

## Causal relationships between foreign direct investment, inequality and economic growth: Evidence from dynamic simultaneous-equations models in African countries

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#### 1. Introduction

The economic literature gives an important place to Foreign Direct Investment (FDI) in the process of globalization. In this context, capital inflows are presented as development vehicles and implicitly reduce inequality. Indeed, economic studies rely on the existence of causality between FDI and growth to deduce the nature of their effects on inequality. However, it is not certain that the growth is synonymous with a decrease in inequality. The study of this canal is the object of this work. It is a question of understanding how FDI can contribute to reducing inequality by affecting growth.

According to economic analysis, one of the most important benefits associated with FDI is the achievement of a faster and less volatile process of economic growth. Despite an enormous literature on the impact of FDI on economic growth (see De Mello, 1999,), there are few empirical studies that explore the effect of FDI on inequality in an international setting.

Tsai (1995) notes that the relationship between FDI and inequality tends to vary greatly across regions, and is generally positive only in East and South Asian countries.

Developing countries seek to attract international investment by offering relatively untapped new markets, access to natural resources, relatively cheap labor, location advantages, and direct and indirect incentives. (Albuquerque 2003, Reece and Sam, 2012).

Lee and Chang (2009) said that FDI has a big direct effect on economic growth and will increase the potential profits related to FDI.

Lamsiraroj and Doucouliagos (2015) conclude that economic growth has a moderate effect in attracting FDI and that this association has not diminished over time.

On the other hand, the economic literature shows that growth and inequality are interdependent.

For Bourguignon (2004), the real challenge in establishing development strategies for poverty reduction is not the relationship between poverty and growth on the one hand and poverty and inequality on the other, but the interaction between distribution and growth.

Kuznets (1955) formulated the relationship between economic growth and inequality as an inverted-U curve. Garcia-Penalosa and Turnovsky (2015) observe the Kuznets explanation of an inverted-U curve rests on "dual economy" dynamics.

The remainder of this paper is organized as follows. In section 2, we briefly summarize the literature review that is directly relevant for the purpose of this paper. The methodological framework is explained in section 3. In section 4, we explain the estimation technique. Data and results are discussed in section 5. Finally, we conclude in section 6.

#### 2. Theoretical literature

This section will be devoted to review the findings of the studies on inequality, FDI and economic growth. In order to estimate the interactions between inequality, FDI and growth in Africa, we construct a model with simultaneous equations. This model is based on the existence of a trilateral relationship between growth, inequality and poverty.

Many theoretical models have been proposed to explain how FDI affect growth. FDI often has a positive impact on growth.

Farrell (2008) defined FDI as a combination of capital and entrepreneurship that enable a firm to operate and offer goods and services in foreign markets.

Economic growth is usually measured as the percent rate of increase in real gross domestic product (GDP).

GDP growth shows that companies are hiring and investing. These indicators are primarily governmentissued national health and growth statistics, particularly on the economic front.

Basu and Guariglia (2005) indicate a strong positive association between FDI and growth.

Szkorupova (2014) analyses the relation between FDI, economic growth and export in Slovakia. The author demonstrates the generally accepted argument that FDI is a positive force for the economic growth.

Almfraji and Almsafir (2014) prove that FDI exerts positive effects on the host country's economic growth. In theory, FDI should have a direct impact on growth through the accumulation of capital and the incorporation of new inputs and foreign technologies the host country's production function. The authors present several researches on the general relationship between FDI and economic growth (see table 1).

## **Research Through Innovation**

Table 1: Researches on the General FDI - EG Relation (1999-2012)

FDI effects on Growth	Sources	Data	<b>Empirical Approach</b>
Significant (Positive)	Manuchehr and Ericsson (2001)	Denmark, Finland, Sweden, and Norway 1970-1997.	Lag-augmented vector autoregression.
	Nair Reichert and Weinhold (2001)	24 developing countries 1971-1995	Mixed fixed and random coefficient approach.
		developing countries, 1971-1995.	HoltzEakin.
	Chowdhury and Mavrotas (2006)	Chile, Malaysia, and Thailand 1969- 2000.	Lag-augmented vector autoregression.
	Shaikh (2010)	47 developing countries 1981- 1999.	OLS regressions.
	Griffiths and Sapsford (2004)	Mexico 1970-1999.	OLS regressions.
	ChakrabortyandNunnenkamp (2006)	India 1987-2000.	Granger causality tests cointegration.
	Al-Iriani (2007)	Bahrain, Kuwait, Oman, Saudi Arabia, and United Arab Emirates 1970- 2004.	Granger causality test of Holtz-Eakin.
	Shaikh (2010)	Malaysia 1970-2005.	OLS regressions.
	Faras and Ghali (2009)	GCC countries 1970- 2006.	Test results for unit roots and test results for unit roots
	Umoh, Jacob and Chuku (2012)	Nigeria 1970-2008.	Single and simultaneous equation systems.

