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Abstract

The need for gender inclusion was highlighted as the fifth sustainable development goal (SDG) (i.e. SDG5) and policies have been gearing towards attaining this objective and its subsequent effect on macroeconomic outcome. Equally, the demonstrated trend of infrastructures in Africa in terms of stocks and future need is unique compared to the rest of the world. The objective of this study is therefore to empirically examine the effect of women's political inclusion on infrastructural development in Africa. The results through the system GMM and Quantile Regression techniques show that women's political inclusion enhances infrastructural development in Africa. The result is robust across different measures of infrastructures and political inclusion. Besides, the positive relationship is maintained across income groups, levels of political stability and export structure. However, the effect is non-significant in countries with infrastructural scores around the extreme quantiles. The results of the study recommend African policymakers to prioritise the inclusion of women in the political agenda as one of the strategies towards the development of infrastructures. This could come through the putting in place of laws that favour women's participation in politics. Moreover, the countries should ratify international conventions that favour gender inclusion.

Key Words: Infrastructures, Women's political empowerment, Africa

1. Introduction

Since the adoption of the millennium development goals (MDGs) in the early 2000 and the adoption of the post-2015 sustainable development goals (SDGs), the quest for gender inclusion has gained recognition in policy debates towards development. To be precise, the need for gender inclusion was highlighted in SDG 5 as vital for economic development. This was especially established by Duflo (2012) who in her broad essay on gender inclusion argues that women empowerment is imperative for economic development and that gender equality for its own sake may be needed to bring about equality between men and women. The author further claims that women empowerment could influence economic development through increased work opportunities, reduced time burdens, improvements in health and education, and women's rights. Women have further been argued to be architects of sustainable development (Achuo *et al.*, 2022; Oparaocha & Dutta, 2011). Equally, in the presence of high economic freedom, women empowerment has been found to be vital for industrialisation (Nchofoung et al., 2021 a). At the institutional level, there is empirical evidence that greater female political participation improves the quality of institutions by reducing corruption and enhancing democracy (see Hessami & da Fonseca, 2020; Nchofoung *et al.*, 2021 b; Ngouhouo and Njoya, 2020). At the same time, better quality of institutions enhances infrastructural development within the economy (Kengdo *et al.*, 2020).

Infrastructural development is a prerequisite for an inclusive economic development (Nchofoung *et al.*, 2022). Infrastructures facilitate both internal and foreign trade, enhance communication and expand the productive capacity of an economy (Albala-Bertrand & Mamatzakis, 2014). In the midst of this multifaceted importance of infrastructures on the economy, the level of infrastructural development in Africa is still dismal though progress is being made (Kengdo *et al.*, 2020; Nchofoung & Asongu, 2022; Nchofoung *et al.*, 2022). In view of the underlined level of infrastructure in Africa, the African Development Bank data on infrastructures established that, by 2020, only 8 of all the 54 African countries had infrastructural development scores above 50. In this, Seychelles was the best performing country (96.73) while Somalia (4.53) was the least performing country. In fact, 35 of these countries (more than 60%) had scores within the first quantile while only 5 countries (less than 1%) had scores within the fourth quantile.

With this deplorable level of infrastructures in the continent, very few studies have attempted to explain the underpinning factors of infrastructural development, especially, in Africa. Among the few existing studies, some argue of the level of external debt as a driver of infrastructural development (Kengdo *et al*., 2020), others argue that the infrastructural stock in an economy depends on the one hand, on how capital investment is financed to meet the government's budget constraint and on the other hand, on the domestic financial depth and links to the rest of the world through trade and foreign investment (Cerra *et al*., 2017). Equally, Dao (2008) has argued that the infrastructural development of developing countries largely depends on wages, public spending on education and health, and on public savings. The latter study highlights determinants that are largely dependent on the political setup and governance in place. Kengdo *et al*. (2020) supported this claim by positing the importance of governance in the management of public debt for infrastructural development in Africa. However, an emerging strand of literature argues that governance is best when there is gender inclusion (Nchofoung *et al*., 2021b; Ngouhouo & Njoya, 2020). Curiously, no study to the best of knowledge has established the effect of gender inclusion on infrastructural development. The objective of this study is therefore to empirically examine the effect of women political inclusion on infrastructural development in Africa.

