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THE MEDIATION EFFECT OF INFORMAL SECTOR GROWTH ON THE RELATIONSHIP BETWEEN POVERTY AND INEQUALITY IN SUB-SAHARAN AFRICA COUNTRIES

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Abstract

The purpose of this research was to examine the mediating effect of informal sector growth on the inequality-poverty nexus. The focus was on 35 countries in sub-Saharan Africa (SSA) for the period 1990 to 2018 and the empirical evidence is based on two steps system Generalized Methods of Moments (SGMM) estimate. Poverty gap, consumption gini coefficient, and multiple indicators multiple causes' model-based (MIMIC) estimates of informal output (% of official GDP) were used to captured poverty, inequality, and informal sector output respectively. Our findings revealed that although a growing informal sector increases inequality and poverty, this same poverty falls as a result of the interaction between informal sector output and inequality. The implication is that a growing informal sector can help mediate the effect of inequality on poverty through its confounding effect on inequality. A main policy recommendation is that SSA policy maker should encourage formal activity that can help provide better job opportunity since informal sector growth increases both inequality and poverty in the society and only help in poverty reduction through it mediating effect

KEY WORDS: informality, poverty, inequality, SGMM, Sub-Sahara Africa

1- Introduction

There have been growing interests on informal economy and its resulting effect on inequality and poverty dynamics (Sharma and Adhikari, 2020). It is generally accepted that economic growth increases income which in turn reduces poverty (Bergstrom, 2020; Cerra *et al.*, 2021) but its impact on inequality and poverty is confusing and depends on the underlying sources of growth (Cerra *et al.*, 2021).

Nonetheless, the contribution of the informal sector as provided by empirical evidence tends to question the theoretical model of Harris *et al.* (1970). The later highlighted that the informal sector is fundamentally a stagnant and unproductive sector which acts as a 'refuge' for the urban jobless and a welcome centre for newly unemployed people from rural areas in quest for better livelihood opportunities. In this case, the progress of the informal sector is viewed as the outcome of underdevelopment and anticipated to vanish once the economy experienced sustainable levels of economic growth (Medina *et al.*, 2019).

Conflicting to the above widely held view, further evidence shows that the informal economy is progressively increasing recently regardless of high levels of growth (Esaku, 2021; Medina *et al.*, 2019). As a result, the empirical literature continues to view the informal sector as a dynamic and efficient sector which contributes meaningfully to the production and distribution of goods and services (Esaku, 2021b, Adhikari 2020). Thus this sector offers opportunities for income generation which profits the most vulnerable members of the society.

Over the past decades, poverty and inequality continue to be crucial subjects of debate in the research and policy arena especially in developing countries and Sub-Saharan Africa (SSA) Africa in particular as both issues undermine the region's harmony and stability (Igbinedion and Abusomwan, 2014). The slowdown in the rate of global poverty reduction even before the COVID-19 pandemic can be attributed to sub-Saharan Africa's close-to-stagnation rates (Ines *et al.*, 2022). Notably, in sub-Saharan Africa the rate of poverty reduction is slower than the population growth rate (Beegle and Christiaensen 2019). Consequently, the absolute number of persons living in poverty has actually increased since the 1990s in SSA and global poverty is becoming progressively an 'African' phenomenon. While the bulk of persons living below the poverty line were concentrated in the East Asia and the Pacific (EAP) region in the 1990s, the clear majority of extremely poor persons now live and die in SSA (Ines *et al.*, 2022).

On the other hand, inequality remains comparatively high and persistent in Africa (Gimba *et al.*, (2021) and high inequality is evident via the lack of economic prospects which has prevented individuals from exploiting their potential and the danger credited by rising inequality can be understood via numerous civil unrest and armed wars in SSA. The United Nations Development Programme (UNDP) also affirms in 2017 that 10 out of the 19 most unequal nations globally are found in SSA (Kunawotor *et al.*; 2020). It is highly acknowledged in recent time that 66.79% of SSA population are suffering with high inequality and 24.11% are experiencing a very high inequality (Gimba *et al.*, 2021) and as such there have been no major change in SSA's aggregate gini since 1990 (Ines *et al.*, 2022). It is well established that poverty reduction is enhanced by rapid growth but the extent of poverty reduction depends on the initial level of inequality (Atangana, 2022). Accordingly, inequality and growth are important factors to be considered in formulating strategies and policies to achieve sustainable poverty reduction towards the attainment of Sustainable Development Goals (SDGs) of the post-2015. It is with this scenario that the paper focuses on how informal sector growth could influence the poverty-inequality nexus in Sub-Saharan African Countries. Thus, with this objective of the study, the growth of the informal sector has been shown as a confounding variable that mitigates the effect of inequality on poverty reduction. In the rest of the paper, we highlight the extant literature in section two, methodology in section three and outcome of the research in section four.

