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Investigating the Influence of Internet Usage on Income Inequality in Transitional Countries

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Abstract: The study investigated the impact of internet usage on income inequality in transitional economies using panel data ranging from 2008 to 2019. The second objective was to find out the influence of the complementarity between internet usage and human capital development on income inequality in transitional economies using the same data set. The available literature on the subject matter is divergent, conflicting, and far from reaching a consensus, hence the reason why the author attempted to empirically investigate the impact of internet usage on income inequality. The lag of income inequality was found to have had a significant positive influence on income inequality under the dynamic generalized methods of moments (GMM). Fixed effects produced results which show that internet usage had a significant negative effect on income inequality, consistent with the available literature. Transitional economies are therefore urged to develop and implement policies that promotes a wide coverage of internet usage to reduce income inequality. The interaction between internet usage and human capital development was found to have had a significant positive impact on income inequality under the fixed effects whilst pooled ordinary least squares (OLS) shows that the impact of the complementarity between internet usage and human capital development on income inequality was negative but significant. Transitional economies are therefore urged to implement enhanced human capital development policies to enable internet usage to play a meaningful role in reducing income inequality in the society. Future research needs to establish minimum threshold levels that internet usage in transitional economies must reach to have a significant influence on income inequality. Such a study enriches the income inequality policy making and implementation programmes.

Keywords: Internet; Income Inequality; Transitional Economies; Panel Data Analysis

JEL Classification: L86; E25; P2

1. Introduction

Background of the study, contribution and organization of the study are three sections covered under the introduction.

Background of the study, research gap and problem statement: Income inequality, unemployment and poverty reduction is one of the United Nations Millennium Development Goals, consistent with Rewilak (2017). Consistent with quite a number of empirical studies such as Ahamad and Pandery (2014), Urama and Oduh (2012), Garcia-Mora and Mora-Rivera (2021), Isife et al (2013), Diga et al

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(2013), Okello et al (2014), Postula et al (2021), Bello and Aderbigbe (2014) and Mogotlhwane et al (2011), internet usage is key to income inequality reduction.

Previous empirical research on the internet usage-income inequality showed results which are mixed. Some noted that internet usage reduces income inequality whilst the other group produced results or argue that internet usage increases income inequality. The other group of empirical researchers noted that income inequality and internet usage influence each other. Majority of the empirical researchers on the internet usage-income inequality nexus wrongly assumed that the relationship between internet usage and income inequality is non-linear. This study assumed a non-linear relationship between internet usage and income inequality hence other factors which influence income inequality are considered in the study. There are five other methodological weaknesses observed from majority of prior research on the nexus between internet usage and income inequality. Firstly, they ignored the non-linear aspect of the relationship between internet usage and income inequality. Secondly, they used outdated data sets which are no longer useful for policy making purposes in the current period. Thirdly, they ignored the endogeneity problem aspect in the relationship between internet usage and income inequality. Fouthly, the argument put forward by Azher (1995) that income inequality is affected by its own lag was totally ignored. Fifthly, transitional economies have largely been ignored by prior empirical research on the subject matter. These gaps and methodological weaknesses of prior empirical research work on the impact of internet usage on income inequality shows that this topic is not yet resolved, still is an unsettled matter and not yet conclusive. The results of the study assist the transitional economies to craft and implement policies that helps to reduce income inequality.

Contribution of the paper: This study contributes to literature in five different ways. Firstly, it is the first study to the author's best knowledge to investigate the impact of internet usage on income inequality in transitional economies. Previous empirical research on the subject matter did not focus on the transitional economies bloc of countries to the best of the author's knowledge. Secondly, majority of the prior empirical studies on the internet usage-income inequality nexus wrongly assumed that the relationship between the two variables is linear in nature. This study corrected that wrong assumption by considering the non-linearity nature of the relationship between internet usage and income inequality. Thirdly, this study considered the endogeneous nature of the relationship between income inequality and internet usage. Fourthly, this study considered the fact that income inequality is affected by its own lag. Fifthly, according to the author's best knowledge, this study is the first of its kind to explore the influence of the complimentarity between internet usage and human capital development on income inequality. Sixthly, unlike available previous research on the subject matter, this study used the most recent data set (2008-2019).