The study focuses on Africa for at least two reasons. Firstly, the demonstrated trend of infrastructures in Africa in terms of stocks and future need is unique compared to the rest of the world. In essence, according to the World Bank classification on infrastructures performance around the globe, while European countries like Germany occupied the top spots, majority of African countries are in the last quarter of the classification with Guinea, Guinea-Bissau and Somalia among the last four countries in the classification (World Bank, 2020). To overcome this deficit in infrastructures, the African Development Bank put in place the program for infrastructural development in Africa with short, medium and long term objectives for meeting the infrastructural needs of the continent by 2030. Secondly, the political representation of women in Africa is still wanting and needs policy attention, with only 25% of women in National parliaments (Nchofoung *et al*., 2021a, b). At the same time efforts are being made in the continent to overturn the situation. For instance, almost all African countries in the continent have ratified the Convention on the Elimination of All Forms of discrimination against Women; more than half have ratified the African Union's Protocol on the Rights of Women in Africa (Nchofoung *et al*., 2021a). Also, in the African Union agenda 2063 for Africa, gender inclusion

in all aspects of life is included as a priority target. In this regard, this study seeks to answer the following question: What is the effect of women's political implication on infrastructural development in Africa?

The study contributes to literature in at least three aspects. Firstly, the literature on the determinants of infrastructural development is still highly under-developed especially at the macroeconomic level. This study therefore contributes in shading light on this field of research that is inevitable in the sustainable development drive of building resilient infrastructures. Secondly, this is the pioneer study on the effect of gender inclusion on infrastructural development. This is of utmost importance given the sustainable development drive on gender inclusion, it is necessary to evaluate a situation whereby we arrive at a scenario of 100% gender balance or even women representing more in the political sphere, if this will be healthy on the economy's infrastructures. Thirdly, the study examines the robustness across the level of political stability, income level and export structure. This is important given that environments that are politically-unstable are associated with less investment in infrastructural development owing to *inter alia*, destruction of infrastructure as a direct result of political instability and less investment in the development of infrastructure from firms and the government given the bleak macroeconomic outlet linked to destruction and fear of destruction of attendant infrastructure. . Besides, rich countries have enough resources required to investment in infrastructures than poor countries. Away from this introductory part, section 2 presents a succinct literature review, section 3 puts forth the econometric strategy, section 4 presents the results and discussions while section 5 concludes with policy implications.

2. Review of literature

This section starts with the presentation of the theory of gender inclusion and economic development, followed by the empirical literature which starts with the determinants of infrastructural development and ends with the effect of gender inclusion on the economy.

On the theoretical front, the theory of economic modernity argues that economic development has resulted to increase in democracy and social choice. In this respect, the theory posits that traditional societies will prosper economically as they develop more modern practices. The theory suggests that internal forces are sources of economic development (Jenkins & Scanlan, 2001; Shrum, 2000). These internal forces include formal education, market based

economy, democracy and circular political structures. From this line of research, the empowerment theory emerged which involves among others, how people think about their ability to influence social and political systems and the actions they take to concretize their thoughts (Perkins & Zimmerman, 1995; Scheyvens, 1999; Zimmerman *et al*., 1992). According to Scheyvens (1999) political empowerment therefore involves the inclusion of all economic agents, ethnicity, social status and gender in the political process and the participation of all these groups in the development process. Scheyvens (1999) therefore argues in his empowerment essay for the inclusion of women in every development process. Duflo (2012) in her broad essay concluded that in as much as economic development is necessary for gender inclusion, gender inclusion is equally necessary for economic development though the relationship is too weak to be self-sustaining.