2-Theoretical and empirical Underpinnings

A number of studies have tried to quantify the effects of informality on poverty and inequality (Canelas, 2018; Delbiso *et al.*; 2018; Nuhu and Abdullahi, 2018, Elgin *et al.*; 2021, Elgin and Elveren 2019). The literature has identified both theoretical and empirical channels through which output growth can influence inequality and poverty. This could be observed from an understanding of the dualistic labour market theory.

The poverty and inequality surplus labour theory suggested by Sir William Arthur Lewis in 1954 provides famous clarification for the links between growth, poverty and inequality. The essential hypothesis of Lewis' Model is the existence of a large surplus of labour in the traditional informal sector of the economy which can be transferred to the modern sector without upsetting the amount of output in the traditional sector. According to William Lewis, there are too numerous workers relative to other factors of production so that reallocation of the surplus labour does not affect the level of output. The theory assumes a situation in which the marginal product of labour in the traditional sector is zero or close to zero. Fei-Ranis (1964) extension of the Lewis model explained that the tendency toward increasing inequality and poverty following a low marginal productivity of excess labour in the traditional or informal sector is reversed when all the surplus labour is absorbed into modern sector occupation (Gallo, 2002).

This school of thought was popularized by the International Labour Organization in the 1970s, and contributes to the notion that the informal sector is comprised of marginal activities which is distinct from and not related to the formal sector that provide income for the poor and a safety net in period of crisis. Accordingly, "the persistence of the informal economy activities is due largely to the fact that not sufficient modern job opportunities have been created to absorb surplus labour due to a slow rate of economic growth and or a faster rate of population growth (Nuhu and Abdullahi, 2018). The theory seems to provide a mechanism by which underdeveloped economies transform their domestic economic structures from a heavy emphasis on traditional subsistence agriculture to a more modern, more urbanized, and more industrially diverse manufacturing and service economy. Thus, since the informal sector has the capacity to absorb the poor population of any society, and subsequently creates a situation of equality via a rise in the wages of the traditional sector, an investigation of the effect of informal sector growth on poverty and inequality relationship is important for policy purpose.

Early empirical studies rely on survey (primary) data to estimate the effect of informal sector growth on poverty. Canelas established that poor household heads are more likely to work informally, and household heads having informal employment as wage or salaried employees are more likely to be poor. On the other hand, the work of Nuhu and Abdullahi revealed that informal economy helps significantly in poverty reduction through employment generation and improved earnings of the operators. The outcome of Delbiso *et al.* (2018) was in line with the finding of Nuhu and Abdullahi (2018).

Empirical literature has revealed inconclusive proof on the relationship between income inequality and the informal sector due to measurement issues for both inequality and informality, and the nonlinear relationship between the variables. Elgin *et al.* (2021) use two novel datasets of the size of the informal economy and income inequality with the

help of system GMM estimation technique to examine the effect of informality on income and wage inequality covering 86 countries from 1960–2016, the study revealed that informality is positively associated with income inequality.

Although Elgin and Elveren (2019) demonstrated that the relationship between informal sector and inequality is more likely to be negative in developed nations and positive in developing countries and Gutiérrez-Romero (2007) found that there is a positive correlation between informal sector size and inequality for developed nations and a negative correlation for developing nations.

Ghecham (2017) used a cross-sectional data to explore the impact that informal sector has on income disparity across different income groups by employing multiple indicators multiple causes (MIMIC) method in which the informal sector was represented as a latent variable using structural equation model (SEM) and with the help of income shares of decile groups of population the results produced a dual role of informal sector in the country. On one hand, informal economy could decrease the gap between income earners at the bottom level of income groups. On the other hand, the size of informal economy could aggravate the gap between top incomes.

Despite the increased research on the effects of informality on poverty and inequality coupled with conflicting conclusions, there is need for further research to look at the role of the growth of informal sector on poverty-inequality nexus since it has been proven that informal economy could decrease the gap between income earners at the bottom level of income groups. The question in mind is does this actually help in poverty reduction? We contribute to the literature by dwelling on the mediating role that informal sector growth can play on the effect of inequality on poverty in SSA countries.

3- Methodology

3.1 Data

The study is based on a panel of 35 countries from Sub-Saharan Africa from the period of 1990 to 2018. A dynamic panel data model estimated using the Generalized Methods of Moments (GMM) was adopted for the analysis.