Organization of the paper: The rest of the paper is structured as follows: Section 2 explains the theoretical influence of internet usage on income inequality. Section 3 summarizes the impact of internet usage on income inequality from an empirical point of view. Section 4 discusses the influence of the explanatory variables of income inequality. Section 5 covers the research methodological framework (data description and its character, general and econometric model specification). Section 6 discusses the pre-estimation diagnostics of the study. Section 7 is the main data analysis. Section 8 summarises the study. Section 9 is the bibliography.

2. The Impact of Internet Usage on Income Inequality – Theoretical Literature Review

There are three theoretical rationales explaining how internet usage reduces income inequality (Litan & Rivlin, 2001). Firstly, by building a global information medium of exchange, internet assist to more efficiently allocates materials on a global scale. This decreases production costs and the prices of goods and services. Secondly, the internet marketplaces serve as an alternative to the traditional retail markets, hence providing convenience to the final consumers. Thirdly, internet reduces the consumers 'search costs and market power, hence improving the welfare of the populace (Brown & Goolsbee. 2002). Fourthly, internet usage creates vast number of employment opportunities, thus taking people out of poverty and leading to income inequality reduction (Bauer, 2015).

On the contrary, internet usage increase income inequality especially when access to online resources is distributed unequally among the people (Hargittai, 1999). People who don't have access to internet won't be able to meaningfully participate in the online national economy hence further promoting income inequalities. Poor internet usage leads to cultural and cultural disparities, argued Howard et al (2010). It is against this background of competing predictions that a further empirical investigation on the impact of internet usage on income inequality is well justified.

3. The Impact of Internet Usage on Poverty – Empirical Literature Review Summary

Table 1. Summary of the Empirical Literature on the Impact of Internet Usage on Poverty Reduction

Author	Country/Countries of study	Period	Methodology	Results
Garcia-Mora and Mora-Rivera (2021)	Mexico	2016 and 2018 survey data	Descriptive statistics	Internet usage had a higher positive impact on poverty reduction in less developed rural areas of Mexico.
Yang et al (2021)	China	Household survey data	Endogenous switching regression model	The results showed that internet usage increase had a multidimensional impact on poverty reduction in the rural China.
Zhang et al (2019)	China	2015 survey data (Chinese General Social Survey)	Probit regression model	An increase in information access had a significant positive influence on poverty reduction efforts in China.
Mora-Rivera and Garcia-Mora (2021)	Mexico	2016 Mexico National Household Income and Expenditure survey	Regression analysis	Internet access had a more significant poverty reduction effect in rural than in urban areas of Mexico.
Yilmaz and Koyuncu (2018)	182 countries	2000 and 2013 survey data	Panel data analysis	Poverty reduction was positively affected by internet usage across all the countries studied.

Bello and Aderbigbe (2014)	Developing countries	Literature review analysis	Literature review analysis	Information and communication technology (ICT) triggered poverty reduction in developing countries.
Mogotlhwane et al (2011)	Developing countries	Literature review analysis	Literature review analysis	ICT had significant deleterious effect on poverty in developing countries.
Okello et al (2014)	Developing countries	Literature review analysis	Literature review analysis	Several literatures on the positive impact of internet usage on poverty alleviation was confirmed.
Postula et al (2021)	European Union countries	2009-2019	Ordinary Least Squares	Internet usage was found to have had a significant positive influence on poverty reduction across all European Union member states.
Isife et al (2013)	Abia State, Nigeria	Survey data	Descriptive statistics	Poverty reduction was enhanced by the implementation of internet usage networks.
Diga et al (2013)	Africa	2005-2012	Case study approach	All the case studies pointed to a positive ICT-led poverty reduction influence in Africa.
Urama and Oduh (2012)	Nigeria	Survey data	Probit regression model	Information and communication technology reduced poverty in Nigeria.
Ahamad and Pandery (2014)	Developing areas	Case study analysis	Case study analysis	Both poverty and internet usage positively affected each other.

