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Innovation and Path to Inclusiveness in Developing Countries

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ABSTRACT

This study examines the effect of innovation on inclusive growth in 63 developing countries and employs System Generalized Method of Moments (GMM) estimation techniques. The study used the global innovation index to measure innovation. In addition, we construct an index of inclusive growth. Further, due to the complex nature of inclusive growth, using a single index may not provide the full picture. So, for substantial empirical support, the study uses a set of dimensions of inclusive growth separately. The empirical results show a positive relationship between the measures of innovation with inclusive growth. Further, the study also constructs indifference curves for selected developing economies to measure the inclusiveness in growth. Finally, it is suggested that developing economies should put in policies to promote innovation activities that include poor segments of society to improve the impact of innovation on inclusive growth.

Keywords: Innovation, Inclusive Growth, Global Innovation Index
JEL Classifications: O31, O33, O15, I32

1. INTRODUCTION

Although the efforts of the international community to eradicate Poverty and promote income equality, the policy has failed to work fully in developing countries. According to a report by the International Monetary Fund (IMF, 2020), the expected fall in growth and the current growth rate both threaten to worsen income inequality and increase poverty, especially in developing countries. This has led to the adoption of anti-poverty initiatives by the governments of developing nations. However, because economic growth has not been equitable, these initiatives have fallen short of the desired outcome (World Bank, 2019). Due to this, the focus of policy has shifted to promoting inclusive growth. This strategy is founded on the idea that inclusive growth is necessary to end poverty (Mlachila et al., 2017). Governments in developing and emerging economies have prioritized achieving inclusive growth and improved income distribution in their policies (Fernández and Villar, 2016; World Bank, 2019). This strategic focus aims to promote economic prosperity that benefits all segments of society and fosters social equity and sustainable development. As a result, once the Sustainable Development Goals (SDGs) were implemented, the UN enabled previously unheard-of efforts to achieve equitable growth on a global scale.

Inclusive growth and pro-poor growth are related terms in absolute definition but not the same in relative terms. In absolute terms, Pro-poor growth means economic growth benefits the poor more than other populations (Ravallion and Chen, 2003; Aslam et al., 2021). In relative terms, the growth will only be considered pro-poor if and if it increases the income of the poor more than the rich. Inclusive growth is an improved kind of pro-poor growth that focuses on increasing productivity creating new productive employment possibilities and effectively reduce poverty and inequality.

