid instruments. These confirm the appropriateness of the

Table 2: Correlation matrix for key variables of the study

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Urbanisation rate	1.000										
(2) Urbanisation level	-0.434***	1.000									
(3) GDP per-capita growth	0.090	-0.034	1.000								
(4) GDP per-capita	-0.158***	0.695***	0.005	1.000							
(5) Agriculture share	0.111*	-0.628***	-0.119**	-0.618***	1.000						
(6) Agriculture value-added growth	0.027	0.036	0.35***	-0.061	-0.001	1.000					
(7) Industry share	0.006	0.557***	0.048	0.552***	-0.730***	0.087	1.000				
(8) Industry value-added growth	0.179***	-0.111*	0.150***	-0.092	0.106*	0.011	-0.089	1.000			
(9) Services share	-0.137**	0.205***	0.041	0.168***	-0.485***	-0.064 -0.182***	-0.055	1.000			
(10) Services value-added growth	0.055	0.021	0.594***	0.019	-0.064 0.382***	0.058	0.110*	-0.013	1.000		
(11) Rural-Urban wage differentials	-0.124**	0.196***	0.002	-0.051	0.131**	0.012	-0.225***	-0.043	0.147***	0.018	1.000

Source: Author's estimation using study data

dynamic models used. The p-values for the J-statistics fall within the generally acceptable p-value range of 0.10-0.60, with 2 out of 4 falling within the "Goldilocks range" of 0.10-0.25 (Roodman, 2009a). The Sargan test is also not significant at 5% level in all estimations. The F-test statistic is significant at 1% level for all estimations. Overall, the results from these standard diagnostic tests confirm the validity of the structural specifications and moment conditions used in the SYS-GMM2 estimations.

Also, due to collinearity problems caused by the inclusion of the respective contemporaneous terms in Equations (3) and (4) , first lag elasticities rather than contemporaneous elasticities are estimated. Similarly, in estimating Equation (4) , Non-Agriculture share of GDP was used for Industry and Services shares of GDP; and Non-Agriculture value added growth for Industry and Services value-added growths.

5.3 Urbanisation as an engine of Economic growth

The results at growth rates and levels as depicted respectively in Tables 3 and 4 show that urbanisation has a positive effect on per-capita GDP in SSA. This is shown by the positive and significant coefficients of the urbanisation elasticities variables namely Lagged[ln(Urbanisation rate)] and Lagged[ln(Urbanisation level)] in both the short-run and long-run. These results which support the urbanisation-led growth viewpoint are in line with Rosenthal and Strange (2004) and converse to the findings of other studies (Brückner, 2012; Nathaniel & Bekun, 2021; Odugbesan & Rjoub, 2020). Also, the magnitude of the urbanisation elasticity at growth rates (levels) decreases (increases) from 0.2 (0.27) in the short-run to 0.1(0.92) in the long-run, suggesting diminishing (increasing) effect of urbanisation on per-capita GDP growth (level) over time.

Also at growth rates in Table 4, the Squared(Urbanisation rate) term is rightly negative and significant in both the short-run and long-run, and is in line with the findings of Nguyen and Nguyen (2018) and Liddle (2017). Additionally, the falling (absolute) magnitude of its coefficient from 6.64 to 4.16 augments the result of diminishing marginal growth effects of urban agglomeration over time.

The first set of control variables used are the agglomeration variables of Population density and Primacy. The latter (former) has a significantly negative (positive) effect on per-capita GDP at growth rates (levels) in both the short-run and the long-run. The latter result also support the findings of Henderson (2002) on the presence of urban agglomeration diseconomies in some primate cities in SSA, resulting from excessive urban concentration. However, the effects of such diseconomies diminish over time, evidenced by the falling magnitude of the ln(Primacy) coefficient from 0.02 in the short-run to 0.01 in the long-run.