Source: Author compilation

4. The Impact of Internet Usage on Income Inequality – Empirical Literature Review

Table 2. Summary of the Empirical Literature on the Impact of Internet Usage on Poverty Reduction

Author	Country/Countries of study	Period	Methodology	Results
Ningsih, Caria; Choi, Yong-Jae (2018)	Southeast Asian countries (ASEAN)	Survey data	Panel regression analysis	Research has shown that internet penetration in place of technological change has visibly reduced income inequality. The tax revenue to GDP ratio has also reduced income inequality, but the effect is not compelling. Income equality has been increased by Globalization measured by FDI and trade to GDP ratio, regardless of the FDI impact proving to be minimal. The knowledge and use of other control variables, such as the ratio of secondary education enrolment, real GDP per capita, and real exchange rate depreciation, have also improved income inequality. Regardless of the facts mentioned above, actual interest rates and inflation have affected income inequality, insignificantly in ASEAN countries.

Chiou, and Tucker (2020)	America	2020 survey data	Empirical analysis	Chiou and Tucker's results propose that the digital divide explains the inequality they recorded in people's ability to self-isolate. This inability to self-isolate may also be affected because income and home Internet access are correlated.
Canh et al (2020)	87 economies	2002 and 2014 survey data	Regression analysis	This study confirms that Internet and mobile use should become an active part of the economic policy, which aims to reduce income inequalities.
Zhang, Li, and Xiao, (2020)	China	2010-2016 CFPS survey data	Two-stage least squares regressions, Gini index	The results of this survey suggest that internet penetration may have a positive effect on consumption inequality. There is also evidence on how buffering effects exist; this is evidence observed where high education rates and high internet penetration rates over 46%will reduce the positive impact of the Internet on consumption inequality.
Asongu, and Odhiambo (2019)	48 countries in Africa	2004-2014	Gini coefficient, Atkinson index and Palma ratio Gini coefficient, Atkinson index and Palma ratio. Gini coefficient, Atkinson index and Palma ratio	The results have implications for Sustainable Development Goals (SDGs) from three main perspectives, notably, the: (i) relevance of inequality in SDGs; (ii) growing non-inclusive development in Africa and (iii) low penetration potential of ICT in Africa relative to other regions of the world. he empirical evidence is based on the Generalised Method of Moments. Enhancing internet penetration and fixed broadband subscriptions have a net effect on reducing the Gini coefficient and the Atkinson index, whereas increasing mobile phone penetration and internet penetration reduces the Palma ratio. Policy implications are discussed in the light of challenges to Sustainable Development Goals. The following main finding has been established. Enhancing internet penetration and fixed broadband subscriptions has a net effect on reducing the Gini coefficient and the Atkinson index, whereas increasing mobile phone penetration and internet penetration reduces the Palma ratio. The results have implications for Sustainable Development Goals (SDGs) from three main perspectives, notably, the: (i) relevance of inequality in SDGs; (ii) growing non-inclusive development in Africa and (iii) low penetration potential of ICT in Africa relative to other regions of the world.

				Asongu and Odhiambo's main finding is that enhancing internet penetration and fixed broadband subscription has a net effect. The effects can be observed in the study when reducing the Gini coefficient, Atkinson index. The study also found that increasing mobile phone and internet penetration reduces the Palma ratio. As a result, implications for sustainable development goals can be implemented (SDGs).
Houngbonon and Liang (2018)	France	2009 to 2013	Data and descriptive statistics	Houngbonon and Liang found out that broadband adoption and quality raise mean income and lower income inequality. The above results are essential to initial conditions and generate policy implications for the deployment of faster broadband Internet.
Panichsombat (2016)	Asia Pacific countries	191 countries around the world from 1990 to 2015	Gini Index and panel data	The empirical results from the Panichsombat study suggested that the effects for developing countries varied. Internet use in developed countries was associated with a higher reduction in the Gini Index. Thus, the assumption of lower inequality compared to their developing counterparts. In this study, Internet penetration in the Asia Pacific had very minimal improvement in inequality, regardless of how Internet use in presently developed Asia harmed income equality less than in developing Asia.
Pepper and Garrithy (2015)	Global across 146 countries	1988 through 2008 survey data	Gini coefficient	In this study, the authors, Pepper and Garrithy, might not yet determine the full impact of ICTs adequately. This observation is mainly in regard to high-speed Internet on income growth. However, much of the rise of within-country inequality has been driven by income growth in the top decile and percentile of the income distribution.
Noh and Yoo (2008)	Global across 60 countries	1995–2002 survey data	Panel data set	The panel for this study estimated that the effect of Internet adoption on growth is negative for countries with high-income inequality. The study shows that this may result from the digital divide, which obstructs economic growth stimulated by the Internet. From a policy standpoint, this result implies that the positive impact of the Internet on development will be reinforced by income redistribution.