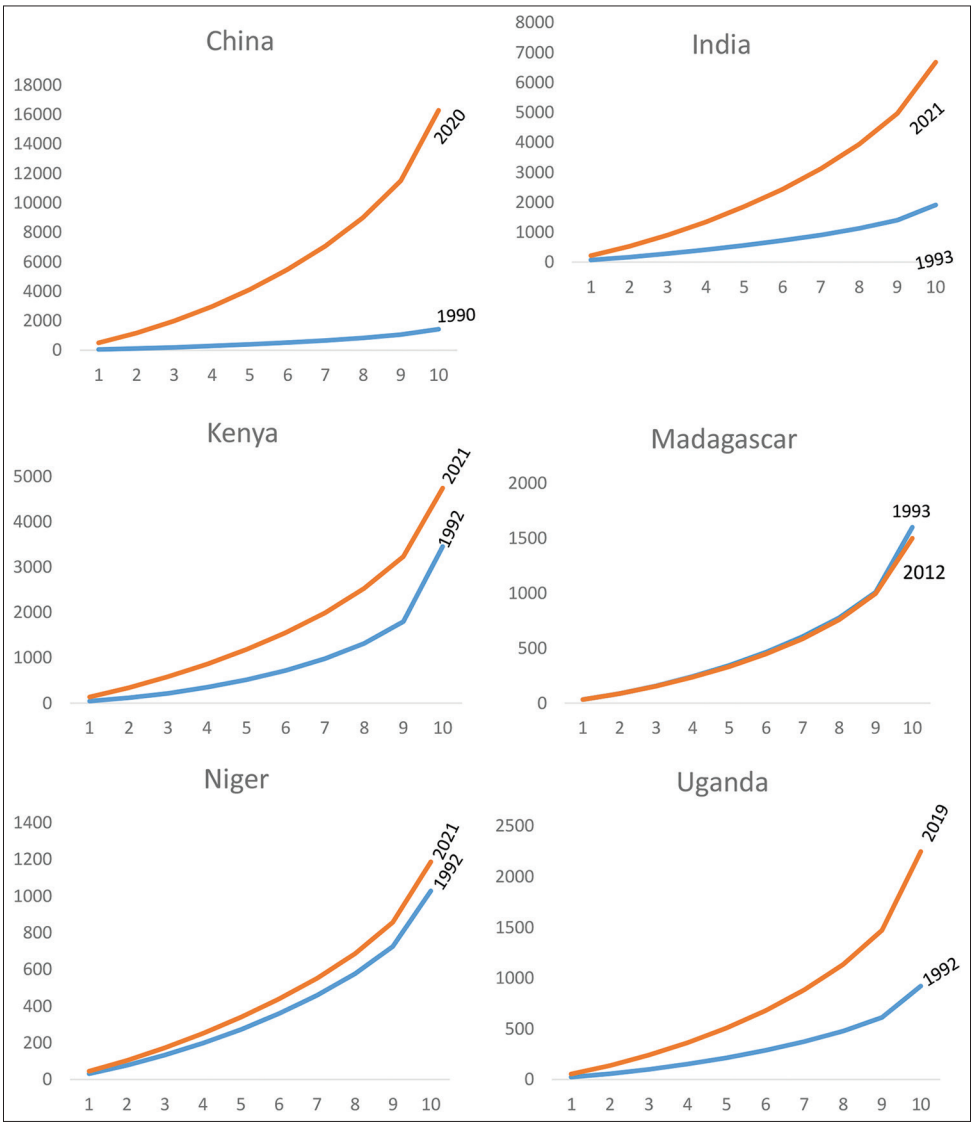
The economic growth that guarantees the improvement of the social well-being of the citizens is less observed in developing countries. This is because economic growth is not always sufficient. Growth to be equally beneficial and have a long-run impact needs to be sustained and inclusive. Inclusive growth requires economic expansions to be equal for all, reduce poverty, improve every sector equally, reduce income inequality, improve the standard of every citizen, and improve sectoral productivity (Kolawole, 2016). Growth itself does not guarantee poverty reduction, reduce inequality, or improve social well-being the relationship between growth, poverty reduction, and inequality is ambiguous in many literature (Samans et al., 2015).

The data presented in Figure 1 shows the average growth of development and GDP growth in low-income countries from 2013 to 2017. Interestingly, low-income countries experienced a positive average growth in GDP and development during this period. However, the trend in average inclusive growth for low-income countries was negative, as indicated by the World Economic Forum (WEF) Inclusive Development Index (2018). Figure 2 data reveals a negative association between growth and development with inclusive growth.

Moreover, Table 1 summarizes the five-year average trends in key economic indicators. The Net Income Gini coefficient measures income distribution after taxes and transfers, with 0 representing perfect equality and 100 indicating perfect inequality. The Wealth Gini coefficient assesses wealth distribution, where higher values signify greater inequality (1 means complete inequality, 0 means complete equality). The Poverty Rate reflects the percentage of people living on <$3.20 per day (2011 internatioHnal prices).

Notably, an uneven pattern of growth is observed. Bangladesh and Sri Lanka exhibit higher average 5-year GDP per capita and labor productivity growth rates than Pakistan, yet Pakistan shows better poverty reduction and income equality during the same period. Similarly, Nepal has lower GDP per capita and labor productivity growth than Iran but experiences the highest poverty reduction and income equality improvements over the same period.