For the second set of control variables, Trade share, is positive and significant at 1% level for

Table 3. Sys-GMM2 Estimation - Urbanisation Rate Vs. GDP per-capita Growth Rate: 1970-2019

Dependent Variable: ln(per-capita GDP growth)	SYS-GMM2 (Short-run)	SYS-GMM2 (Long-run)
Lagged [ln(per-capita GDP growth)]	-0.60	-0.37
	(0.25)**	(0.10)***
Lagged [ln(Urbanisation rate)]	0.02	0.01
	(0.01)**	(0.004)***
Squared (Urbanisation rate)	-6.64	-4.16
	(2.81)**	(1.51)***
ln(Initial per-capita GDP)	-0.03	-0.02
	(0.01)***	(0.004)***
ln(Trade share)	0.02	0.01
	(0.01)***	(0.004)***
ln(Investment share)	0.02	0.01
	(0.01)***	(0.004)***
ln(Tertiary education)	0.01	0.01
	(0.01)**	(0.002)***
ln(Government share)	-0.02	-0.01
	(0.01)***	(0.01)***
Lag3(Population growth)	0.09	
	(0.44)	
Lag3(Fertility)	0.01	
	-0.01	
Lag2(Life expectancy)	-0.0003	
	(0.001)	
Population density	0.0001	
	(0.0001)	
ln(Primacy)	-0.02	-0.01
	(0.01)**	(0.01)**
Constant	0.32	
	(0.10)***	
Countries	30	
No. of Instruments	28	
Time	7	
Observations	210	
F-test	3.76 (0.00)	
AR(1)	-0.23 (0.82)	
AR(2)	-1.44 (0.15)	
Sargan	19 (0.17)	
Hansen	18.96 (0.17)	

Notes: *, **, *** indicates significance levels 10%, 5%, 1% respectively. The standard errors (robust); p-values of F, AR (1), AR (2), Sargan and Hansen tests are in parentheses.

both the growth rates and levels regressions. This result which is in line with the findings of (Fay & Opal, 2000; Glaeser, 2013; Gollin et al., 2016; Jedwab, 2013) supports the openness hypothesis that globalization spurs economic growth in the Global South. Additionally, at both growth rates and levels, two variables that are fundamental to the empirics of the Solow growth model namely Investment share and Tertiary education are each positive and significant in both the short-run and the long-run. Government share has a negative and significant effect at both growth rates and levels. These results also support the findings of Brülhart and Sbergami (2009).

Table 4. Sys-GMM2 Estimation - Urbanisation Level Vs. GDP per-capita: 1970-2019

Dependent Variable: ln(per-capita GDP)	SYS-GMM2 (Short-run)	SYS-GMM2 (Long-run)
Lagged [ln(per-capita GDP)]	0.70	2.36
	(0.08)***	(0.88)***
Lagged [ln(Urbanisation level)]	0.27	0.92
	(0.13)**	(0.42)**
Lagged [ln(Trade share)]	0.31	1.03
	(0.12)***	(0.33)***
Investment share	2.32	7.77
	(0.77)***	(2.63)***
Lag3(Tertiary education)	2.96	-0.57
	(1.71)*	(0.27)**
Lagged [ln(Government share)]	-0.17	-0.57
	(0.07)**	(0.27)**
Lag3(Population growth)	-4.82	-16.16
	(2.58)*	(8.68)*
Lag3(Fertility)	0.13	0.43
	(0.06)**	(0.20)**
Lag3(Life expectancy)	0.006	
	(0.01)	
Population density	0.002	0.01
	(0.001)***	(0.002)***
Primacy	-0.24	
	(0.35)	
Time	-0.06	-0.19
	(0.02)**	(0.06)***
Constant	6.53	
	(2.63)**	
Countries	30	
No. of Instruments	28	
Time	7	
Observations	210	
F-test	72.36 (0.00)	
AR(1)	-1.99 (0.47)	
AR(2)	-1.44 (0.15)	
Sargan	28.58 (0.07)	
Hansen	24.17 (0.19)	

Notes: *, **, *** indicates significance levels 10%, 5%, 1% respectively. The standard errors (robust); p-values of F, AR (1), AR (2), Sargan and Hansen tests are in parentheses.