Source: Author compilation

5. The impact of Explanatory Variables of Income Inequality

Table 3. Theory Intuition and Expected Sign(s)

Variable	Theory intuition	Source	Expected sign
FDI	According to Amin (1974), the economy and income distribution is negatively influenced by over-reliance on foreign direct investment. On the other hand, Nguyen (2003) noted that foreign direct investment flows with it alongside capital, skills, jobs creation and managerial skills, all of which contribute towards income inequality and poverty reduction.	Amin (1974), Nguyen (2003)	- +
HCD	Inequalities in the provision of education, training and skills exacerbate income inequality and poverty trap (Afzal et al. 2010). The chances of securing not just a job but a better paying one are increased as one becomes more and more skilled (Chaudhry and Rehman. 2009). All this enhances income inequality reduction among the people.	Afzal et al (2010), Chaudhry and Rehman (2009)	+/-
SAV	Increased amount of savings can enable one to commence self-help projects, self-employment, and the creation of more community-based jobs, hence contributing to income inequality and poverty reduction (Azher. 1995).	Azher (1995)	-
OPEN	According to Pradhan and Mahesh (2014), high levels of trade openness enable industry and consumers to have easy and cheaper access to variety of international goods and services. This reduces the unit cost of goods and enhances expansion, job creation and poverty and income inequality reduction among the people.	Pradhan and Mahesh (2014)	-
FIN	Higher levels of financial development enable the people to easily access cheaper loans, capital which they can use to kick start their own income generating projects, hence contributing to income inequality and poverty reduction (Stiglitz. 1998). The same author also argued that financial development enhances economic growth, spurs economic activities and drives jobs creation activities thus helping to effectively fight income inequality and poverty.	Stiglitz (1998)	-
INFL	According to the UNCTAD (2012), labour costs and real wages are lowered down by high levels of inflation hence enabling the company to employ more people and helping to fight poverty and income inequality. The purchasing power of people's savings is eroded by high levels of inflation. This further subject the people to misery and vicious cycle of poverty and income inequality (Aye and Edoja. 2017).	Shahidur (2012), UNCTAD (2012)	+/-

Source: Author compilation

6. Research Methodological Framework

This section covers data description and its character and general and econometric model specification.

Data description and character: This paper used panel data ranging from 2008 to 2019 to study the impact of internet usage on poverty alleviation in BRICS countries. The latter include Argentina, Colombia, Greece, Peru, Portugal, Thailand, Brazil, Czech Republic, Mexico, Poland, Russia and Turkey. African Development Bank, United Nations Development Programme, World Development Indicators, International Financial Statistics and International Monetary Fund are the internationally recognised and reputable databases from which the panel data was extracted.

General and econometric model specification: The general model specification of the income inequality function is represented by equation 1 below.

INEQ =f(INTERNET, HCD, FDI, SAV, INFL, OPEN, FIN) (1)

As already been described earlier on, INEQ, INTERNET, HCD, FDI, SAV, INFL, OPEN and FIN respectively stands for income inequality, internet usage, human capital development, foreign direct investment, savings, inflation, trade openness and financial development. The proxies which were used to measure these main variables of the study are summarised in Table 4.