Looking at the empirical literature, the first strand of debate focuses on the determinants of infrastructural development. In this regard, several macroeconomic covariates have been established as determinants of infrastructures. Kengdo *et al*. (2020) argue that external debts stock greatly explain the level of infrastructural development in Africa, with the effect being negative and non-linear. In this respect, above an established sustainable debt threshold, the effect becomes negative meanwhile the effect is enhancing below this threshold. The authors further established that foreign aid, trade openness and institutional quality as determinants of infrastructural development in Africa. Also, Cerra *et al*. (2017) posit that both public financing and private sector participation help in the improvement of the stocks of infrastructures especially for the case of Latin America and the Caribbean. The authors however conclude that this relationship depends on the level of financial development and globalisation. Besides, Dao (2008) argues that for developing economies, the level of infrastructures highly depend on government spending on pensions, health and education. Equally, he argues that public savings and public service wage greatly explain variations in the stock of infrastructures. On his part, Kim (2002) argues that the consumer price inflation and economic growth are the key macroeconomic aggregates that explain the level of transport infrastructures. Moreover, one key variable that established divided views has been on the ability of foreign aid to improve on the stocks on infrastructures. Donaubauer and Nunnenkamp (2016) argue that aid for infrastructure is ineffective in improving the stock of infrastructure in recipient countries, an assessment that was supported by the work of Kengdo *et* al. (2020). Equally, Olaoye *et al*. (2021) posit that foreign financial inflows notably, foreign debt, foreign aid and foreign direct investments have

substituted government spending on infrastructures in the Economic Community of West African States (ECOWAS) region mostly attributed to poor institutional setup in this region which has contributed to deterring economic growth. Anyaduba and Aronmwan (2015) rather argue of the importance of fiscal policy in infrastructural development, positing that tertiary education and company income taxes matter a lot for the development of infrastructures in Nigeria while value added taxes do not.

On the second strand of empirical literature, several empirical evidences exist on the effect of women empowerment on macroeconomic outcomes. At the institutional level, there is empirical evidence that greater female political participation improves the quality of institutions by reducing corruption and enhancing democracy (Hessami & da Fonseca, 2020; Nchofoung et al., 2021 b; Ngouhouo & Njoya, 2020). In this respect therefore, the authors argue that women are less adverse to risk taking and are segacious than men in decision making, thereby reducing corruption. Asongu *et al*. (2021) argue that for the African case, gender inclusion matters for tax revenue mobilisation. In this case, female employment in industry enhances non-resource taxes while the net effect on total tax revenue is negative. Besides, women empowerment leads to better health status and food security (Ross *et al*., 2015; Yaya *et al*., 2020). Women political inclusion leads to industrial development in an economy with high levels of economic freedom and high female economic participation though the relationship is negative when both economic freedom and female economic inclusion are low (Nchofoung *et al*., 2021a). Farther, Achuo *et al*. (2022) argue that women socio-economic inclusion is environmental enhancing and that economic growth and foreign direct investments play a vital role in the enhancement of this relationship. Moreover, Tadadjeu *et al*. (2021) establish that women political empowerment leads to increase in public health expenditure in Africa.

The highlighted literature presents on the one hand, the effect of gender inclusion on the economy and on the other, the determinants of infrastructures. No study from extant literature has verified the effect of political inclusion on the level of infrastructural development. This study therefore fills this research gap.

3. Empirical methodology

3.1.Data and scope of study

The data for this study is collected from 50[1] African countries between the 2003-2020 periods. The choice of the study period and countries considered are principally based on the availability of data on infrastructural development and women political inclusion. The data are collected from several sources: the African Development Bank for the variables on infrastructures, the Varieties of democracy (V-DEM) for the variables on political inclusion and democracy and the World Development indicators of the World Bank for the rest of the variables.

Dependent variable

The dependent variable is the infrastructural development index (AIDI). It captures the infrastructural stock of the country available to meet present and future development needs of the country (Nchofoung *et al*., 2022). It is a composite index that englobes the transport composite index (transport), the information and communication infrastructures composite index (ICT), the electricity infrastructures composite index (electricity) and the water and sanitation infrastructures composite index (WSS). These sub-indexes are therefore further integrated into the regression framework for robustness and sectoral infrastructural sensitivity. Similar approaches have been used in literature (Kengdo *et al*., 2020; Nchofoung *et al*., 2022; Nchofoung & Asongu, 2022).