The third set of control variables features the demographic factors namely population growth, fertility and life expectancy. At levels regression in Table 3, population growth and fertility are significant with respectively negative and positive lag effects on per-capita GDP growth in both the short-run and the long-run.

5.4 Urbanisation as a product of Economic growth

The results from Tables 5 and 6 show that per-capita GDP growth has a positive effect on urbanisation in SSA at both growth rates and levels. This is indicated by the significance of the per-capita GDP elasticities variables namely Lagged[ln(per-capita GDP growth)] and Lagged[ln(per-capita GDP)] in both the short-run and long-run. Also, at growth rates in Table 4, the Squared(per-capita GDP growth) variable is significant at 1% level in both the short-run and the long-run. This reinforces the previous findings of a non-linear relationship between urbanisation and economic growth. Overall, these results which support the growth-led urbanisation viewpoint are also in line with the findings of Chen et al. (2017) and Odugbesan and Rjoub (2020).

The effects of economic structure variables on urbanisation are mixed. Agriculture valued added growth is negative (positive) and significant in both the short-run and the long-run at growth rates (levels). These conflicting results are both supported in the literature. For instance, the green revolution in East Asia during 1965-1990 raised agricultural productivity and released surplus rural labor to urban areas (Gollin et al., 2018). Conversely, Fay and Opal (2000) found that agriculture value-added growth slowed the global rate of urbanisation between 1970-1995.

Furthermore, non-agriculture value-added growth is not significant and may give credence to the findings of (Fay & Opal, 2000; Gollin et al., 2016; Jedwab et al., 2017) on urbanisation occurring without structural transformation in SSA. Also, in consonance with the findings of Fay and Opal (2000), both the magnitude and significance of the variable Rural-Urban wage differentials increase with time for both growth rates and levels regressions in Table 5 and 6 respectively, implying that rural-urban wage gap is an important urban pull factor in SSA. Likewise, at growth rates, higher education represented by Lag3[ln(Tertiary education)] is positive and significant throughout, a result in accordance with the general findings in the literature.

Additionally, this study specifically tests the findings of Fay and Opal (2000) that the speed of urbanisation in SSA was faster than expected prior to 1980 and slower than expected post 1980. This is done by including the Post1980 binary dummy as a separate regressor in the growth rate estimation. From Table 4, its coefficient is negative and significant throughout and the result confirm previous findings. According to Annez and Buckley (2009), colonial powers in most SSA countries prior to independence actively restricted rural to urban migration. However, post-independence in the 1960s and 1970s when such restrictions were no more, rapid rural to urban migrations occurred until after the early 1980s when it gradually eased.

5.5 Comparing Urbanisation and Economic growth effects

Table 7 presents the estimated elasticities for comparisons. At growth rates, the dominant causal direction is from economic growth to urbanisation. Particularly, a 1 percentage point increase in urbanisation rate induces 0.02(0.01) percentage points increase in GDP per-capita growth in the short-run (long-run). Conversely, a 1 percentage point increase in GDP per-capita growth induces 5.30(10.68) percentage points increase in urbanisation rate in the short-run (long-run).

However, at levels, the dominant causal direction is from urbanisation to economic growth. Precisely, a 1% increase in urbanisation level induces 0.27% (0.92%) increase in GDP per-capita in the short-run (long-run). Conversely, a 1% increase in GDP per-capita induces 0.03% (0.21%) increase in urbanisation level in the short-run (long-run).

Table 5. Sys-GMM2 Estimation - GDP per-capita growth rate Vs Urbanisation rate: 1970-2019