Source: Almfraji and Almsafir (2014)

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### **Research Through Innovation**

For Lamsiraroj and Doucouliagos (2015), there are several reasons why foreign investors might prefer faster growing markets. Higher economic growth indicates the size of the potential market that may expand in the future. Economic growth prompts foreign firms to plan new projects or new production facilities.

Al Nasser (2010) explores the relationship between FDI and economic growth. He provides evidence that the link between FDI and economic growth is bidirectional for Latin American countries, which indicates that economic growth initially could attract more FDI, which, in turn, would then result in accelerated economic growth.

Mohamed and Sidiropoulos (2010) show that the most important determinants of FDI's inflow in MENA countries are the size of the economy, the government size, the natural resources and the institutional variables. They conclude that countries with less foreign investments may be more attractive to potential foreign investors.

Now, it's evident an interdependence between FDI and growth. So, how can this relation affect the inequality? The relationship between economic growth and inequality has a long history dating back to Kuznets (1955). Kuznets (1955) found an inverted-U shape between per capita income and inequality based on a cross-section of countries: as countries developed, income inequality first increased, peaked, and then decreased.

Mehrara and Mohammadian (2015) indicated that, in Iran, the GDP growth is the most important variable affecting inequality. Economic growth may be a result of oil revenues in the Iranian economy, leading to an unequal distribution of income.

Santos-Paulino (2012) indicated that the impact of growth on poverty reduction depends on the position of poverty line in the income distribution. Related to this, Deaton (2005) found that when economic growth is distributed unequally, the impact of growth on poverty reduction is smaller depending on whether the poor have less (or more) incomes than average.

Ostry, Berg and Tsangarides (2014) found that countries with high inequality, as measured by the gini index, had lower economic growth and shorter growth periods.

Herzer and Nunnenkamp (2011) examined the relationship between FDI and income inequality in a sample of ten European countries. They find that FDI has a positive effect on income inequality in Europe in the short term and in the long term he suggests an effect of FDI on inequality, but negative on average.

Chintrakarn et al. (2010) explored the relationship between inward FDI and income inequality in the United States. They find that the short-run effects of FDI on income inequality are insignificant or weakly significant and negative. Over the long term, however, FDI has a significant and powerful negative impact on US income inequality.

According to Figini and Gorg (1999), the Irish case shows an inverted U-shaped pattern, with FDI first increasing inequality and then decreasing.

Choi (2004) concluded that income inequality and FDI are positively related. The author found that income inequality increases as FDI stocks as a percentage of GDP increase.

Figini and Gorg (1999) found that the effect of FDI differs according to the level of development: wage inequality increases with FDI but this effect diminishes with further increases in FDI. In advanced economies, wage inequality decreases with FDI, but there is no evidence that this effect is non-linear.

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Im and McLaren (2015) found that FDI helps reduce both inequality and poverty rates in host countries. FDI reduces income of Southern capitalists, which itself reduces inequality, but it increases wage inequality and pushes in the opposite direction.

Our study adds to this literature, in that we examine the proposed relationship for a global panel of countries and for three different types of African countries based on income level: upper middle, lower middle, and low income countries. Our classification of African countries into sub-panels based on income level is crucial in terms of homogenizing countries into similar characteristics. This disaggregated panel data analysis allows comparison and contrasting of results by income level.

#### **3** Econometric modeling

The objective of the paper is to explain the interrelationship between inequality, FDI and economic growth. These variables are in fact endogenous. Therefore, it is worth investigating the relationship between the three variables by considering them together in one modeling framework. Based on this interaction, this modeling helps policymakers formulate sound economic policies to sustain economic development.