Independent variable of interest

The independent variable of interest used in the present study is the women political empowerment index. This is the V-Dem women's political empowerment index of Sundström *et al*. (2017) who approach the political empowerment of women as enabling the capacity building of women, leading to greater choice, agency, and participation in societal decision-making. The

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[1] Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Dem. Rep., Congo, Rep., Côte d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Tanzania (United Republic of), Togo, Tunisia, Uganda, Zambia, Zimbabwe

index is a composite indicator of women's political participation, women's civil liberty, and women's civil society participation. This index has been used in recent empirical studies (Nchofoung *et al*., 2017 a, b; Tadadjeu *et al*., 2021). This index is advantageous compared to other indexes in that it covers a broader time frame and is explicit. The scale of the indicator together with its sub-indexes is from 0-1, with zero indicating the absence of women empowerment and 1 representing the ideal situation of empowerment. The index is expected to have a positive effect on infrastructure in accordance with the study of Tadadjeu *et al*. (2021) who argue that women's political empowerment enhances public expenditures. These expenditures could therefore come through public infrastructural development.

Control variables

The first control variable used in this study is external debt (%GNP). This is in accordance with the study of Kengdo *et al*. (2020) who argue that external debt has a non-linear effect on infrastructures. This variable can therefore be positive or negative depending on the sustainability threshold. The next control variable is foreign direct investment inflows (%GDP), which is expected to have a negative sign in accordance with the study of Olaoye et al. (2021). Foreign aid captured by net official development assistance per capita is expected to have a negative sign following the same study. Based on the study of Kim (2002), per capita growth is expected to have a positive sign as it is equally used as a control variable. Total natural resources rents (%GDP) is used in the study and the sign is expected to be positive in line with the study of Kengdo *et al*. (2020). The last but not the least variable used in the model is democracy which is expected to have a positive sign in accordance with the study of Kendgo *et al*. (20200. Tables 1 and 2 present the summary statistics and the correlation matrix respectively.

Table 1. Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
AIDI	900	21.565	19.042	.369	96.732
Women empowerment index	900	.68	.162	.164	.895
Women civil liberty	900	.629	.204	.025	.922
Women civil society participation	900	.628	.184	.062	.896
Women political participation	900	.797	.188	.184	1
GDP per capita (log)	881	7.256	.988	5.555	9.707
external Debt stock (log)	820	3.586	.777	.937	6.414
Foreign aid	856	7.836	8.908	-.251	92.141
Natural resources rent	839	12.044	12.133	.001	67.918
Foreign direct investment	890	4.71	8.158	-11.199	103.337
Transport infrastructure index	900	10.674	12.639	0	58.756
Electricity infrastructure index	898	10.022	18.204	0	100
ICT infrastructures index	900	7.763	11.603	0	71.813
Water and sanitation infrastructures	900	51.741	22.486	0	99.793

Source: authors' computation

Table 2. Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) AIDI	1.000													
(2) women empowerment	0.189	1.000												
(3) women civil liberty	0.252	0.869	1.000											
(4) women civil society participation	0.122	0.871	0.724	1.000										
(5) women political participation	0.096	0.786	0.457	0.514	1.000									
(6) GDP per capita	0.549	0.098	0.261	0.061	-0.081	1.000								
(7) External Debt	-0.035	-0.058	-0.081	-0.149	0.072	-0.122	1.000							
(8) Foreign aid	-0.244	0.058	-0.060	0.067	0.144	-0.558	0.342	1.000						
(9) Natural resource	-0.202	-0.369	-0.389	-0.289	-0.243	-0.056	-0.024	0.095	1.000					
(10)Foreign aid	0.027	0.027	0.045	0.016	0.004	-0.070	0.131	0.298	0.170	1.000				
(11) Transport infrastructure	0.780	0.099	0.203	0.042	-0.008	0.305	-0.076	-0.080	-0.163	0.166	1.000			
(12) Electricity infrastructure	0.776	0.224	0.207	0.176	0.184	0.457	-0.014	-0.192	-0.067	0.093	0.588	1.000		
(13) ICT infrastructure	0.651	0.141	0.160	0.128	0.070	0.394	0.001	-0.217	-0.196	-0.082	0.258	0.325	1.000	
(14)Water and sanitation infrastructure	0.832	0.166	0.248	0.053	0.100	0.578	-0.059	-0.250	-0.172	-0.003	0.681	0.593	0.438	1.000