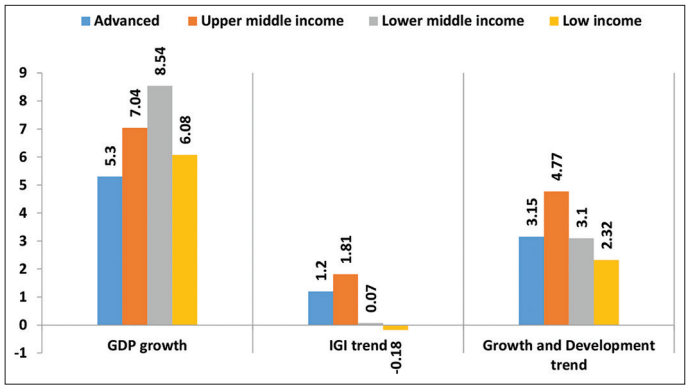
Figure 1: Indifference curves of selected developing countries



Source: Author's calculation using World Bank, PovcalNet database

Moreover, the measurement of inclusive growth has also been an issue and is still under consideration. The majority of empirical studies have used an aggregate monetary-based measurement (GDP per capita/GDP per capita PPP term) as a proxy for inclusive growth (Kolawole, 2016; Munir and Ullah, 2018). GDP has frequently been criticized for unilaterally capturing social development processes without accounting for their qualitative aspect, so undermining its usefulness as an indicator of economic success (Stiglitz 2021). Only a few literature are available for the measurement of inclusive growth (Anand et al., 2013; Mckinley, 2010; Ranieri and Ramos, 2013; UNCTAD, 2020). Even though there is still no standard by which to compare the feasibility of different measures of inclusive growth. Inclusive growth is a global concern and received a prominent place in the 2030 Agenda, specifically goals 5, 8, 10, and 16. The 2030 Agenda for Sustainable Development was endorsed by all United Nations, Member States to bring peace and prosperity. The Sustainable Development Goals (SDGs) are the most significant components of the Agenda. The SDG goals focus on eradicating poverty, reducing inequality, improving health and education, and boosting economic growth in a parallel way which means the growth must be sustainable, ecologically prudent, and inclusive. Recently, according to a report from the World Bank (2023), the global efforts to eradicate extreme poverty by 2030 is off track in many developing countries. Governments in developing and emerging economies are considered to achieve inclusive growth as a key policy goal to improve income distribution, decrease poverty, and address the issue of gender, health, and educational disparities (OECD, 2015; World Bank, 2019).

Figure 2: Growth, development, and inclusive growth last 5-year trend by income groups



Source: WEF Inclusive Development Report, (2018)

According to Cherif et al. (2023), encouraging innovation could decrease market power and increase business dynamism, both of which would be beneficial for inclusive growth generally. Importantly, innovation has been integrated into the SDGs framework and is recognized as a critical policy-making process. Innovation initiatives can directly contribute to progress in areas such as poverty, gender equality, access to health and education (UNDP, 2015). In addition to this, innovation improves efficiency (Sun et al., 2021), productivity (Aslam et al., 2021), and living conditions (Antipina et al., 2022). Very few studies have investigated the impact of innovation on inclusive growth (Oyinlola et al., 2021) and used GDP per capita to measure inclusive growth. In addition to this, the innovation and growth nexus are ambiguous and limited as well that a portion of the

Table 1: Performance of selected developing countries

Country/Indicator	Growth & Development			Inclusion		
	GDP per capita growth rate %	Labor productivity growth %	Employment trend %	Net income Gini trend	Poverty trend %	Wealth Gini trend
Pakistan	2.5	1.9	0.1	−0.2	−8.1	−11.2
Bangladesh	5.2	4.3	0.3	−0.1	−5.8	−6.7
Sri Lanka	4.4	4.8	−2.2	−0.4	−2.2	−1.5
Nepal	2.4	0.9	−0.8	−3.8	−24.6	2.6
India	5.6	5.4	−0.1	0.3	−9.6	1.7
Indonesia	4	3.5	0	1.3	−14.6	0.9
Iran	−1.6	−0.2	1.4	−2.5	2.5	0.5
Malaysia	3.3	2.4	1.3	−0.9	−0.3	0.5