We employ the production function<sup>1</sup> incorporating capital and labor as additional factors of production. Anwar and Nguyen (2010) include the FDI variable in their empirical model to examine the impact of this variable on economic growth. While they find generally that FDI stimulates economic growth. Furthermore, Bruno and Easterly (1998) and Anwar and Sun (2011), empirically tested the impact of inflation (INF) on economic growth and these studies showed that inflation has a statistical significant influence on economic growth. Thus, in line with the more extensive literature on the determinants of economic growth above, our proposed model takes the form:

We introduce the inequality by the Gini index in this function to test our problematic. We write equation (1) in growth form with time series specification as follows:

$$gY_t = \alpha_0 + \alpha_1 FDI_t + \theta_0 GINI_t + \varphi_0 LF_t + \delta_0 INF_t + \varepsilon_t$$

Since our study is a panel data study, Eq. (1) can be written in panel data form as follows:

$$gY_{i,t} = \alpha_0 + \alpha_1 FDI_{i,t} + \theta_0 GINI_{i,t} + \varphi_0 LF_{i,t} + \delta_0 INF_{i,t} + \varepsilon_{i,t}$$

where the index i=1,...,N denotes the country (in our study, we have 52 countries) and t=1,...,T denotes the time period (our time frame is 1990–2014); gY represents growth rate of per capita GDP; GFCF is measured by the gross fixed capital formation (% of GDP); LF is the working capital as measured by the rate of participation in the total labor force (% of total population aged 15 and over); INF represents the inflation rate; GINI indicates the Gini index and FDI indicates the foreign direct investment, net inflows (%GDP).

According to Walsh and Yu (2010), previous work has looked at the relationship of FDI with several macroeconomic variables. Associated with FDI flows are size and growth potential, economic stability, openness and infrastructure.

Artige and Nicolini (2006) found that market size, measured in terms of GDP or GDP per capita, appears to be the strongest determinant of FDI in econometric studies.

<sup>&</sup>lt;sup>1</sup> We employ the Cobb–Douglas production function including capital and labor as additional factors of production. IJNRD2305837 International Journal of Novel Research and Development (www.ijnrd.org)

Charkrabarti (2001) stated that there is mixed evidence concerning the significance of openness, which is measured mostly by the ratio of exports plus imports to GDP, in determining FDI, as well.

Jordaan (2004) argued that high quality, well-developed infrastructure increases the productivity potential of investments in a country, therefore stimulates FDI in a country.

According to Vijayakumar, Sridharan and Rao (2010), economic stability as measured by inflation is negatively insignificant in determining FDI inflows. Thus a country which has a stable macroeconomic condition will receive more FDI inflows than a more volatile economy.

For Shah (2014), the amount, availability and quality of supportive infrastructure are essential for the smooth functioning of multinational's affiliate production and trade activities.

Thus, our proposed model takes the following form:

$$FDI = f\{gY, INF, OP, Infr\}$$

We introduce also the inequality by the Gini index in this function to test our problematic. We write equation (2) in FDI form with panel data form as follows:

#### $FDI_{i,t} = \alpha_2 + \alpha_3 gY_{i,t} + \theta_1 GINI_{i,t} + \varphi_1 INF_{i,t} + \delta_1 Infr_{i,t} + \beta_1 OP_{i,t} + \varepsilon_{i,t}$

where the index i=1,...,N denotes the country (in our study, we have 53 countries) and t=1,...,T denotes the time period (our time frame is 1990–2014); gY represents growth rate of per capita GDP; INF represents the inflation rate; Infr indicates the infrastructure which measured by the number of fixed line telephone and mobile phone subscribers (% of population); and OP indicates the trade openness, measured as exports plus imports as a percentage of GDP.

The Gini index is the most frequently used indicator of inequality. It is defined as a ratio with values between zero and one in which zero means perfect quality and one means complete inequality. Many studies have been proven to influence income distribution, including growth, inflation, education, FDI, and trade openness.

Kuznets (1955) found an inverted-U shape between per capita income and inequality based on a cross-section of countries. In this context it can be mentioned that Fields (2000) directly concludes that there is no Kuznets curve for African countries.

According to Walsh and Yu (2012), inflation generally worsens inequality. Li and Zou (2002) indicated that when inflation is taking place, price rises tend to run ahead of increases in money wages. Inflation therefore leads to a shift in income from wage earners to profits. On this ground, inflation is claimed to increase income inequality because it hurts the poor relatively more than the rich.