3.2. Model specification

(Theil, 1971 and Besley, 1988) have used the two (2SLS) or three stages least square (3SLS) estimators for the growth-poverty model. Although these can be more efficient comparative to the pooled ordinary least square, their application to the growth-poverty model will yield less efficient estimates than the generalised method of moment (GMM) particularly when the time period of the data is more than three ($T > 3$). This is because at higher time periods more instruments become available for the differentiated model. Ravallion (2001) suggested instrumenting the mean income with its first lag to control for endogeneity issues. These reasons will compel us to use the two steps system Generalized Methods of Moments (SGMM). In this study, we first of all examined the direct effect of informal sector growth on inequality and the growth of the informal sector is furthered used as a confounding variable influencing the poverty and inequality relationship based on a modified model of Sunge *et al.* (2021) which includes a two-way interaction between informal sector growth and inequality as presented in the equation below:

$$GINI_{it} = \alpha_0 + \lambda_1 GINI_{it-1} + \lambda_2 INF_{it} + \lambda_3 UEMP_{it} + \lambda_4 TO_{it} + \lambda_5 \ln GOVC_{it} + \lambda_6 \ln GDFCF_{it} + \lambda_7 \ln GDPPC_{it} + v_i + \varepsilon_{it} \quad (1)$$

$$POV_{it} = \alpha_0 + \lambda_1 POV_{it-1} + \lambda_2 INF_{it} + \lambda_3 GINI_{it} + \lambda_4 \ln POP_{it} + \lambda_5 \ln GOVC_{it} + \lambda_6 (INF * GINI)_{it} + \lambda_7 \ln GDPPC_{it} + v_i + \varepsilon_{it} \quad (2)$$

Where: POV_{it-1} = lag of poverty head count or poverty gap, POV_{it} = poverty rate of country i at time t , INF_{it} = informal sector output of country i at time t , $GINI_{it}$ = gini coefficient of country i at time t , $UEMP_{it}$ = Total unemployment rate of country i at time t , TO_{it} = trade openness of country i at time t , POP_{it} = population of country i at time t , $GOVC_{it}$ = government consumption expenditure of country i at time t , $GDFCF_{it}$ = gross domestic fixed capital formation proxy to investment of country i at time t , $(INF * GINI)_{it}$ is the mediating variable (informal sector growth and inequality), $GDPPC_{it}$ = gross domestic product per capita of country i at time t , v_i = country specific effect and ε_{it} = error term.

We transform equation 1 and 2 into a dynamic form and estimate it using the two steps system Generalized Methods of Moments (GMM). Our choice of dynamic system GMM is inspired by four main reasons which are in agreement with contemporary GMM-centric literature (Kunawotor *et al.*, 2020; Ogbeide and Adeboje, 2020). The first condition is that the cross-sectional units (N) must be higher than the time period (T). In this case, the number of countries is 35 while the time period is 29 years (1990-2018). Accordingly, the GMM model is appropriate for $N > T$ and N (i.e. 35) should be substantially higher than T (i.e. 29). However, it is also important to note that the minimum T for a GMM is five (i.e. T must be ≥ 5). With a $T=29$, four year data averages can produce 7 data points so that $T=7$. Addressing the concern here could be to work with data averages in terms of overlapping intervals with the 7th year having 5 years and this fulfils the first condition and so prevents instrument proliferation. The second condition is that the data set must be panel in nature and the empirical technique accounts for cross-country differences in the estimation process. Third, endogeneity worries are addressed in two ways: system GMM controls for unobserved heterogeneity by accounting for time-invariant omitted variables. Similarly, system GMM produces internal instruments that account for simultaneity bias or reverse causality. Poverty is known to be persistent and depends on its lags (Atangana, 2022) thus for this reason, the first period lag of the Poverty head count is used as an explanatory variable. Lastly, Generalized Methods of Moments (GMM) is chosen as an approximation strategy because there are common difficulties in finding external instruments.

Nevertheless, the major shortcoming of this method is the employment of data-means such that estimated coefficients are interpreted as short-run effects and not long-run effects (Asongu and Odhiambo, 2019). Therefore, based on the above empirical underpinning, the effect of informal sector growth on inequality and the role of the growth of informal sector on the link between poverty and inequality is investigated in the short-run and the four equations below in levels and first difference give the recap of the approximation process.

$$GINI_{it} = \alpha_0 + \alpha_1 GINI_{it-1} + \alpha_2 INF_{it} + \alpha_3 UEMP_{it} + \alpha_4 TO_{it} + \alpha_5 \ln GOVC_{it} + \alpha_6 \ln GDFCF_{it} + \alpha_7 \ln GDPPC_{it} + \square_i + \theta_t + e_{it} \quad (3)$$

$$GINI_{it} - GINI_{it-1} = \alpha_1(GINI_{it-1} - GINI_{it-2}) + \alpha_2(INF_{it} - INF_{it-1}) + \alpha_3(UEMP_{it} - UEMP_{it-1}) + \alpha_4(TO_{it} - TO_{it-1}) + \alpha_5(\ln GOVC_{it} - \ln GOVC_{it-1}) + \alpha_6 \ln(GDFCF_{it} - GDFCF_{it-1}) + \alpha_7(\ln GDP_{it} - \ln GDP_{it-1}) + (\theta_t - \theta_{t-1}) + (e_{it} - e_{it-1}) \quad (4)$$