Source: Authors' computation

Table 1 shows that the dependent variable (AIDI) ranges between 0.369 and 96.732 with a high standard deviation value of 19.042 and a mean value of 21.565, though the sub-indexes have values in some years as low as zero, with a scoring of 100, the electricity infrastructure is at optimal score in some years in some countries. As for the women empowerment index, the value ranges between 0.164 and 0.895 with a standard deviation value of 0.162 with women political empowerment index scoring the deal in some years in some countries with a value of 1. This is the case of Rwanda with one of the best political inclusive systems in the world. In Table 2, the independent variables have very low correlation coefficients within themselves, this permits these variables to be used in the same model.

3.2. Model specification and regression methodology

Based on the study of Kengdo et al. (2020), the following empirical model is specified.

$$INFRA_{it} = \beta_0 + \beta_1 GENDER_{it} + \beta_j X_{it} + \upsilon_i + \gamma_+ + \varepsilon_{it} \qquad (1)$$

Where INFRA is the infrastructural development index of country i, at time, t. GENDER is the political inclusion index, X is the vector of control variables, υ is the country specific effect, γ is time fixed effect, ε is the error term and β is the coefficient of explanatory variables.

The regression is done at first place through the system GMM method and at second place through the quantile regression method. Several factors motivate the choice of GMM as a regression methodology. Firstly, the first period lag of dependent variable is highly correlated with its value at level, there is therefore the need for the inclusion of this lag value as an explanatory variable in accordance with attendant literature (Tchamyou, 2019; Nchofoung *et al*., 2022; Nchofoung & Asongu, 2022). Secondly, the individual dimension (50 countries) is greater than the time dimension (18 years), which satisfies the condition of Roodman (2009) for the use of GMM as a regression methodology. Thirdly, the GMM regression methodology resolves possible endogeneity resulting from double causality and the Nickell (1981) bias due to an omission of explanatory variables in the model. Besides, the method corrects for cross-sectional dependence that results from movement of macroeconomic variables between countries as a result of globalisation (Nchofoung & Asongu, 2022; Nchofoung et al., 2022; Tchamyou, 2019). The method can therefore be specified at level and first difference as in (2) and (3), with the variables all defined as above.

$$INFRA_{it} = \beta_0 + \beta_1 INFRA_{i(t-\tau)} + \beta_2 GENDER_{it} + \sum_{h=1}^{k} \delta_h X_{h,i(t-\tau)} + \upsilon_t + \gamma_i + \varepsilon_{it} \qquad (2)$$

$$INFRA_{it} - INFRA_{i(t-\tau)}$$
$$= \beta_1 \big(INFRA_{i(t-\tau)} - INFRA_{i(t-2\tau)}\big) + \beta_2 \big(GENDER_{it} - GENDER_{i(t-\tau)}\big) + \sum_{h=1}^{k} \delta_h \big(X_{h,i(t-\tau)}$$
$$- X_{h,i(t-2\tau)}\big) \, (\upsilon_t - \upsilon_{t-\tau}) + \varepsilon_{i(t-\tau)} \qquad (3)$$

The adoption of the GMM framework methodology however encounters several challenges. These are the problems of identification, restriction and simultaneity. In this regard, all explanatory variables are suspected as endogenous and treated as such in accordance with attendant literature on the subject (Nchofoung & Asongu, 2022; Nchofoung et al., 2022; Tchamyou, 2019).

Equally, high standard deviation values of our variables of interest show that the variables are very much dispersed from the mean and drawing a conclusion with a regression method that takes in to account the mean value may be misleading. The Quantile regression methodology is thus further used to see the outcome of the results across different quantiles of the distribution and takes into account unobserved heterogeneity and heterogeneous covariate effect (Canay, 2011). Section 4 presents and discusses the results from these regression methods.

4. Results and discussion

This section presents at first place the results of the system GMM regression with robustness across alternative measures of infrastructures and political inclusion. Secondly the quantile regression methodology is presented while the section concludes with the sensitivity of the results across income groups, level of political stability, and export structures.