Autor (2014) considered growth in wage premiums related to higher education and cognitive skills as the most important factor increasing inequality among households outside the top one percent.

McCall and Kenworthy (2009) found that Americans prefer increased spending on education spending in response to growing concerns about inequality.

For Herzer and Nunnenkamp (2011), several empirical studies supported the hypothesis derived from the North South models that FDI is associated with greater inequality by increasing skills premiums in poorer host countries.

Anderson (2005) pointed out that while most empirical time series studies show that greater openness increases inequality of wages, cross-sectional studies tend to show that increased openness had little effect on inequality.

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According to Lim and McNelis (2014), a result indicated that trade opening had only a small impact on low income countries, but a significant negative impact on middle income countries.

Thus, our proposed model takes the following form:

$$GINI = f\{gY, INF, OP, FDI, EDUC\}$$

We write equation (3) in inequality form with panel data form as follows:

$$GINI_{i,t} = \alpha_4 + \alpha_5 gY_{i,t} + \theta_2 FDI_{i,t} + \varphi_2 INF_{i,t} + \delta_2 EDUC_{i,t} + \beta_2 OP_{i,t} + \varepsilon_{i,t}$$

where the index i=1,...,N denotes the country (in our study, we have 53 countries) and t=1,...,T denotes the time period (our time frame is 1990–2014); gY represents growth rate of per capita GDP; FDI indicates the growth rate of foreign direct investment; INF represents the inflation rate; EDUC indicates the level of education measured by school enrollment, tertiary (gross), and OP indicates the trade openness, measured as exports plus imports as a percentage of GDP.

We use the following simultaneous equations model to investigate the interrelationship between inequality, FDI and economic growth. The triple relationship between these variables is empirically explored using the following three equations:

$$gY_{i,t} = \alpha_0 + \alpha_1 FDI_{i,t} + \theta_0 GINI_{i,t} + \varphi_0 LF_{i,t} + \delta_0 INF_{i,t} + \varepsilon_{i,t}$$
  

$$FDI_{i,t} = \alpha_2 + \alpha_3 gY_{i,t} + \theta_1 GINI_{i,t} + \varphi_1 INF_{i,t} + \delta_1 Infr_{i,t} + \beta_1 OP_{i,t} + \varepsilon_{i,t}$$
  

$$GINI_{i,t} = \alpha_4 + \alpha_5 gY_{i,t} + \theta_2 FDI_{i,t} + \varphi_2 INF_{i,t} + \delta_2 EDUC_{i,t} + \beta_2 OP_{i,t} + \varepsilon_{i,t}$$

#### 4 Estimation technique

In this study, we have a dynamic panel data models in a simultaneous-equations where lagged levels of economic growth, FDI and inequality are taken into account by using the Arellano and Bond (1991) GMM estimator. Generalized Method of Moments (GMM) is the estimation method most commonly used in dynamic models with panel data and a lagged dependent variable. This method uses a set of instrumental variables to solve the endogeneity problem of the regressors. Our proposed modeling is as follows:

$$gY_{i,t} = \alpha_0 gY_{i,t-1} + \alpha_1 FDI_{i,t} + \theta_0 GINI_{i,t} + \varphi_0 LF_{i,t} + \delta_0 INF_{i,t} + \varepsilon_{it}$$
  

$$FDI_{i,t} = \alpha_2 FDI_{i,t-1} + \alpha_3 gY_{i,t} + \theta_1 GINI_{i,t} + \varphi_1 INF_{i,t} + \delta_1 Infr_{i,t} + \beta_1 OP_{i,t} + \varepsilon_{i,t}$$
  

$$GINI_{i,t} = \alpha_4 GINI_{i,t-1} + \alpha_5 gY_{i,t} + \theta_2 FDI_{i,t} + \varphi_2 INF_{i,t} + \delta_2 EDUC_{i,t} + \beta_2 OP_{i,t} + \varepsilon_{i,t}$$

Since the lagged dependant variables  $(gY_{i,t-1}, FDI_{i,t-1}, and GINI_{i,t-1})$  are correlated with the error term, the use of panel ordinary least squares (OLS) estimator (with fixed and random effects) is problematic. The Arellano and Bond (1991) approach solved this problem by first differentiating the above equations. This removes country-specific effects.