Table 4. The Proxies of Variables Used

Income inequality (INEQ)	GINI ratio
Internet usage (INTERNET)	Individuals using internet (% of population)
Human capital development (HCD)	Human capital development index
Financial development (FIN)	Domestic credit to private sector (% of GDP)
Trade openness (OPEN)	Total imports and exports (% of GDP)
Inflation (INFL)	Inflation consumer prices (annual %)
Foreign direct investment (FDI)	Net FDI inflow (% of GDP)
Savings (SAV)	Gross domestic savings (% of GDP)

Source: Author's compilation

Income inequality is the dependent variable in equation 1 whilst independent (explanatory) variables include internet usage, human capital development, financial development, trade openness, inflation, savings and foreign direct investment. Empirical studies which influenced the choice of the explanatory variables of the income inequality function include but are not limited to Garcia-Mora and Mora-Rivera (2021), Ahamad and Pandery (2014), Urama and Oduh (2012), Diga et al (2013), Isife et al (2013), Postula et al (2021), Okello et al (2014), Mogotlhwane et al (2011) and Bello and Aderbigbe (2014).

Equation 2 is the income inequality's econometric equation. It is equation 1 transformed into econometric format.

$$INEQ_{it} = \beta_0 + \beta_1 INTERNET_{it} + \beta_2 HCD_{it} + \beta_3 FDI_{it} + \beta_4 SAV_{it} + \beta_5 INFL_{it} + \beta_6 OPEN_{it} + \beta_7 FIN_{it} + \varepsilon_{it} \quad (2)$$

Table 5. Variables' Interpretation

β_0	Intercept term
i	Country
t	Time
β_1 to β_7	Co-efficient of explanatory variables
$INEQ_{it}$	Income inequality in country i at time t
$INTERNET_{it}$	Internet usage in country i at time t
εit	Error term
HCD_{it}	Human capital development in country i at time t
FDI_{it}	Foreign direct investment in country i at time t
SAV_{it}	Savings in country i at time t
$INFL_{it}$	Inflation in country i at time t
$OPEN_{it}$	Trade openness in country i at time t
FIN_{it}	Financial development in country i at time t

Source: Author compilation

$$INEQ_{it} = \beta_0 + \beta_1 INTERNET_{it} + \beta_2 HCD_{it} + \beta_3 (INTERNET_{it} . HCD_{it}) + \beta_4 FDI_{it} + \beta_5 SAV_{it} + \beta_6 INFL_{it} + \beta_7 OPEN_{it} + \beta_8 FIN_{it} + \varepsilon it \quad (3)$$

Equation 3 introduced the impact of the complementary variable (internet usage x human capital development) on income inequality, consistent with Canh et al (2020), whose study argued that the usage of internet by educated and skilled people enhances not only innovation but also promotes entrepreneurship and self-employment. Pooled ordinary least squares (OLS), random effects and fixed effects are the panel data analysis methods used to econometrically estimate equation 3.

Equation 4 introduced the lag of the dependable (lag of income inequality), consistent with Azher (1995) whose study argued that poverty and income inequality perpetuates another poverty and income inequality (promotes vicious cycle). According to Liu (2017), the inclusion of the lag of income inequality captures structural and a series of time-invariant institutional features that persistently influence income inequality. The omitted variable bias is to a greater extent reduced by the inclusion of the lag of income inequality in equation 4.

$$INEQ_{it} = \beta_0 + \beta_1 INEQ_{it-1} + \beta_2 INTERNET_{it} + \beta_3 HCD_{it} + \beta_4 (INTERNET_{it} . HCD_{it}) + \beta_5 FDI_{it} + \beta_6 SAV_{it} + \beta_7 NFL_{it} + \beta_8 OPEN_{it} + \beta_9 FIN_{it} + \varepsilon it \quad (4)$$

The dynamic GMM econometric methodology was used to estimate equation 4.

7. Pre-Estimation Diagnostics

Correlation analysis, descriptive statistics and mean trend analysis of the major variables constitutes this section.