Table 3. Results and discussions

VARIABLES	(1) AIDI	(2) Transport	(3) Electricity	(4) ICT	(5) WSS	(6)	(7)	(8)
				Dependent variable:				
	AIDI	Transport	Electricity	ICT	WSS	AIDI	AIDI	AIDI
AIDI (L)	0.251***					0.250***	0.257***	0.888***
	(0.0260)					(0.0290)	(0.0238)	(0.0762)
Women empowerment	26.77*	47.90**	18.13**	6.515	45.64**			
	(14.79)	(21.90)	(7.560)	(10.28)	(17.26)			
GDP per capita	-0.0886	6.203	0.659	-9.890*	13.60	-0.546	0.788	-1.590
	(3.612)	(5.924)	(1.738)	(5.322)	(8.859)	(3.629)	(5.012)	(7.046)
External Debt	0.909	0.195	0.863	1.704*	-0.0778	0.778	0.715	1.733**
	(0.666)	(0.762)	(0.519)	(0.947)	(0.899)	(0.741)	(0.726)	(0.711)
Foreign aid	-0.199***	-0.162***	-0.216***	0.103**	-0.156***	-0.174***	-0.205***	-0.132***
	(0.0279)	(0.0446)	(0.0215)	(0.0396)	(0.0345)	(0.0251)	(0.0314)	(0.0450)
Resources rents	0.141*	0.117	0.177***	0.103	0.00740	0.120*	0.122**	0.106
	(0.0724)	(0.0911)	(0.0380)	(0.0805)	(0.0884)	(0.0696)	(0.0593)	(0.0829)
Foreign direct investment	0.106***	0.228***	0.0924***	0.0140	0.0618	0.113***	0.114***	0.158***
	(0.0230)	(0.0301)	(0.0153)	(0.0255)	(0.0416)	(0.0197)	(0.0285)	(0.0315)
Democracy	1.812	-11.07	-3.142	-19.87	-14.13	4.217	0.136	2.472
	(5.537)	(10.49)	(3.327)	(15.00)	(12.00)	(5.512)	(5.866)	(12.64)
Transport (L)		1.022***						
		(0.0655)						
Electricity (L)			0.207***					
			(0.0119)					
ICT (L)				0.674***				
				(0.0360)				
WSS(L)					0.913***			
					(0.0390)			
Women civil						14.79*		
						(8.607)		
Women civil society part							26.79***	
							(9.920)	
Women parliamentary part								10.05
								(7.389)
Constant	-7.201	-76.94*	-14.24	69.96*	-119.4*	5.685	-12.13	-2.114
	(25.27)	(44.58)	(12.27)	(38.26)	(66.81)	(24.65)	(37.07)	(48.47)
Period Fixed effect	yes	yes	yes	yes	yes	yes	yes	yes
Observations	719	719	717	719	719	719	719	719
Number of countries	46	46	46	46	46	46	46	46
Prop>AR1	0.00531	0.00353	0.0369	0.000437	1.89e-05	0.00516	0.00208	0.00321
Prop>AR1	0.391	0.872	0.314	0.227	0.0739	0.678	0.644	0.913
Instrument	40	32	40	32	40	40	40	32
Prop>Hansen	0.272	0.557	0.107	0.127	0.153	0.298	0.245	0.606
Fisher	137.0***	256.9***	218.5***	125.6***	463.3***	71.77***	40.41***	151.9***

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' computation

13

The results on Table 3 show that political inclusion has a positive effect on infrastructural development in Africa. This result is robust across alternative measures of infrastructures and women political inclusion measures used. The results are in line with that of Tadadjeu *et al*. (2021) who argue that women political inclusion enhances public expenditure in Africa. Public expenditures could come in the form of building infrastructure, leading to increase in the infrastructural stocks required to meet development needs. Every women as a politician would want to leave her mark in development and this could come through the putting in place of infrastructures that she will be remembered for. One of the significant concerns in the lag of infrastructural development in Africa has been poor governance especially increased corruption. Studies have shown that women political empowerment reduces corruption as women are more prudent in public decision making (Dirienzo & Das, 2019). A reduction in corruption especially in the realisation of public infrastructures leads to increase in the infrastructural stock within the economy. Women's political participation equally leads to a gender balance in the workforce leading to increase in economic growth. Besides, Goltz *et al*. (2015) argue that women's political empowerment enhances women entrepreneurship through removing constraints on the economic behaviour of women which all contribute in enhancing economic growth. Extra income from increase in growth can be used in the development of infrastructures.