#### 5 Data and results

#### 5.1/ Data

Economic growth is an annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars (GDP is the sum of gross value). This variable is downloaded from the World Bank National Accounts data and OECD National Accounts data files.

FDI is the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise of an economy other than that of the investor. This is the sum of capital, reinvestment of earnings, other long-term capital and short-term capital as reported in the balance of payments. This series shows net foreign investor inflows to the reporting country divided by GDP. This variable is downloaded from International Monetary Fund, International Financial Statistics and Balance of Payments databases and World Bank.

Labor force participation rate (LF) is the percentage of the economically active population aged 15 and over. That is, anyone who provides labor for the production of goods or services during a particular period of time. This variable is downloaded from International Labour Organization and Key Indicators of the Labour Market database.

Inflation (INF) as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that can be fixed or varied at certain intervals annualy. The Laspeyres formula is generally used. This variable is downloaded from International Monetary Fund, International Financial Statistics and data files.

Openness of trade (OP) is measured as the ratio of imports and exports to GDP. Exports of goods and services represent the value of all goods and other market services provided to the rest of the world, while imports of goods and services represent the value of all goods and other market services received from other parts of the world. This variable is downloaded from the World Bank National Accounts data and OECD National Accounts data files.

The infrastructure is measured by the number of fixed line telephone and mobile phone subscribers (% of total population). Fixed line connections refers to the total number of active analogue fixed line connections. Also, a mobile phone contract is a subscription to public mobile phone service using cellular technology. This variable is downloaded from International Telecommunication Union and Development Report and database. Education is measured by gross enrollment ratio. It expresses total enrollment in secondary education as a percentage of the population of formal secondary school age, regardless of age. Gross enrollment rate may exceed 100% due to early/late admission, repetition of grades. This variable is downloaded from United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics.

The Gini coefficient measures how much the distribution of individual or household income (and possibly consumption) within an economy deviates from a perfectly even distribution. The Lorenz curve plots the cumulative percentage of total income received versus the cumulative number of recipients, starting with the poorest person or household. The Gini index measures the area between the Lorenz curve and the imaginary line of absolute equality, expressed as a percentage of the maximum area under the line. Thus, a Gini index of 0 represents perfect equality and an index of 100 represents perfect inequality. This is downloaded from the WIID data.

Data is for the period 1990–2014.

The countries selected for the study and the timeframe were dictated by data availability. These include 52 countries (Burkina Faso, Burundi, Central African, Democratic Republic of Congo, Eritrea, Ethiopia, Gambia, Guinea, Guinea Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Togo, Uganda, Benin, Cameroon, Chad, Comoros, Congo, Côte d'Ivoire, Djibouti, Egypt, Ghana,

Kenya, Lesotho, Mauritania, Morocco, Nigeria, Sao Tome and Principe, Senegal, Sudan, Swaziland, Tanzania, Zambia, Zimbabwe, Algeria, Angola, Botswana, Cabo Verde, Equatorial Guinea, Gabon, Libya, Mauritius, Namibia, Seychelles, South Africa, Tunisia).

#### 5.2/ Main results and discussions

We start the results by performing the panel unit root test proposed by Im, Pesaran and Shin (2003). Our objective about this test is to decide which variables should enter the proposed modeling in difference form and which variables should enter the models in their level form. In our panel, we find that for labor force, inflation rate, trade openness, infrastructure, and education, the unit root null is rejected. This means that these variables are stationary and they can enter our proposed modeling without changing them in difference form, while for the three other variables (namely, economic growth, FDI, and Gini index), the null hypothesis of the panel unit root is not rejected, indicating that these variables are non-stationary. This implies that there is a need to change these variables into the difference form.

After checking the form in which variables would enter the empirical modeling, we use the Arellano and Bond (1991) GMM estimator to find the three-ways linkages between inequality, FDI and economic growth for our panels. These models present the estimated coefficients of equations which are given in Tables 2, 3, 4 and 5. We also present the most reasonable results, those that behave favorably in terms of the diagnostic tests of over identification (Hansen J-test) and the absence of a 2<sup>nd</sup> order autocorrelation in first differences (AR<sup>2</sup> test).