Dependent Variable: ln(Urbanisation rate)	SYS-GMM2 (Short-run)	SYS-GMM2 (Long-run)
Lagged [ln(Urbanisation rate)]	0.50	1.01
	(0.12)***	(0.48)**
Lagged [ln(per-capita GDP growth)]	5.30	10.68
	(2.33)**	(5.20)**
Squared (per-capita GDP growth)	37.17	74.88
	(11.41)***	(22.79)***
Initial Urbanisation level	-2.17	-4.38
	(0.70)***	(0.97)***
Lag1 (Agriculture value-added growth)	-4.81	-9.69
	(1.74)***	(3.25)***
Lag3 (Non-Agriculture value-added growth)	0.09	
	(0.30)	
Rural-Urban wage differentials	0.42	0.85
	(0.21)*	(0.39)**
Lag3 [ln(Tertiary education)]	0.17	0.35
	(0.06)***	(0.15)**
Post1980	-0.30	-0.60
	(0.11)**	(0.29)**
Lagged [ln(Population density)]	-0.0004	
	(0.001)	
Lag3 (Primacy)	-0.37	
	(0.24)	
Time	-0.07	-0.15
	(0.03)**	(0.05)***
Constant	4.60	
	(1.84)**	
Countries	30	
Time	7	
Observations	210	
No. of Instruments	29	
F-test	89.65 (0.00)	
AR(1)	-1.92 (0.06)	
AR(2)	-1.61 (0.11)	
Sargan	17.28 (0.50)	
Hansen	15.93 (0.59)	

Notes: *, **, *** indicates significance levels 10%, 5%, 1% respectively. The standard errors (robust); p-values of F, AR (1), AR (2), Sargan and Hansen tests are in parentheses.

Table 6. Sys-GMM2 Estimation - GDP per-capita Vs Urbanisation level: 1970-2019

Dependent Variable: ln(Urbanisation rate)	SYS-GMM2 (Short-run)	SYS-GMM2 (Long-run)
Lagged [ln(Urbanisation level)]	0.84	5.44
	(0.05)***	(1.86)***
Lagged [ln(per-capita GDP)]	0.03	0.21
	(0.01)**	(0.09)**
ln(Agriculture share)	-0.003	
	(0.02)	
Lag2[ln (Non-Agriculture share)]	0.11	0.72
	(0.06)*	(0.29)**
ln(Agriculture value-added growth)	0.43	2.76
	(0.21)**	(1.10)**
ln(Non-Agriculture value-added growth)	0.20	
	(0.15)	
Lagged (Rural-Urban wage differentials)	0.09	0.59
	(0.04)**	(0.21)***
Lag3 [ln(Tertiary education)]	0.00	
	(0.01)	
Population density	-0.0002	-0.001
	(0.0001)*	(0.001)***
Lag3[ln(Primacy)]	0.06	
	(0.06)	
Constant	-0.36	
	(0.15)**	
Countries	30	
Time	7	
Observations	210	
No. of Instruments	29	
F-test	1391.25 (0.00)	
AR(1)	1.29 (0.20)	
AR(2)	-1.15 (0.25)	
Sargan	17.7 (0.54)	
Hansen	20.15 (0.39)	

Notes: *, **, *** indicates significance levels 10%, 5%, 1% respectively. The standard errors (robust); p-values of F, AR (1), AR (2), Sargan and Hansen tests are in parentheses.

Additionally, the study employed the Dumitrescu and Hurlin (2012) procedure for Granger (1969) causality as an alternative method to investigate the causal nexus between urbanisation and economic growth. This is presented in Appendix A. The results obtained as indicated in Table A.2 confirm a bi-directional Granger causality running from urbanisation to economic growth and from economic growth to urbanisation.

6. Conclusion

The study examined the causal relationship between urbanisation and economic growth from the two dominant viewpoints in the literature namely urbanisation-led growth and growth-led urbanisation for a balanced panel of 30 countries in SSA with positive annual urbanisation rates between 1970-2019. The SYS-GMM2 and the Dumitrescu and Hurlin (2012) procedure for Granger (1969) causality

Table 7. Elasticities comparisons - Urbanisation vs. Economic growth: 1970-2019

	Growth rates of Urbanisation and GDP per-capita			Levels of Urbanisation and GDP per-capita		
Estimated equations	3	4		3	4	
Table Number	Table 3	Table 4		Table 4	Table 6	
Dependent variable	ln(GDP growth rate)	ln(Urbanisation rate)	***Dominant causality***	ln(GDP per capita)	ln(Urbanisation level)	***Dominant causality***
Main explanatory variable	Lagged [ln(Urbanisation rate)]	Lagged Lagged[ln(GDP growth rate)]		Lagged [ln(Urbanisation level]	Lagged [ln(per-capita GDP]	
Short-run elasticity	0.02 (0.01)**	5.30 (2.33)**	***Economic growth***	0.27 (0.13)**	0.03 (0.01)**	***Urbanisation***
Long-run elasticity	0.01 (0.004)***	10.68 (5.20)**	***Economic growth***	0.92 (0.42)**	0.21 (0.09)**	***Urbanisation***