The negative effect of foreign aid on infrastructure established in Table 3 is in accordance with the work of Olaoye et al. (2021) who argue for a negative effect of foreign aid on infrastructures in Africa. This is mostly attributed to the fact that aid for development comes to replace public spending in Africa mostly attributed with poor institutional set-up. Ngouhouo *et al*. (2021) established that Africa has one of the worst institutions in the World and therefore development aid especially for infrastructures that is channelled through government agencies has always ended in private pockets than actually being used for economic development. However, the positive effect of foreign direct investment contradicts the study of Olaoye *et al*. (2021). Foreign investors most often establish their investments after constructing the required infrastructures necessary for the take up of such investments. For instance most telecommunication companies across Africa are foreign owned including Orange and MTN (except in South Africa). Telecommunication infrastructures have been set up by these companies for effective communication operations.

The lag of the dependent variables positive enhances inclusive infrastructural development. The initial level of infrastructural development therefore strongly determines its outcome in the next period. This put into the evidence the importance of initial conditions for infrastructure development. Initial conditions are however a necessary and not a sufficient condition for economic development (Bolt, 2010; Lee & Jeong, 2006). There is thus the need to maintain the growth path of infrastructures towards an increasing trajectory given that a drop in the infrastructural development in a period will engender a decrease into the next period with very high magnitude. These initial conditions to be met within the framework of this study include sufficient infrastructural development to meet the sanitation, health, electricity, communication and transportation needs. Table 4 presents the discussed results across different quantiles

Table 4. Quantile regression

	(1)	(2)	(3)	(4)	(5)
	Dependent variable: infrastructural development index				
VARIABLES	q15	q25	q50	q75	q90
Women empowerment index	4.422	8.102***	12.83***	12.01**	-4.193
	(3.440)	(3.081)	(2.872)	(4.652)	(14.58)
GDP per capita	4.430***	5.488***	8.539***	15.75***	24.33***
	(0.634)	(0.701)	(0.507)	(1.383)	(2.271)
External Debt	1.230*	0.286	0.788	0.241	2.206
	(0.669)	(0.467)	(0.631)	(1.032)	(1.625)
Foreign aid	0.0362	0.0170	0.125	0.527***	0.946***
	(0.0268)	(0.0324)	(0.0831)	(0.121)	(0.240)
Resources rents	-0.0733*	-0.102***	-0.189***	-0.213***	-0.637***
	(0.0374)	(0.0343)	(0.0378)	(0.0804)	(0.196)
Foreign direct investment	-0.0358	0.0460	0.0760	0.269*	0.328**
	(0.0509)	(0.0477)	(0.120)	(0.139)	(0.156)
Democracy	0.703	1.109	0.979	-10.74	-26.94**
	(5.882)	(5.094)	(4.681)	(7.287)	(12.20)
Constant	-24.57***	-29.49***	-52.88***	-96.81***	-131.6***
	(4.167)	(5.351)	(4.509)	(10.35)	(13.12)
Period Fixed effect	yes	yes	yes	yes	yes
Observations	764	764	764	764	764
reps	100	100	100	100	100
Pseudo R-Squared	0.1335	0.1642	0.2207	0.2852	0.3526

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

Source: Authors' computation

Table 4 shows that the positive effect of women empowerment on infrastructures is maintained though the effect is only feasible from the 25th to the 75th quantiles. The effect is non-

significant at the 15th quantile and negative and non-significant at the 90th quantile. Therefore, one can conclude that countries with infrastructural scores around the extreme scores will not see any significant effect of women political inclusion on their infrastructural development. Table 5 presents these results across different levels of political stability, income group and export structures.