$$POV_{it} = \alpha_0 + \alpha_1 POV_{it-1} + \alpha_2 INF_{it} + \alpha_3 GINI_{it} + \alpha_4 (INF * GINI)_{it} + \alpha_5 \ln POP_{it} + \alpha_6 \ln GOVC_{it} + \alpha_7 \ln GDP_{it} + \square_i + \theta_t + e_{it} \quad (5)$$

$$POV_{it} - POV_{it-1} = \alpha_1(POV_{it-1} - POV_{it-2}) + \alpha_2(INF_{it} - INF_{it-1}) + \alpha_3(GINI_{it} - GINI_{it-1}) + \alpha_4 \{(INF * GINI)_{it} - (INF * GINI)_{it-1}\} + \alpha_5(\ln POP_{it} - \ln POP_{it-1}) + \alpha_6(\ln GOVC_{it} - \ln GOVC_{it-1}) + \alpha_7(\ln GDP_{it} - \ln GDP_{it-1}) + (\theta_t - \theta_{t-1}) + (e_{it} - e_{it-1}) \quad (6)$$

Where t denotes the period, i stands for a country, \square_i is a country-specific effect; θ_t is a time-specific constant and e_{it} an error term. The rest of the variables remain the same as defined earlier. The estimation process consists of jointly estimating the equations in levels with those in first difference which help in exploiting all the orthogonal conditions between error term and the lagged endogenous vectors. In specifying the equations, a two-step procedure is preferred to one-step since it controls for heteroscedasticity.

3.3 Variables and data sources

Data used in this study was obtained from three recognized secondary sources. Consumption Gini Coefficient and poverty head count data were extracted from Global Consumption and Income Project (GCIP) database, informal sector output data came from Informal world development indicator (IWDI). The World Development Indicators database provided data for the remaining variables. Table A1 in the appendix describes the variables, their units of measurement and the source (s) from which the data was obtained.

We used multiple causes (MIMIC) method because it is an interesting measurement procedure of informal sector. This procedure makes use not only of one indicator but multiple observable indicators in order to measure unobservable concept which is informal sector. This approach is quite useful for the purpose of our paper. MIMIC approach allows the use of multiple observable indicators that manifest simultaneously and correlate strongly in explaining informal sector concept.

3.4 Identification and exclusion restriction

Agreeing with associated current GMM-centric literature for a strong specification, the narrative on the identification strategy and the equivalent exclusion restrictions is necessary (Asongu *et al.*, 2020; Kunawotor *et al.*, 2020; Ogbeide and Adeboje, 2020, Gimba *et al.*, 2021). Borrowing from the GMM centric literature, years are acknowledged to represent the strictly exogenous vectors while the predetermined vectors are considered to be elements in the conditioning information set and the independent variables of interest. Literature supports the approach of exclusion restrictions because it has been disputed that it is questionable for years to be endogenous after the first difference (Asongu *et al.*, 2020).

The robustness of Generalized Methods of Moments (GMM) is demonstrated in two tests. The Hansen test for over identifying restrictions tests for the validity of the moment conditions. Moreover, the test of the null hypothesis of second-order serial correlation is

executed by the Arellano–Bond test for autocorrelation (AR (2). The latter is corrected by including additional lag of the dependent variable to the estimation equation, which is the common way in the time series literature to account for the serial correlation. Here, we introduced up to the fourth lag of the dependent variable, to account for more persistence in the poverty variable which may be causing the serial correlation issue. It is sensible to note that in contemporary instrumental variable (IV) methodology, the validity of the identification strategy is evaluated with a rejection of the Sargan/Hansen over identifying restrictions test. Therefore, the null hypothesis of the equivalent test should not be rejected in order for the instruments to be valid (Kunawotor *et al.*, 2020). Nevertheless, with a system GMM strategy using forward orthogonal disparities, the Difference in Hansen Test (DHT) is employed to examine the validity of exclusion restrictions and related identification strategy. Consequently, when the null hypothesis of the DHT is not rejected, it implies that the instruments are valid due to the fact that they explain the outcome variable entirely via the exogenous components of the predetermined indicators.

4- Empirical results

Table 4.1 below shows the descriptive statistics of poverty and inequality data with the determining factors for the SSA countries. The overall sample of this study is 1015 constituting 35 cross section units (countries) over the 29 years period (1990–2018). The average income inequality for the region stood at 0.45 (45%). Poverty increases at an average of 74.2% for poverty head count and in the case of poverty gap; the mean poverty rate in this region is 20.4%. The informal output grew at an average of 40.71527% (40.72%). The mean unemployment rate remained at 7.58% which is the same with the finding of Gimba *et al.*, (2021). Total trade openness had a mean value of 63.78%. The average total population of SSA stood at 19 million people. The average government consumption expenditure was 3,560 million constant US dollars. Average investment in SSA stood at 4,420 million constant US dollars and gross domestic product per capita in SSA economy grew at an average of 1590.429. It can be observed that there are more variations across than within Sub-Saharan African countries signifying a heterogeneous pattern in the data which points to individual country patterns.