Independent variables	Model 1	Model 2	Model 3
	Growth	FDI	Inequality
gYt	-	0.197***	-0.750***
gYt-1	0.197	-	-
<b>FDI</b> <sub>t</sub>	0,644***		2.189**
FDI <sub>t-1</sub>	ntional i	0.202**	Journal
GINI <sub>t</sub>	-8.142**	0.213	-
GINIt-1	-	-	3.126
LFt	0.313*		-
INF <sub>t</sub>	-0.025	1.578	2.873
Infrt	_	0.316**	
OP <sub>t</sub>	arc <mark>h</mark> Thr	3.143**	5.189**
<b>EDUC</b> <sub>t</sub>	-	-	-0.291**
Constant	17.767*	0.217**	-7.368***
Hansen J-test (p-value)	21.66 (0.127)	19.286 (0.385)	14.12 (0.308)
AR <sup>2</sup> test (p-value)	0.149 (0.745)	0.086 (0.841)	0.187 (0.795)

Table 2: Results for upper middle income countries

Notes: Values in parentheses are the estimated p-values.

Hansen J-test - over identification test of restrictions in GMM estimation.

AR<sup>2</sup> test – Arellano–Bond's test to analyze the existence of 2<sup>nd</sup> order autocorrelation in first differences.

\*Coefficient significant at 1% level.

\*\*Coefficient significant at 5% level.

\*\*\*Coefficient significant at 10% level.

For the upper middle income countries, the findings reveal that there are bi-directional causal relationships between FDI inflows and economic growth. There is also uni-directional causal relationship from FDI to inequality and from economic growth to inequality.

In model 1, we find that FDI has positive and statistically significant (at the 1% level) effect on economic growth. The magnitude of 0.644 implies that a 1% increase in the FDI increases the economic growth of the upper middle income countries by 0.64%.

Labor force (LF) is also statistically significant determinant of economic growth (at the 10% level), while inflation (INF) and the previous growth remain statistically insignificant.

The Gini index has negative and statistically significant (at the 5% level) effect on economic growth. The magnitude of 8.14 implies that a 1% increase in the Gini index decreases the economic growth of the upper middle income countries by 8.14%.

In model 2, we find that the effects of economic growth and the previous FDI on actual FDI are positive and statistically significant at the 1% and 5% levels, respectively. The magnitude of 0.197 and 0.202 implies that a 1% increase in economic growth and in the previous FDI increases the FDI of the upper middle income countries by around 0.10%.

The infrastructure (Infr) and trade openness (OP) are also statistically significant determinants of FDI (at the 5%), while inflation and the Gini index are statistically insignificant.

Finally, in model 3, we find that the effects of economic growth and education on inequality (measured by the Gini index) are negative and statistically significant at the 1% and 5% level, respectively. The magnitude of 0.750 and 0.291 implies that a 1% increase in economic growth and the education decreases the inequality of the upper middle income countries by 0.75% and 0.3%, respectively. This means that an increase in economic growth and in education tends to less inequality (see, Breen and Chung 2015).

FDI and trade openness (OP) have positive and significant effects on Gini index at the 5% level, while inflation remains statistically insignificant.

Indepen <mark>den</mark> t variables	Model 1	Model 2	Model 3
	Growth	FDI	Inequality
gYt	_	0.593***	-0.429**
gY <sub>t-1</sub>	0.197	ough-Inno	vation
FDI <sub>t</sub>	0,281**	-	3.618*
FDI <sub>t-1</sub>	-	0.621***	-
GINIt	-5.312**	0.213	-
GINI <sub>t-1</sub>	-	-	3.126
LFt	0.192**	-	-
INFt	-0.549*	1.578	2.873
Infrt	-	0.627*	-
OPt	-	4.358*	6.578*

#### Table 3: Results for lower middle income countries

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<b>EDUC</b> t	-	-	-0.312*	
Constant	21.473*	10.217**	-5.081***	
Hansen J-test (p-value)	23.52 (0.115)	18.249 (0.245)	20.684 (0.510)	
AR <sup>2</sup> test (p-value)	0.192 (0.753)	0.542 (0.628)	0.278 (0.304)	

Notes: Values in parentheses are the estimated p-values.

Hansen J-test - over identification test of restrictions in GMM estimation.

 $AR^2$  test – Arellano–Bond's test to analyze the existence of  $2^{nd}$  order autocorrelation in first differences.

\*Coefficient significant at 1% level.

\*\*Coefficient significant at 5% level.

\*\*\*Coefficient significant at 10% level.