Table 6. Correlation Results

	INEQ	INTERNET	HCD	FDI	SAV	INFL	OPEN	FIN
INEQ	1.00							
INTERNET	-0.45***	1.00						
HCD	-0.76***	0.77***	1.00					
FDI	0.14*	-0.06	-0.18**	1.00				
SAV	-0.22***	-0.01	-0.11	0.14	1.00			
INFL	0.27***	-0.004	-0.09	-0.21**	-0.04	1.00		
OPEN	-0.75***	0.17**	0.35***	0.04	0.52***	-0.48***	1.00	
FIN	-0.34***	-0.01	0.14	-0.04	-0.12	-0.44***	04***	1.00

Note: ***/**/* denotes statistical significance at the 1%/5%/10% level respectively.
Source: Author compilation from E-Views

Internet usage, human capital development, savings, trade openness and financial development were separately found to have had a significant negative relationship with income inequality. The results may mean that these variables significantly reduced income inequality in transitional economies during the period under study. However, the weakness of correlation analysis is that it does not show the direction of causality between the variables. A significant positive relationship between (1) FDI and income inequality and (2) inflation and income inequality were also observed, results of which also resonates with available literature. The highest correlation (77%) was found between human capital development and internet usage, evidence of the existence of multicollinearity between and among the variables studied in line with Stead (1996).

Table 7. Results of Descriptive Statistics

	INEQ	INTERNET	HCD	FDI	SAV	INFL	OPEN	FIN
Mean	0.41	55.1	0.79	2.82	22.1	4.83	68.2	63.1
Median	0.40	57.79	0.78	2.75	21.45	3.58	57.83	50.7
Maximum	0.56	82.6	0.90	10.7	34.9	24.9	160.9	159.86
Minimum	0.25	18.2	0.65	0.15	8.33	0.01	22.1	12.3
Standard. deviation	0.08	16.4	0.06	1.50	6.94	4.52	36.04	38.91
Skewness	0.05	-0.34	0.03	1.04	0.06	1.91	0.91	1.04
Kurtosis	2.32	2.07	2.06	6.78	2.14	7.34	2.88	3.03
Jarque-Bera	2.81	7.99	5.27	111.8	4.46	200.2	19.79	26.02
Probability	0.25	0.02	0.07	0.00	0.11	0.00	0.00	0.00
Observations	144	144	144	144	144	144	144	144

Source: Author compilation from E-Views

Across all the variables studied, the difference between the minimum and the maximum is large, which shows that extreme values exist (see Table 7). Standard deviation of trade openness and financial development is greater than 30, a further indication that there exist extreme values. Except internet usage data, all the other variables used in the study are skewed to the right, an indication that the data is not normally distributed. The probability of the Jarque-Bera criteria (not zero) for income inequality, internet, human capital development and savings also provides further evidence that the data for these variables is not normally distributed.

Table 8. Mean Internet Usage and Income Inequality Trends in Transitional Economies (2008-2019)

	Individuals using internet (% of population)	GINI ratio
Argentina	58.59	0.43
Brazil	53.71	0.53
Colombia	49.26	0.53
Czech Republic	73.41	0.26
Greece	59.04	0.35
Mexico	46.71	0.47
Peru	41.84	0.45
Poland	66.95	0.32
Portugal	62.57	0.35
Russia	61.07	0.39
Thailand	36.49	0.38
Turkey	51.49	0.41
Overall mean	**55.09**	**0.41**

Source: Author's compilation

Argentina, Czech Republic, Greece, Poland, Portugal and Russia are the six transitional economies whose mean internet usage exceeded the overall mean internet usage of 55.09% of the population. The remaining countries had their mean internet usage lower than the overall mean internet usage of 55.09% of the population. It is evident that Czech Republic, Peru, Poland and Thailand are outliers because their mean internet usage deviated from the overall mean internet usage of 55.09% of the population by a very wide margin (more than 10 percentage points).

Regarding income inequality, Argentina, Brazil, Colombia, Mexico and Peru had their mean income inequality (GINI ratio) greater than the overall mean income inequality of 0.41. Apart from Turkey (0.41), the remaining transitional economies had their mean income inequality below the overall mean income inequality of 0.41. Brazil, Colombia and Czech Republic are regarded as outliers in this case because their mean income inequality ratios deviated from the overall mean income inequality by more than 10 percentage points.