Table 4.1: Summary statistics and sampled countries

Variable		Mean	Std.Dev	Min	Max	Observations
Informal sector output	Overall	40.71527	7.689262	21.3	64.09999	N = 1015
	Between		7.541809	22.54828	57.83793	n = 35
	within		1.953584	32.28079	50.42216	T = 29
Consumption gini index	Overall	.4454399	.0816252	.2962399	.8751824	N = 1015
	Between		.0713733	.3469972	.6421581	n = 35
	within		.0413425	.2514096	.6784642	T = 29
Poverty head count	Overall	74.17233	21.83776	2.498014	100	N = 1015
	Between		20.552	12.61572	96.51259	n = 35
	within		8.134276	28.04714	101.4297	T = 29
Poverty gap	Overall	20.4331	15.69922	-.66	103.825	N = 1015
	Between		12.1545	.1	58.5	n = 35
	within		10.13968	-24.8919	72.81586	T = 29
Unemployment rate	Overall	7.577382	7.760677	.256	37.94	N = 1015
	Between		7.717352	.8437241	31.26028	n = 35
	within		1.521569	-.8698939	14.25711	T = 29
Trade openness	Overall	63.77587	35.30491	3.749496	231.7896	N = 1015
	Between		32.34093	12.25591	177.9066	n = 35
	within		15.14539	-5.098009	140.0837	T = 29
Total population	Overall	19,000,000	27,600,000	411,598	196,000,000	N = 1015
	Between		27,000,000	606,631	139,000,000	n = 35
	within		7,322,393	-24,900,000	75,700,000	T = 29
Government consumption expenditure	Overall	3,560,000,000	9,160,000,000	-707,000,000	67,600,000,000	N = 1015
	Between		8,630,000,000	76,600,000	49,900,000,000	n = 35
	within		3,370,000,000	-10,800,000,000	27,500,000,000	T = 29
Gross domestic fixed capital formation	Overall	4420,000,000	14,900,000,000	-91,500,000,000	73,100,000,000	N = 1015
	Between		12,800,000,000	-24,700,000,000	58,800,000,000	n = 35
	within		7,940,000,000	-62,300,000,000	6,300,000,000	T = 29
Gross domestic product per capita	Overall	1590.429	1897.307	204.0242	10335.85	N = 1015
	Between		1865.103	329.453	7799.111	n = 35
	within		466.0698	-1217.542	5399.915	T = 29

Sampled Countries (35)

“Angola, Benin, Botswana, Burundi, Cameroon, Central African Republic, Chad, Comoros, Congo Democratic Republic, Congo Republic, Côte d’Ivoire, Djibouti, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, and Togo’

Table 4.2 below reports the pairwise correlation matrix of the variables used in the regression. The correlations between informal output and consumption gini (-0.2338) and between the informal output and poverty head count (0.4676) as well as poverty gap (0.2701) are sufficiently low. All other correlations values are below 0.8 signifying the absence of multicollinearity among the explanatory variables in our equation.

Table 4.2: Pairwise correlation matrix

	pov1	pov21	infmimic1	cgini1	tol	uempl	lpop	lrgdppc	lgdfcf	lgovco	inter_~m
pov1	1.0000										
pov21	0.6449	1.0000									
infmimic1	0.4676	0.2701	1.0000								
cgini1	-0.1441	0.0121	-0.2338	1.0000							
tol	-0.3271	-0.2173	-0.2248	0.2533	1.0000						
uempl	-0.4189	-0.2446	-0.3417	0.5795	0.5900	1.0000					
lpop	0.3837	0.1692	0.2773	-0.2574	-0.3832	-0.3542	1.0000				
lrgdppc	-0.7719	-0.6185	-0.2494	0.3459	0.4159	0.6019	-0.2473	1.0000			
lgdfcf	-0.1496	-0.2085	0.0031	0.0554	0.1154	0.1202	0.1227	0.3158	1.0000		
lgovco	-0.1971	-0.2503	-0.0737	0.0593	0.0088	0.1742	0.6755	0.4396	0.2562	1.0000	
inter_term	0.3524	0.3433	0.5957	0.5162	-0.0657	0.0496	-0.0893	-0.0575	-0.0268	-0.2191	1.0000

pov1=poverty head count, pov21= poverty gap, infmimic1= informal sector output, cgini1= consumption gini index, uempl= unemployment rate, tol= trade openness, lpop=log of total population, lgovco=log of government consumption expenditure, lgdfcf=log of gross domestic fixed capital formation, lgdppc=log of gross domestic product per capita, inter_term= mediation variable.