For the lower middle income panel, the findings reveal that there are bi-directional causal relationships between FDI inflows and economic growth. There is also uni-directional causal relationship from FDI to inequality and from economic growth to inequality.

In model 1, we find that FDI and labor force (LF) have positive and statistically significant effects (at the 5% level) on economic growth. The magnitude of 0.281 and 0.192 implies that a 1% increase in FDI and labor force increases the economic growth of the lower middle income countries by around 0.3% and 0.2%, respectively.

The Gini index has negative and statistically significant (at the 5% level) effect on economic growth. The magnitude of 5.31 implies that a 1% increase in the Gini index decreases the economic growth of the lower middle income countries by 5.31%.

The impact of inflation is found to be negative and statistically significant (at the 10% level). The previous growth remains statistically insignificant.

In model 2, we find that the economic growth and the previous FDI have a significant positive effect (at the 1% level) on FDI. The magnitude of 0.593 and 0.621 implies that a 1% increase in economic growth and in the previous FDI increases the FDI of the lower middle income countries by around 0.6%.

The infrastructure (Infr) and trade openness (OP) are also statistically significant determinants of FDI (at the 10% level), whereas inflation and the Gini index are statistically insignificant.

In model 3, both economic growth and education have negative and significant impacts on inequality at the 5% and the 10% levels, respectively. The magnitude of 0.429 and 0.312 implies that a 1% increase in economic growth and education decreases the Gini index by 0.43% and 0.31%, respectively.

There are also positive and statistically significant impacts of FDI and trade openness (OP) on Gini index at the 10% level, while inflation has a positive and insignificant effect on Gini index.

Independent variables	Model 1	Model 2	Model 3
	Growth	FDI	Inequality
gYt	-	0.316*	-0.876**
gY <sub>t-1</sub>	0.289*	-	-
FDI <sub>t</sub>	0,598***	-	5.843*
FDI <sub>t-1</sub>	-	0.402*	-
GINIt	-6.134	0.587	-
GINI <sub>t-1</sub>	-	-	4.812
LFt	0.625***	-	-
INFt	-0.691	2.857	3.942
Infr <sub>t</sub>	-	0.845	-
OPt		6.842	7.248*
EDUCt			-0.901*
Constant 🥏	15.281	6.493*	0.638
Hansen J-test (p-value)	25.07 <mark>3 (0.49</mark> 2)	17.806 (0.580)	16.425 (0.503)
AR <sup>2</sup> tes <mark>t (p</mark> -value)	0.273 (0. <mark>751</mark> )	0.061 (0.540)	0.158 (0.943)

 Table 4: Results for low income countries

Notes: Values in parentheses are the estimated p-values.

Hansen J-test – over identification test of restrictions in GMM estimation.

 $AR^2$  test – Arellano–Bond's test to analyze the existence of  $2^{nd}$  order autocorrelation in first differences.

\*Coefficient significant at 1% level.

\*\*Coefficient significant at 5% level.

\*\*\*Coefficient significant at 10% level.

For the low income panel, the findings reveal that there are bi-directional causal relationships between FDI inflows and economic growth. There is also uni-directional causal relationship from FDI to inequality.

In model 1, we find that labor force (LB) and FDI have a positive and statistically significant effect (at the 1% level) on economic growth. The magnitude of 0.625 and 0.598 implies that a 1% increase in labor force (LF) and FDI increases the economic growth of the low income countries by around 0.6%.

The previous growth has positive and statistically significant at the 10% level effect on economic growth.

Both Gini index and inflation have negative and statistically insignificant effect on economic growth.

In model 2, we find that the economic growth and the previous FDI have a significant positive effect on FDI at the 10% level. The magnitude of 0.316 and 0.402 implies that a 1% increase in economic growth and the previous FDI leads to an increase in FDI by 0.31% and 0.40%, respectively.

The findings reveal also that the infrastructure (Infr) and trade openness (OP) have insignificant effects on FDI.

Inflation and Gini index are statistically insignificant.

In the final model, we find that economic growth and education have negative and significant impacts on inequality at the 10% level. The magnitude of 0.876 and 0.901 implies that a 1% increase in economic growth and education leads to a decrease in inequality by around 0.9%.

We find also that FDI and trade openness (OP) have significant impacts on inequality at the 10% level, while inflation and the previous Gini index have insignificant impacts.