Notes: *, **, *** indicates significance levels 10%, 5%, 1% respectively. The standard errors (robust); p-values of F, AR (1), AR (2), Sargan and Hansen tests are in parentheses.

test were employed. The results obtained show positive bi-directional causality, and non-linear relationship between urbanisation and economic growth in SSA. These findings are at variance with the popular literature that largely describes the urbanisation process in SSA as economically dysfunctional. It also builds upon the prior findings of Obeng-Odoom (2010, 2012), Njoh (2003), the 'Africa on the rise' discourse and other studies on urban governance in SSA that have challenged the orthodox view.

The policy implications of this study are several. One, urbanisation in SSA must be fully embraced and effectively managed at both national and sub-regional levels. Two, to fully embrace urbanisation, policy makers must be informed about the economic, social and political transformation potential of the urbanisation process towards achieving sustainable economic growth and development. Three, the full social, political and economic benefits of urbanisation cannot be reaped automatically without substantial investment in urban planning, public infrastructure and services provisions in cities across SSA, more especially, in the new and emerging habitats. Four, cross-country policy coordination is required for the successful management of the urbanisation process and its ramifications. This calls for sub-regional and cross-border investment in major infrastructures including roads, railways, telecommunications networks, ports and harbors. Five, successful urbanisation in SSA also requires legal provision and enforcement of private property rights over land and structures that make up the urban built environment.

A clear limitation of this study is its limited scope. First, the effect of other agglomeration variables such as urban concentration and how the nature/type of the urban agglomeration affects economic growth was not addressed. Second, political factors, tax incentives, public policies and others that are crucial for urbanisation and economic development were not considered. These areas present avenues for future research.

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Conflicts of interest
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A.1. A Granger causality test in heterogeneous panel data

The basic definition of Granger causality is that the cause precedes the effect and the causal series contain information concerning the effect that is not contained in any other series according to the conditional distributions (Granger, 2003). For example, if the past values of the series x_t are important predictors of the current value of the series y_t even when the past values of y_t are considered, then x_t is said to be causing y_t (Granger, 1969). The Granger (1969) model for analyzing the causal relationship between x_t and y_t is given as:

$$y_t = \pi + \sum_{k=1}^{K} \theta_k y_{t-k} + \sum_{k=1}^{K} \lambda_k x_{t-k} + e_t \text{ with } t = 1, \ldots, T$$

where x_t and y_t are two stationary variables; π, θ and λ are parameters; K is the optimal lag order; and e_t the error term. From Equation (A.1), causality can be investigated using an F-test under the null hypothesis: $H_0 : \lambda_1 = \cdots = \lambda_K = 0$. If H_0 is rejected, it means that x Granger causes y. Also, x and y can be interchanged in Equation (A.1) to test for causality running from y to x (Lopez & Weber, 2017).

Dumitrescu and Hurlin (2012) developed a methodology that extends the Granger (1969) causality test to heterogeneous panel data. The model for the Dumitrescu & Hurlin (DH) test is given as:

$$y_{it} = \pi_i + \sum_{k=1}^{K} \theta_{ik} y_{i,t-k} + \sum_{k=1}^{K} \lambda_{ik} x_{i,t-k} + e_{it} \text{ with } t = 1, \ldots, T$$

where x_{it} and y_{it} are two stationary variables for cross-section i in period t. The parameters π, θ and λ are time invariant but differ among cross-section units. Also, the lag order K is identical for all cross-section units.