The regression estimates are presented in Table 4.3, 4.4 and 4.5. Table 4.3 focuses on the direct effect of informal sector growth on inequality. Table 4.4 and 4.5 shows the mediating effect of informal sector growth on poverty through inequality. In table 4.4, we used poverty head count as the independent variables and in table 4.5 poverty gap is used. We interpreted only the result in table 4.5 because Poverty gap data look at the mean shortfall in income or consumption from the poverty line \$2.15 a day counting the non-poor as having zero shortfall and it is expressed as a percentage of the poverty line. This measure reflects the depth of poverty as well as its incidence.

Table 4.3: Direct Effect of Informal Sector Growth on Inequality

VARIABLES	Gini index	Gini index	Gini index
Lag of gini index	0.804***	0.805***	0.799***
	(0.0242)	(0.0244)	(0.0244)
lag2		-6.54e-05	0.000167
		(0.000116)	(0.000269)
lag3			-0.000173
			(0.000183)
Informal sector output	0.000754***	0.000823***	0.000757**
	(0.000261)	(0.000298)	(0.000312)
Unemployment rate	0.00116***	0.00115***	0.00119***
	(0.000196)	(0.000202)	(0.000213)
Log of gross domestic product per capita	0.00220	0.000885	0.00208
	(0.00241)	(0.00314)	(0.00352)
Trade openness	-5.01e-05	-4.40e-05	-4.67e-05
	(4.16e-05)	(4.43e-05)	(4.46e-05)
Log of gross domestic fixed capital formation	0.000435***	0.000448***	0.000490***
	(8.07e-05)	(8.74e-05)	(9.23e-05)
Log of government consumption expenditure	0.000768	0.000816	0.000816
	(0.00136)	(0.00140)	(0.00131)
yr1	0.00279	0.00283	0.00197
	(0.00185)	(0.00186)	(0.00189)
yr2	0.00267	0.00347	0.00365
	(0.00183)	(0.00219)	(0.00220)
yr3	0.00190	0.00262	0.00251
	(0.00212)	(0.00237)	(0.00244)
yr4	-0.000340	0.000256	2.24e-05
	(0.00145)	(0.00168)	(0.00167)
yr5	0.00212***	0.00206***	0.00232***
	(0.000600)	(0.000634)	(0.000743)
yr6	-0.000619	-0.000589	-0.000621
	(0.000572)	(0.000575)	(0.000594)
Constant	0.00854	0.0175	0.00949
	(0.0357)	(0.0396)	(0.0438)
Time effects	Yes	Yes	Yes
F-stat	417655.74	461093.54	212822.45
Prob > F	0.000	0.000	0.000
AR(1):(Pr > z)	0.249	0.250	0.249
AR(2):(Pr > z)	0.450	0.448	0.450
Sargan OIR Prob > chi2	0.764	0.706	0.658
Hansen OIR Prob > chi	0.548	0.503	0.371
DHT for instruments (a) Instruments in levels			
H excluding group	0.610	0.509	0.392
Dif(null, H = exogenous (b) IV (years, eq(diff))	0.439	0.448	0.361

H excluding group	0.558	0.483	0.385
Dif(null, H = exogenous)	0.425	0.452	0.363
Instruments	33	33	33
Countries	35	35	35
Observations	965	1964	963

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

***, **, *: significance levels at 1%, 5% and 10% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments Subsets.

Dif: Difference. OIR: Over-identifying Restrictions Test. F: test for overall significant of the finding. AR(1): First order autocorrelation test & AR(2): Second order autocorrelation test and standard errors in parentheses

Table 4.4: The mediating effect of informal sector growth on poverty head count-inequality nexus

	Model 1	Model 2	Model 3	Model 4
VARIABLES	Poverty head count	Poverty head count	Poverty head count	Poverty head count
Lag of Poverty head count	0.876***	0.842***	0.814***	0.818***
	(0.0202)	(0.0223)	(0.0251)	(0.0310)
Consumption gini index	31.06***	28.14***	28.51***	26.35***
	(7.470)	(7.348)	(8.048)	(7.859)
lag2		0.0309	-0.0444	-0.0293
		(0.0185)	(0.0402)	(0.0581)
lag3			0.109**	0.0727
			(0.0494)	(0.115)
lag4				0.0100
				(0.0581)
Informal sector output	0.420***	0.418***	0.408***	0.410***
	(0.0683)	(0.0702)	(0.0792)	(0.0735)
Mediation variable	-35.25**	-32.39**	-28.51*	-25.64*
	(14.18)	(13.62)	(14.89)	(14.41)
Log of gross domestic product per capita	-1.949*	-2.386**	-2.574**	-2.209*
	(0.966)	(0.976)	(1.087)	(1.113)
Log of total population	-0.411	-0.764	-0.747	-0.725
	(0.431)	(0.457)	(0.454)	(0.499)
Log of government consumption expenditure	0.269***	0.341***	0.348**	0.351***
	(0.0951)	(0.104)	(0.128)	(0.120)
yr1	1.410**	1.440**	2.382***	2.267***
	(0.587)	(0.568)	(0.708)	(0.645)
yr2	0.850	0.611	0.645	0.682
	(0.624)	(0.638)	(0.658)	(0.567)
yr3	0.693	0.561	0.476	0.513
	(0.490)	(0.489)	(0.515)	(0.424)