Source: WEF, Inclusive development report

Table 2: Data description and sources

Variable	Description	Source	Year
Grow40	Annual growth rate in the average consumption or income per capita of the bottom 40 of the population	Authors calculation using WIID and PovcalNet database	2008-2020
GDM	GDP per person employed (constat 2021 PPP)	WDI, World Bank	2008-2020
HDI	Human development index	UNDP	2008-2020
GII	Gender inequality index	UNDP	2008-2020
CO_2	Carbon production	UNDP	2008-2020
Inclusive Growth index	Growth adjusted for equity.	Author construction using PovcalNet and WIID database	2008-2020
Innovation	Global innovation index	World intellectual property organization (WIPO)	2008-2020
GFCF	Gross Fixed capital formation (annual %)	World Bank	2008-2020
GS	Government final consumption expenditure (annual %)	World Bank	2008-2020
FDI	Inflows (% of GDP)	World Bank	2008-2020

literature has found a positive link between innovation and economic growth (Galindo and Méndez, 2014; Huňady and Orviská, 2014; Petrakis et al., 2015; Zhu et al., 2020), Bidirectional causality (Maradana et al., 2019), no relation (Genç and Atasoy, 2008; Inekwe, 2014; Tuna et al., 2015).

2. LITERATURE REVIEW

There is very limited or no literature available on inclusive growth and innovation nexus, however, a plethora of recent literature is available to find the indirect channel through which innovation affects inclusive growth.

Schumpeter coined the term "creative destruction" to link innovation and its impacts on the market and economy. Creative destruction occurs when innovation frees up outdated resources to be used in other ways that increase economic efficiency. For example, labor replaced by machine puts their labor into another enterprise which leads to increased productivity. In this way, innovations replace old industries and create new ones, leading to overall economic growth (Swedberg, 2008). Technological progress in the form of innovation, research & development expenditure, human capital accumulation, and the role of education are the main drivers of long-term economic growth (Aghion and Howitt, 1990; Lucas Jr., 1988; Mankiw et al., 2020; Nelson and Phelps, 1965; Romer, 1986; Romer, 1990).

The connection between innovation and growth policies to achieve inclusiveness is also complex and depends upon some other factors, such as market power and competition (Aghion et al., 2021). A rise in market concentration through innovations leads to productivity gain, and a large number of good-paying jobs, and supports broad-based growth through their contribution to export and spillovers (Schaltegger et al., 2016). However, innovation through market power and competition may also lead to inequalities as firms exit but at the same time, innovation in existing firms leads to the higher entrance as new firms adopt the technology (Aghion, 2016).

Dempere et al. (2023) used the global innovation index (GII) to measure innovation and check its impact on GDP, employment, and foreign direct investment (FDI) in a panel of 120 countries. The empirical findings of the study show that GII and GDP are positively related. However, the result also showed that innovation negatively affects self-employment but positively affects formal employment. Further, the study recommends that investments in innovation play a key and positive role in the growth-innovation nexus. Similarly, Autio et al. (2013) support the idea that the link between innovation and self-employment is multifaceted. In country-specific analysis, Wang and Xu (2022) show a positive link between innovation and economic growth in China. Rooj and Kaushik, (2023) in case of India. Law et al. (2020) in the case of Malaysia, and Rahman et al. (2023) in the case of Bangladesh.

Sarangi et al. (2022) scrutinized the relationship between innovation and economic growth in G20 countries over the period of 1961-2019. The results revealed a long-run bi-directional causality in a few countries while short-run bidirectional causality was found in most of the countries.

Hémous and Olsen (2022) build an endogenous growth model by incorporating automation (replacement of labor by machine) in the model and determine automation as an endogenous variable. The results show that automation innovation increases the wage of high-skill labor and possibly decreases the wage of low-skill labor. Further, they argued that automation innovation exacerbates income inequality by increasing the wage gap between high and low skill labors and also decrease the labor share in total national income.