Independent variables	Model 1	Model 2	Model 3
	Growth	FDI	Inequality
gYt	-	0.750*	-0.767**
gY <sub>t-1</sub>	0.319*	-	-
FDI <sub>t</sub>	0.382***	-	6.132*
FDI <sub>t-1</sub>	-	0.382*	-
GINIt	-2.572*	0.728*	-
GINI <sub>t-1</sub>			4.812
LFt	0.292***		-
INFt	-0.563*	5.637	2.821*
Infr <sub>t</sub> 🦲		0.561*	-
OPt		5.371*	8.020*
EDUC <sub>t</sub>			-1.843*
Constant	20.731*	0.129*	-10.637**
Hansen J-test (p-value)	19.384 (0.706)	13.816 (0.900)	21.381 (0.799)
AR <sup>2</sup> test (p-value)	0. <mark>162</mark> (0.544)	0.084 (0.739)	0.172 (0.860)

 Table 5: Results for global panel

Notes: Values in parentheses are the estimated p-values.

Hansen J-test – over identification test of restrictions in GMM estimation.

 $AR^2$  test – Arellano–Bond's test to analyze the existence of  $2^{nd}$  order autocorrelation in first differences.

\*Coefficient significant at 1% level.

\*\*Coefficient significant at 5% level.

\*\*\*Coefficient significant at 10% level.

# Table 5 reports the results for the global panel. Evidence from models 1–3 reveals that there is bi-directional

causal relationship between FDI inflows and economic growth. There is also uni-directional causal relationship from FDI to inequality and from economic growth to inequality.

In model 1, we find that FDI and labor force (LF) have positive and statistically significant effects (at the 1% level) on economic growth. The magnitude of 0.382 and 0.292 implies that a 1% increase in FDI and labor force leads to an increase in the economic growth of the global panel by around 0.4% and 0.3%, respectively. The Gini index has negative and statistically significant (at the 10% level) effect on economic growth. The magnitude of 2.57 implies that a 1% increase in the Gini index decreases the economic growth of the global panel by 2.57%.

Inflation has significant effects (at the 10 % level) on economic growth. The findings reveal also that the previous growth becomes statistically significant at the 10% level.

In model 2, we find that the economic growth and the previous FDI have a significant positive effect (at the 10% level) on FDI.

The infrastructure (Infr), the Gini index and trade openness (OP) are also statistically significant determinants of FDI (at the 10% level), whereas inflation is statistically insignificant.

In the final model, we find that both economic growth and education have negative and significant impacts on inequality at the 5% and the 10% levels, respectively.

The findings reveal also positive and statistically significant impacts of FDI, inflation and trade openness on inequality.

Finally, we have summarized the above results concerning the three-ways linkages between inequality, FDI and economic growth for the four panels as follows.

First, we have found that the effect economic growth on FDI inflows is positive and statistically significant in the four panels. This suggests higher economic growth is sending a positive signal to potential foreign investors. This confirms the results showed by Soltani and Ochi (2012).

It has also found that the impact of economic growth on inequality in the four panels of countries is negative and statistically significant. This implies that an increase in economic growth tends to decrease inequality.

Second, FDI inflows are found to have a statistically significant effect on economic growth and on inequality in the four panels. This implies that the economic growth and inequality are more closely related to the FDI inflows.

Third, inequality has a negative statistically significant effect on economic growth in the three groups panels and insignificant only for the low income countries. This indicates that a decrease in inequality tends to promote economic growth. It has also been found that inequality has a significant impact on FDI inflows only in the global panel.

Fourth, education has a negative statistically significant effect on inequality in the four panels of countries. In fact, education is one of the major factors improving the degree of income inequality. Policymakers typically justify spending on higher education as a powerful tool to reduce income inequality.

#### 6 Conclusion:

This paper examines the interrelationship between FDI, economic growth and inequality in African countries using dynamic simultaneous-equation panel data models for a global panel of 52 African countries over the period 1990 - 2014. We divide the panel into three groups which are constructed based on the income level of countries. In this way, we end up with three income panels; namely, upper middle income, lower middle income, and low income panels.

The results show that there is bi-directional causal relationship between economic growth and FDI inflows. This confirms that an increase in the stock of FDI will drive economic growth and attract more FDI to these countries. The results also reveal that there is uni-directional causal relationship from economic growth to inequality. We find also that there is uni-directional causal relationship from FDI inflows to inequality.

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