In summary, (1) multi-collinearity between internet usage and human capital development data was observed, (2) outliers and (3) data not following a normal distribution were noted using both descriptive statistics and mean trend analysis approaches. Consistent with Aye and Edoja (2017), all the data sets were first transformed into natural logarithms in order to effectively deal with the negative effects of these data characteristics (multi-collinearity, outliers, abnormally distributed) on the quality of the final results.

8. Main Data Analysis

From Table 9, it is evident that not all variables were stationary at level. However, all the variables were stationary at first difference. Consistent with Owusu and Odhiambo (2014), all the variables were integrated of order 1, hence paving way for panel co-integration tests.

Table 9. Panel Root Tests – Individual Intercept

	Level				First difference			
	LLC	IPS	ADF	PP	LLC	IPS	ADF	PP
INEQ	-1.94**	1.25	14.85	14.55	-5.23***	-2.69***	47.20***	94.73***
INTERNET	-6.61***	-3.36***	67.51***	95.62***	-5.89***	-1.55**	34.66**	65.35***
HCD	-6.40***	-0.85	33.29*	6.27	-3.47***	-4.41***	65.61***	187.59***
FDI	-3.18***	-2.07**	37.51**	70.42***	-12.10***	-7.66***	102.13***	219.51***
SAV	0.82	2.00	10.35	19.48	-5.63***	-3.30***	53.41***	101.85***
INFL	-1.93**	-0.95	32.24	33.20	-5.84***	-3.78***	58.76***	117.37***
OPEN	-5.74***	-2.05**	40.50**	23.44	-3.52***	-3.91***	60.57***	132.57***
FIN	-4.53***	-4.47**	37.20**	51.26***	-3.13***	-9.94***	101.56***	123.95***

Note: LLC, IPS, ADF and PP stands for Levin, Lin and Chu; Im, Pesaran and Shin; ADF Fisher Chi Square and PP Fisher Chi Square tests respectively. *, ** and *** denote 1%, 5% and 10% levels of significance, respectively.

Source: Author's compilation from E-Views

The Kao (1999) panel co-integration tests were done and produced the results presented in Table 10.

Table 10. Kao Residual Co-integration Test - Individual intercept

	T-statistic	Probability
Augmented Dickey-Fuller (ADF)	-1.0820	0.0065

Source: Author's compilation from E-Views

From Table 10, it is evident that the null hypothesis which says that the variables are not co-integrated is rejected. In other words, the Kao (1999) co-integration tests show that there is a long run relationship among the variables studied (income inequality, internet usage, human capital development, foreign direct investment, savings, inflation, trade openness and financial development.

Table 11. Panel Data Analysis Results

	Dynamic GMM	Fixed effects	Random effects	Pooled OLS
INEQ Lag	0.95***	-	-	-
INTERNET	-0.02	-0.08*	-0.04	-0.09
HCD	0.28	-0.86	-0.30	0.37
INTERACTION TERM	-0.09	0.25**	-0.08	-0.55**
FDI	-0.002	0.002	0.005	0.01
SAV	-0.01**	0.06***	0.11***	-0.04***
INFL	0.003*	0.001	0.003	0.01
OPEN	-0.003*	0.09***	-0.08***	-0.20***
FIN	-0.002***	-0.06***	-0.03*	-0.01**
Adjusted R-squared	0.79	0.78	0.57	0.62
J/F-statistic	134.00	314.46	45.96	108.41
Prob (J/F-statistic)	0.00	0.00	0.00	0.00

***, ** and * denote 1%, 5% and 10% levels of significance, respectively.

Source: Author's compilation from E-Views

In Table 11, income inequality was positively and significantly influenced by its own lag, consistent with Azher (1995) whose study argued that income inequality perpetuates income inequality. Internet usage had a non-significant negative impact on income inequality under the dynamic GMM, random effects and pooled OLS. Fixed effects produced results which show that internet usage had a significant

negative influence on income inequality. The results mean that internet usage reduced income inequality, consistent with Bauer (2015) whose study argued that

internet usage creates vast number of employment opportunities, thus taking people out of poverty and leading to income inequality reduction.