Dzator et al. (2023) investigated the impact of innovation (ICT) on poverty reduction in 44 Sub-Saharan African (SSA) countries and employed two-step system GMM. The study used 2 different measures for poverty such as; youth and middle-aged poverty and total adult poverty. The findings indicate that ICT imports, and mobile/telephone penetration help in reducing poverty while, ICT export, broadband, and internet penetration increase poverty in SSA. Finally, the interaction of ICT variables with economic growth, access to credit, and inequality also shows that innovation worsens poverty in SSA through these variables as well. Similarly, Mushtaq and Bruneau (2019) using a panel of 62 countries also revealed that ICT-related technologies such as mobile subscriptions and Internet users significantly reduce poverty. However, according to Afzal et al. (2022), the impact of technological penetration on poverty can be negative and U-shaped as well depending upon the income level of the country. Additionally, they found a positive consistent association between technological penetration and income inequality in all income levels.

3. METHODOLOGY AND DATA

Based on the nature of the data and diagnostic tests performed the study used system generalized method of moment (GMM) estimators to estimate the models. To address the problem of endogeneity several approaches and methods can be used. But in the case of dynamic panel settings where N is greater than T, the generalized method of moment (GMM), particularly system GMM is most effective (Roodman, 2009). GMM uses lagged values as instruments and uses moment conditions to estimate parameters and control for unobserved heterogeneity. Differenced GMM developed by (Arellano and Bond, 1991) and system GMM developed by (Arellano and Bover, 1995). The system GMM estimator is preferred over the difference GMM for several reasons: it allows for more instruments, improves efficiency, handles unbalanced panels better, and retains fixed effects. These estimators are robust and do not rely on distributional assumptions like normality, making them flexible and suitable for various types of data. For detail (Greene, 2008; Piper, 2014; Roodman, 2009).

3.1. Model Specification

$$IGI_{it} = \beta_0 + \beta_1 INV_{it} + \beta_2 FDI_{it} + \beta_3 GS_{it} + \beta_4 FDI_{it} + \beta_7 CPI_{it} + \mu_{it}$$

Where subscript t and i represent the years and country respectively, $i = 1\ldots\ldots N$ and $t = 1\ldots\ldots T$.

IGI = inclusive growth, *INV* = Innovation, *FDI* = Foreign direct investment, *GS* = Government final consumption expenditure and *CPI* = Consumer price index.

3.2. Measurement of Inclusive Growth

(Ali and Son, 2007) introduced the idea of a generalized concentration curve, also known as a social mobility curve (SMC), denoted as *Sc*:

$$Sc \approx \left[y_1, \frac{y_1 + y_2}{2}, \ldots\ldots\ldots, \frac{y_1 + y_2 + \ldots y_n}{n} \right] \quad (1)$$

Where n is the number of persons in the population with incomes $y_1, y_2, y_3 \ldots\ldots y_n$, where y_1 is the poorest person and y_n the richest person.

To calculate the magnitude of income distribution (Anand et al., 2013) use a simple form of social mobility function to calculate the social mobility index from the area under the social mobility curve.

$$\bar{y}^* = \int_0^{100} \bar{y}_i di \quad (2)$$

When $\bar{y}^*$ is higher, it indicates higher income levels across the population. Conversely, if all individuals have equal income, $\bar{y}^*$ will match the mean income $\bar{y}$. However, if $\bar{y}^*$ is lower than $\bar{y}$ it suggests an unequal distribution of income.

(Ali and Son, 2007) proposed the income equity index (IEI):

$$\omega = \frac{\bar{y}^*}{\bar{y}_i} \quad (3)$$

Which ranges from 0 to 1. Where 1 indicates the perfect equal distribution and 0 indicates the perfect unequal distribution: by rearranging equation (3) we obtain

$$\bar{y}^* = \omega * \bar{y}_i \quad (4)$$

To obtain an inclusive growth equation, differentiate equation (4):

$$d\bar{y}^* = \omega * d\bar{y} + d\omega * \bar{y} \quad (5)$$

Where, $d\bar{y}^*$ is a change in inclusive growth, if $d\bar{y}^* > 0$ growth is considered inclusive and vice versa.

Rearrange equation (5)

$$\frac{d\bar{y}^*}{\bar{y}^*} = \frac{d\bar{y}}{\bar{y}} + \frac{d\omega}{\omega} \quad (6)$$

Equation (6) is the equation that combines GDP per capita growth and equity index growth into a unified measure of inclusive growth that can be compared over time. Inclusive growth can be attained by: (i) raising average income growth, (ii) increasing the income equity index growth, or (iii) a combination of both.