yr4	0.574	0.414	0.422	0.401
	(0.398)	(0.407)	(0.429)	(0.367)
yr5	0.545*	0.409	0.433	0.382
	(0.295)	(0.309)	(0.312)	(0.289)
yr6	0.0996	0.0753	0.0117	0.0268
	(0.221)	(0.231)	(0.227)	(0.225)
Constant	-2.060	6.254	6.177	4.211
	(14.72)	(14.96)	(16.13)	(16.75)
Time effect	yes	yes	yes	yes
F-stat	24689.46	49071.62	34295.09	57896.44
Prob > F	0.000	0.000	0.000	0.000
AR(1):(Pr > z)	0.002	0.003	0.002	0.003
AR(2):(Pr > z)	0.048	0.072	0.028	0.148
Sargan OIR Prob > chi2	0.000	0.000	0.000	0.000
Hansen OIR Prob > chi	0.178	0.157	0.053	0.038
DHT for instruments				
(a) Instruments in levels				
H excluding group	0.011	0.032	0.013	0.017
Dif(null, H = exogenous (b) IV (years, eq(diff))	0.846	0.548	0.326	0.194
H excluding group	0.169	0.172	0.098	0.073
Dif(null, H = exogenous)	0.342	0.278	0.123	0.114
Instruments	33	33	33	33
Observations	965	964	963	962
Countries	35	35	35	35

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

***, **, *: significance levels at 1%, 5% and 10% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments Subsets.

Dif: Difference. OIR: Over-identifying Restrictions Test. F: test for overall significant of the finding. AR(1): First order autocorrelation test & AR(2): Second order autocorrelation test and standard errors in parentheses

Table 4.5: The mediating effect of informal sector growth on poverty gap-inequality nexus

	Model 1	Model 2
VARIABLES	Poverty gap	Poverty gap
Lag poverty gap	0.979***	0.975***
	(0.00856)	(0.00894)
Consumption gini index	5.039	9.023**
	(3.193)	(4.138)
lag2		-0.0567***
		(0.0172)
Informal sector output	0.0712	0.193***
	(0.0629)	(0.0626)
Mediation variable	-23.34***	-29.40**
	(7.098)	(10.82)
Log of gross domestic product per capita	1.331*	0.830

	(0.698)	(0.612)
Log of population	0.517***	0.234
	(0.187)	(0.374)
Log government consumption expenditure	-0.252***	-0.238**
	(0.0630)	(0.106)
yr1	1.091***	1.014***
	(0.274)	(0.363)
yr2	1.061***	1.496***
	(0.246)	(0.328)
yr3	0.690***	1.079***
	(0.240)	(0.306)
yr4	0.518***	0.813***
	(0.147)	(0.211)
yr5	0.431***	0.725***
	(0.115)	(0.135)
yr6	0.198**	0.396***
	(0.0754)	(0.0942)
Constant	-14.40*	-8.490
	(7.155)	(8.844)
	(0.306)	(0.267)
Time effects	Yes	Yes
F-stat	11899.32	34866.61
Prob > F	0.000	0.000
AR(1):(Pr > z)	0.135	0.078
AR(2):(Pr > z)	0.312	0.156
Sargan OIR Prob > chi2	0.000	0.000
Hansen OIR Prob > chi2	0.416	0.342
DHT for instruments		
(a) Instruments in levels		
H excluding group	0.073	0.086
Dif(null, H = exogenous (b) IV (years, eq(diff)	0.836	0.677
H excluding group	0.304	0.582
Dif(null, H = exogenous)	0.597	0.150
Instruments	33	33
Countries	35	35
Observations	965	1964

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

***, **, *: significance levels at 1%, 5% and 10% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments Subsets.
Dif: Difference. OIR: Over-identifying Restrictions Test. F: test for overall significant of the finding. AR(1): First order autocorrelation test & AR(2): Second order autocorrelation test and standard errors in parentheses

Our results in table 4.3 confirm the essence of the usage of a dynamic model as the first period lag of consumption inequality is found to be a positive significant driver of current level of consumption inequality at 1% level. That is, previous year rate of inequality worsen the current year inequality rate.