Table 5. Sensitivity across different clusters

	(1)	(2)	(3)	(4)	(5)	(6)
	Stable countries	Unstable countries	Middle income countries	Low income countries	Non-fuel exporters	Fuel exporters
VARIABLES	Dependent variable: infrastructural development index					
Women empowerment index	14.11*	16.01***	12.83	11.44***	15.66***	25.54
	(7.865)	(6.166)	(8.718)	(2.870)	(3.931)	(17.21)
GDP per capita	8.467***	12.18***	8.891***	2.511	10.45***	8.106**
	(0.796)	(1.116)	(1.643)	(1.762)	(0.860)	(3.116)
External Debt	-0.374	1.657**	1.453	1.429**	1.372**	-7.237***
	(1.206)	(0.766)	(2.116)	(0.635)	(0.644)	(2.568)
Foreign aid	0.0263	0.225**	0.0162	0.0325	0.0298	0.949
	(0.122)	(0.0888)	(0.221)	(0.0902)	(0.0889)	(0.637)
Resources rents	-0.257***	0.0663	-0.226***	-0.117**	0.0487	0.102
	(0.0914)	(0.0644)	(0.0817)	(0.0458)	(0.0641)	(0.170)
Foreign direct investment	0.396***	-0.223	0.0839	0.0556	-0.0326	0.370**
	(0.141)	(0.150)	(0.137)	(0.187)	(0.103)	(0.144)
democracy	-0.957	1.075	6.271	-3.593	-4.429	-18.23
	(7.738)	(9.051)	(12.75)	(5.393)	(4.896)	(22.05)
Constant	-48.96***	-84.15***	-57.08***	-14.90	-68.46***	-34.91**
	(8.712)	(8.540)	(14.91)	(11.14)	(7.638)	(16.75)
Period fixed effect	yes	yes	yes	yes	yes	yes
Observations	415	349	398	366	628	136
Reps	100	100	100	100	100	100
Pesudo R-Squared	0.1888	0.3431	0.1801	0.1270	0.2417	0.3567

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

Source: Authors' computation

Table 5 shows that the positive effect of women political inclusion is robust across different levels of political stability, income groups and export structures, though the effect is insignificant in fuel-exporting countries and middle income countries. The magnitude of the effect is larger in unstable countries than in stable countries and equally greater in middle income countries than in low income countries.

5. Conclusion, Policy recommendations and Caveats

Since the adoption of the MDGs in the early 2000 and the implementation of the post-2015 SDGs, the quest for gender inclusion has gained recognition in policy debates towards surrounding economic development. To be precise, the need for gender inclusion is apparent in SDG5. Equally, the demonstrated trend of infrastructures in Africa in terms of stocks and future need is unique compared to the rest of the world. In essence, according to the World Bank's classification on infrastructures performance around the globe, while European countries like Germany occupied the top spots, majority of African countries are in the last quarter of the classification with Guinea, Guinea-Bissau and Somalia among the last-four countries in the classification(World Bank, 2020). The objective of this study was therefore to empirically examine the effect of women political inclusion on infrastructural development in Africa. The results through the system GMM and Quantile Regression techniques show that women political inclusion enhances infrastructural development in Africa. The result was robust across different measures of infrastructures and political inclusion. Besides, the positive relationship was maintained across income groups, levels of political stability and export structures.

The results of the study recommend to African policy makers to enhance the inclusion of women in the political agenda as one of the strategies towards the development of infrastructures. This could come through the putting in place of laws that favour women participation in politics. Equally, the sampled countries should ratify international conventions that favour gender inclusion. In developing these strategies, countries at extreme infrastructural values should be cautious. While focusing on gender inclusion will not witness any significant effect on infrastructures in countries with infrastructural scores around the 15th quantile, other complementary policies should be of preference in these countries. This goes the same for countries around the 90th percentile. It follows that policies designed to improve female political participation in order to achieve infrastructural development should be contingent on initial levels of infrastructural development and tailored differently across countries with the least and highest initial levels of infrastructural development.

The study on the subject is not however conclusive, the study has failed to integrated the educational background and colonial history of these countries. Besides, grouping a panel of 50 countries may not always take into account country specificities. There is therefore the need for

country specific studies and the integration of the colonial history of these countries in future studies. Besides, transmission mechanisms could be considered in future studies.

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