In addition to this, the study also used shared prosperity to measure inclusive growth which measures how growth is distributed among population and measure inclusiveness (World Bank, 2022). Shared prosperity is annualized change in income or consumption of bottom 40% income holder. Furthermore, the study employs the Human Development Index (HDI) as a proxy for inclusive growth, encompassing health, income, and education dimensions. GDP per person employed serves as an indicator of the employment dimension of inclusive growth, providing a robust measure. Additionally, CO_2 emissions and the Gender Inequality Index (GII) are utilized to gauge the environmental and gender dimensions of inclusive growth, respectively. Table 2 shows the data description and sources.

4. RESULTS AND DISCUSSION

Figure 1 illustrates the indifference curves of several developing countries, derived using the social mobility curve methodology (proposed by Ali and Son, 2007; Anand et al., 2013). The y-axis displays the cumulative average GDP per capita per population decile, while the x-axis represents population deciles ordered from 1 to 10.

The average income per decile is computed by multiplying the income share by the GDP per capita (PPP, constant 2017 international $) and then dividing by the population share. Different levels of inclusiveness in growth are evident among the selected countries. Despite overall economic growth over time, the magnitude of how inclusive this growth is varying. For instance, China's growth has benefitted all segments of the population, but the gains have been significantly greater for the top-income earners compared to the lower deciles. Conversely, in Kenya, the curvature of the indifference curves becomes flatter for the wealthiest 20%, indicating that income growth has favored the poorer segments more than the wealthy.

In India and Uganda, the inclusiveness in growth is more similar to that of China, where substantial growth has occurred but the advantages have been skewed towards higher-income individuals. In Niger, there is inclusiveness in growth, albeit at a slower pace compared to other countries, as evidenced by the modest shift in the indifference curve over time. Finally, in Madagascar, neither growth nor equity has significantly changed over time.

Table 3 presents the pairwise correlations among the independent variables. The correlation coefficients, all falling between −0.9 and 0.9, suggest there is no multicollinearity among the independent variables (Agyei and Idan, 2022).

4.1. Interpretation of Regression Results

We used innovation index and use the global innovation index to measure innovation as previously used by (Dempere et al., 2023) to measure innovation. Table 4 shows that a one percent increase in innovation (measured by the global innovation index) increases

Table 3: Correlation matrix

Variables	GRW40	INV	FDI	GFCF	GS
GRW40	1.000	−0.042	0.089	0.083	−0.037
INV	−0.042	1.000	−0.027	0.040	−0.005
FDI	0.089	−0.027	1.000	0.208	−0.030
GFCF	0.083	0.040	0.208	1.000	0.203
GS	−0.037	−0.005	−0.030	0.203	1.000

Table 4: The impact of innovation on inclusive growth

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	IGI	HDI	GII	Growth 40	Co_2	GDM
IGI (−1)	0.207***					
	(0.085)					
HDI (−1)		0.637***				
		(0.279)				
GII (−1)			0.952***			
			(0.024)			
Growth40 (−1)				0.329***		
				(0.077)		
CO_2 (−1)					0.837***	
					(0.065)	
GDM (−1)						0.883***
						(0.032)
LN INV index	0.126*	0.110**	−0.028**	0.061**	1.320***	0.330**
	(0.075)	(0.047)	(0.014)	(0.029)	(0.502)	(0.133)
Control						
LN GFCF	0.057**	0.001*	−0.001	1.036**	0.218	0.091
	(0.028)	(0.007)	(0.007)	(0.448)	(0.244)	(0.070)
LN GS	−0.142***	0.012	−0.010*	−2.065	0.189	0.027
	(0.038)	(0.019)	(0.006)	(0.641)	(0.233)	(0.045)
FDI	0.098***	0.003*	−0.001***	−0.084	0.051***	−0.005*
	(0.031)	(0.001)	(0.0004)	(0.180)	(0.014)	(0.003)
CPI	−0.044***	0.000006	−0.00003*	−0.003	0.001	−0.00002
	(0.007)	(0.00001	(0.00002)	(0.005)	(0.001)	(0.0001)
Constant	−1.262	−46.13	0.168*	3.221	−0.170	−0.363
	(1.865)	(43.47)	(0.090)	(2.665)	(5.514)	(0.648)
Diagnostics						
AR (1) [P-value]	−3.93	−0.08	−1.95	−3.79	−0.53	−1.42
	[0.000]	[0.932]	[0.051]	[0.000]	[0.594]	[0.156]
AR (2) [P-value]	−0.06	−0.21	0.83	−0.00	−1.25	−1.48
	[0.949]	[0.833]	[0.407]+++	[0.996]	[0.210]	[0.139]
Hansen [P-value]	39.84	19.61	27.69	42.86	53.23	45.31
	[0.345]	[0.719]	[0.806]	[0.563]	[0.096]	[0.297]
Hansen Difference	10.40	14.11	2.27	16.38	22.42	9.37
	[0.581]	[0.517]	[0.894]	[0.229]	[0.097]	[0.858]
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	567	586	599	567	599	599
Instruments	52	41	53	60	58	58
Groups	65	63	63	65	63	63