The growth of the informal sector has a positive and significant association with consumption inequality at 1% level. This implied that increase in the growth of informal sector will lead to increase in the rate of consumption inequality in sub-Saharan African's region. This finding is in line with the empirical result of Elgin *et al.* (2021). This equally confirmed the view of Ghecham (2017) which indicated that the growth of the informal sector could aggravate the gap between the top income earners indicating further concentration of income.

Unemployment rate is equally positively and significantly associated with consumption inequality at 1% level. The implication is that increase in unemployment rate will lead to increase in the level of inequality in SSA. This may be due to the fact that unemployment pushed the poor into informal activity which only increases the size of the informal sector and hence, increase in inequality as seen above.

Gross domestic fixed capital formation is also positively and significantly associated with consumption inequality. This indicated that increase in investment will lead to increase in the level of inequality. This is due to the fact that the rich in every society has the power and possibility to invest more than the poor in the society.

The AR(2) results for all the models in table 4.3 show that the presence of serial correlation is rejected since the probability values are insignificant. The Hansen results reject the null hypothesis that the instruments are not valid because it is equally insignificant. The F-Statistic is statistically significant at 1% level indicating that collectively, the independent variables are statistically significant in predicting the overall variation in consumption inequality.

Table 4.5 also indicated that the poverty model is a dynamic model since the lag of poverty gap is significantly and positively related with the current year of poverty rate at 1% level. The consequence is that the past year level of poverty drags the current level of poverty from falling. That is, increase in the previous year poverty rate will lead to increase in the number of poor people in SSA. Lag2 shows that over the years, the rate of poverty reduces. This may be due to increase in employment in the formal sector since the growth of the informal sector increases the rate of poverty in the society.

Consumption inequality is positively and significantly related with poverty rate in SSA. The implication is that increase in the rate of inequality in SSA lead to increase in the rate of poverty in our region

The growth of the informal sector also has a positive and significant association with poverty rate at 1% level. The result shows that increase in informal sector growth will equality lead to increase in the number of poor people in SSA. This is because poor household heads are more likely to work informally, and household heads having informal employment as wage or salaried employees are more likely to be poor (Canelas, 2018). However, this result is contrary to the empirical finding of Delbiso *et al.* (2018) and Nuhu and Abdullahi (2018) may be due to the fact that they used but primary data for their analysis.

The mediating variable has a negative significant effect on poverty reduction at 5% level. Thus the growth of the informal sector improves the growth elasticity of poverty

reduction through inequality. This is because informal sector growth reduces the gap between income earners at the bottom level of income categories (Ghecham, 2017). Therefore, despite the fact that inequality increases poverty and informal sector growth increases inequality at the top income category (Ghecham, 2017) and it aggravate the rate of poverty, the mediating effect of informal sector growth turn to reduce the rate of poverty in SSA.

We found out that government consumption expenditure significantly help in poverty reduction at 5% level. That is, increase in government consumption expenditure reduces poverty. This is due to the fact that government consumption expenditure usually target but the poor in every society.

AR(2) results show that the presence of serial correlation is rejected as seen in models 2 of table 4.5 and the Hansen results reject the null hypothesis that the instruments are not valid. The F-Statistic is statistically significant at 1% level indicating that collectively, the independent variables are statistically significant in predicting variations in poverty.

5. Summary and conclusions

This study assesses the effect informal sector growth on inequality and how informal sector growth mediates the effect of inequality on poverty. In the light of the results, clarification of findings and corresponding implications policy, it will be necessary to create more formal employment opportunities since the informal sector increases both inequality and poverty in the society and only help in poverty reduction through it mediating effect. It will be worthwhile for future studies to investigate the mediating effect of informal sector growth on inequality through poverty.

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7 Appendix

Appendix A: Definitions of variables and Data source

Short name	Description of variable	Unit of measurement	Source
INF	Informal sector output	multiple indicators multiple causes model-based (MIMIC) estimates of informal output (% of official GDP)	Informal world development indicator (IWDI)
GINI	Consumption inequality	Consumption Gini Coefficient	Global Consumption and Income Project (GCIP) data based
pov	poverty	Poverty head count or poverty gap	Global Consumption and Income Project (GCIP) data base/ World Development (WDI)
inter_term	Mediation variable	Informal sector out * gini index	Computed by authors
uemp1	Unemployment rate	It is the total percentage of the labour force that is not working. It consists of individuals without work but who are able and willing to work.	World Development (WDI)
to1	Trade openness	It is estimated by the summation of imports and exports divided by the level of GDP.	World Development Indicators (WDI)
lrgdppc	Log of gross domestic product per capital	Annual GDP per head	World Development Indicators (WDI)
lpop	Log of total Population	It is the total number of people in in the economy	World Development Indicators (WDI)
lgdfcf	Log of Gross domestic fixed	Annual total investment in US dollars	World Development Indicators (WDI)

	capital formation		
lgovco	Log of Government consumption expenditure	Government expenditure on good and services in US dollars	World Development Indicators (WDI)