From Equation (A.2), the DH test for causality running from x_{it} to y_{it}, follows Granger (1969) and tests for the significance of the effects of past values of x_{it} on the current value of y_{it}. The DH test procedure assumes the absence of causation relationships for the cross-section units of the panel under the null hypothesis of Homogeneous Non-Causality (HNC) defined as: $H_0 : \lambda_{i1} = \cdots = \lambda_{iK} = 0$ for all $i = 1, \ldots, N$; against the alternative hypothesis of causation relationship from x_{it} to y_{it} for only a subgroup of the individual cross-sections under the Heterogeneous Non-Causality (HENC) defined as:

$$\begin{array}{ll} H_1 : \lambda_{i1} = \cdots = \lambda_{iK} = 0 & \text{for all } i = 1, \ldots, N_1; \\ \lambda_{i1} \neq 0, \text{ or } \ldots \text{ or } \lambda_{iK} \neq 0 & \text{for all } i = N_1 + 1, \ldots, N; \end{array}$$

where $N_1 < N$. If $N_1 = N$, there is no causality for any of the individual cross-sections in the panel and as such H_1 reduces to H_0. If $N_1 = 0$, it implies causality for all the cross-sections in the panel. Also, rejecting the null hypothesis of HNC does not rule out non-causality for some crosssections. Furthermore, as compared to the traditional Granger causality tests, Monte-Carlo studies by Dumitrescu and Hurlin (2012) show that the DH test gives more reliable and robust results, more so, in finite samples.

The two requirements for the DH test is a balanced panel and stationarity of all variables (Lopez & Weber, 2017). The Im-Pesaran-Shin (IPS) unit-root test as outlined in Im et al. (2003) is employed to test for stationarity. [5] The IPS test results in Table A.1 show the Z-bar tilde statistic is significant at 1% level for Urbanisation rate and GDP per-capita growth. The H_0 that all panels contain unit roots is rejected in favor of H_1 that the variables are stationary at levels, and thus integrated of order 0 , i.e. I (0).

5. All estimations in this section employs annual data to obtain a larger number of bootstrap replications.

Table A.1: Im-Pesaran-Shin unit-root test for heterogeneous panel: 1970-2019

Variable	Z-bar tilde statistic	Prob.
Urbanisation rate	-3.579 * * *	0.000
GDP per-capita growth	-23.937 * * *	0.000
Number of Panels	30	30
Number of Periods	57	57
H0: All panels contain unit roots		
H1: Some panels are stationary		

Note: * * * indicates rejection of the null hypothesis at significant level of 1 % .

A third critical empirical issue in heterogeneous panel data is the existence of cross-sectional dependence. The inclusion of the demean option in the IPS test mitigates the impact of cross-sectional dependence (Im et al., 2003). For the DH test, Dumitrescu and Hurlin (2012) proposed a blocked bootstrap procedure to calculate bootstrapped critical values for the Z-bar tilde statistic. A fourth empirical issue concerns the specification of the optimal lag structure K. Lopez and Weber (2017) propose the use of an information criterion to select the optimal lags for the DH test. The results for the DH test following the estimation procedure of Lopez and Weber (2017) is presented in Table A.2.

Table A.2: Dumitrescu-Hurlin Granger causality tests for heterogeneous panel: 1970-2019

Null Hypothesis:	Z-bar tilde statistic	Prob.	Bootstrap replications	Optimal lag length (K)
Urbanisation rate does not homogenously cause GDP per-capita growth	1.917**	0.042	500	17
GDP per-capita growth does not homogenously cause Urbanisation rate	4.159***	0.006	500	17

Notes: ***, ** indicate rejection of the null hypothesis at significant levels of 1%, 5% respectively.
The optimal lag length is selected based on Akaike Information Criterion.

From the Table, the optimal lag length selected in each case was 17. Also, the number of bootstrap replications used for each estimation was 500. The results show a feedback causality whereby Urbanisation rate Granger causes per-capita GDP growth and conversely per-capita GDP growth Granger causes Urbanisation rate. This result is in line with Nguyen and Nguyen (2018) and Wang et al. (2018) and converse with Bloom et al. (2008). These findings also confirm the SYS-GMM2 results of a bi-directional causal relationship between urbanisation and economic growth in SSA.