All values in () are robust standard and values in [] are probability values. One-step system GMM is applied to all models, (−1) represents the lagged dependent variable. HDI is the human development index; GII is the gender inequality index, Co_2 is carbon emission production; Grw40 is income growth of the bottom 40%; GDM is GDP per person employed; Ln INV index is log of global innovation index; GFCF is the gross fixed capital formation; CPI is consumer price index; GS is government final consumption expenditure and FDI is foreign direct investment. ***, ** and * shows level of significance at 1%, 5% and 10% respectively

inclusive growth index, HDI, income growth of the bottom 40%, CO_2 emission, and GDP per person employed by 0.126, 0.110, 0.061, 1.320 and 0.330% respectively. Conversely, innovation is found to be negatively associated with gender inequality as expected. The coefficient indicates that a one percent increase in innovation reduces gender inequality by 0.028%. In general, most of the findings are consistent with previous measures of innovation. Expect model 2 and model 4, where we find a significant relationship after changing the proxy of innovation which was insignificant initially.

However, we find some diagnostic issues. In models 2, 5, and 6 the probability values in both AR (1) and AR (2) are greater than the level of significance at 5% which indicates that there is no first and second-order serial correlation in these models. Which is not in accordance with GMM theory (Roodman, 2009). For model 3 we used the ARtest (3) option to get insignificant AR (3) which was significant at AR (2).

The result clearly indicates that innovation is an important factor to overall inclusive growth. Our results are consistent with previous findings of (Aghion and Howitt, 1990; Lucas Jr., 1988) who consider technological progress in the form of innovation, research and development expenditure, human capital accumulation, role of education are the main drivers of long-term economic growth. in addition, Sarpong and Nketiah-Amponsah (2022) also found positive association between GFC with inclusive growth and insignificant relation of FDI with inclusive growth. Finally post estimation of system GMM revealed that there is no second order serial correlation and Hansen J test show that instruments used in both models are valid.

5. CONCLUSION AND RECOMMENDATIONS

A plethora of literature is available on the impact of innovation on economic growth in developing countries. However, the impact

of innovation on inclusive growth has received little attention in the literature. This study contributes in two ways, first, the study constructs the indifference curve for selected developing countries to access the inclusiveness in growth and second, the study employed a dynamic panel model (Sys-GMM) to check the impact of innovation on inclusive growth.

The results affirm that innovation leads to an increase overall inclusive growth as measure by an index and set of dimension separately. Thus, the study recommends that policies should be implemented in developing countries to foster innovation that benefits not only the top-income holders but also the bottom-income holders, aiming to achieve inclusiveness. This approach ensures that the benefits of innovation are more equitably distributed across society, narrowing the income gap and promoting economic and social development for all segments of the population. By prioritizing inclusivity in innovation policies, governments can create opportunities for marginalized communities to participate in and benefit from technological advancements, ultimately fostering more sustainable and equitable growth.

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