Human capital development's influence on income inequality was found to be positive but non-significant under the dynamic GMM and pooled OLS, in line with Afzal et al (2010) whose study noted that inequalities in the provision of education, training and skills exacerbate income inequality and poverty trap. Fixed and random effects show that human capital development influenced income inequality in a negative but non-significant way, results which resonates with Chaudhry and Rehman (2009) whose study observed that the chances of securing not just a job but a better paying one are increased as one becomes more and more skilled.

The complementarity between internet usage and human capital development produced results which show that it had a non-significant negative influence on income inequality under the dynamic GMM and random effects. The pooled OLS noted that the interaction between internet usage and human capital development had a significant deleterious effect on income inequality. These results are in line with Canh et al (2020) whose study argued that the usage of internet by educated and skilled people enhances not only innovation but also promotes entrepreneurship and self-employment. Contrary to the available literature, the interaction between internet usage and human capital development had a significant positive effect on income inequality under the fixed effects.

FDI had a non-significant negative effect on income inequality under the dynamic GMM approach, in line with Amin (1974) whose study noted that the economy and income distribution is negatively influenced by over-reliance on foreign direct investment. However, the influence of FDI on income inequality was found to be positive but non-significant under the random effects, pooled OLS and fixed effects. These results support Nguyen (2003)'s argument that foreign direct investment flows with it alongside capital, skills, jobs creation and managerial skills, all of which contribute towards income inequality and poverty reduction.

Under the pooled OLS and the dynamic GMM, the impact of savings on income inequality was found to be negative and significant. This means that savings reduced income inequality, in line with Azher (1995) whose study argued that increased amount of savings can enable one to commence self-help projects, self-employment, and the creation of more community-based jobs, hence contributing to income inequality and poverty reduction. However, fixed and random effects show that savings' impact on income inequality was positive and significant, in contradiction to the available literature on the subject matter.

Under the dynamic GMM, inflation was found to have had a significant positive influence on income inequality. On the other hand, a non-significant positive relationship running from inflation towards income inequality was observed under the fixed effects, pooled OLS and random effects. The results are consistent with an argument by Shahidur (2012) whose study noted that the purchasing power of people's savings is eroded by high levels of inflation hence further subjecting the people to misery and vicious cycle of poverty and income inequality.

Trade openness was found to have had a significant deleterious effect on income inequality under the dynamic GMM, random effects and pooled OLS. The results show that trade openness reduced income

inequality in transitional economies, in line with Pradhan and Mahesh (2014). The latter argued that high levels of trade openness enable industry and consumers to have easy and cheaper access to variety of international goods and services hence enhancing job creation, poverty and income inequality reduction among the people. The impact of trade openness on income inequality under the fixed effects was observed to be positive and significant, in contradiction to most of the available literature on the subject matter.

Financial development's deleterious influence on income inequality was confirmed under all the four econometric approaches, consistent with an argument by Stiglitz (1998) whose study observed that higher levels of financial development enable the people to easily access cheaper loans, capital which they can use to kick start their own income generating projects, hence contributing to income inequality and poverty reduction.

9. Summary of the Study

The study investigated the impact of internet usage on income inequality in transitional economies using panel data ranging from 2008 to 2019. The second objective was to find out the influence of the complementarity between internet usage and human capital development on income inequality in transitional economies using the same data set. The available literature on the subject matter is divergent, conflicting, and far from reaching a consensus, hence the reason why the author attempted to empirically investigate the impact of internet usage on income inequality. The lag of income inequality was found to have had a significant positive influence on income inequality under the dynamic GMM. Fixed effects produced results which show that internet usage had a significant negative effect on income inequality, consistent with the available literature. Transitional economies are therefore urged to develop and implement policies that promotes a wide coverage of internet usage to reduce income inequality. The interaction between internet usage and human capital development was found to have had a significant positive impact on income inequality under the fixed effects whilst pooled OLS shows that the impact of the complementarity between internet usage and human capital development on income inequality was negative but significant. Transitional economies are therefore urged to implement enhanced human capital development policies to enable internet usage to play a meaningful role in reducing income inequality in the society. Future research needs to establish minimum threshold levels that internet usage in transitional economies must reach to have a significant influence on income inequality. Such a study enriches the income inequality policy making and implementation programmes.

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