Journal of Sustainability Science and Management
Volume 17 Number 9, September 2022: 62-74
eISSN: 2672-7226

GREEN ECONOMY AND GOOD GOVERNANCE TOWARDS INCOME EQUALITY: A QUANTILE ANALYSIS

HAR WAI MUN*, KEE XUAN NI, LEE HUI SHAN AND LOW CHOON WEI

Faculty of Accountancy and Management, Universiti Tunku Abdul Rahman, Jalan Sungai Long, Bandar Sungai Long, 43000 Kajang, Selangor, Malaysia.

**Corresponding author: harwm@utar.edu.my*
Submitted final draft: 23 June 2022 *Accepted: 4 August 2022* http://doi.org/10.46754/jssm.2022.09.005

Abstract: The world is moving towards a greener economy, a more equal society and better governance under the Sustainable Development Goals (SDGs) and the "Environmental, Social and Governance" initiative. Doubts remain on whether a greener economy and better governance are helpful in achieving income equality. This study aims to examine the relationship between green economy, governance and income inequality, applying quantile regression to capture the different relationships in different levels of income inequality between 2009 and 2019 in 30 countries. The results reveal that green economy proxies are mostly not significant in high-income countries but can aggravate income inequality in middle-income countries at lower quantiles to create a green economy-income inequality trap. Better governance can reduce inequality in high-income countries but worsen inequality in middle-income countries. The findings imply that high-income countries can pursue a sustainable green economy without needing to be concerned about income inequality, which is reduced only with better governance. In contrast, good governance is harmful to income inequality in middle-income countries. It hints at serious fundamental flaws in institutional structure. These are urgent challenges in policy formulation and economic planning regarding the SDGs towards achieving the sustainability trinity of lowering inequality, a greener economy and better governance.

Keywords: Sustainable Development Goals, green economy, income inequality, governance, quantile regression.

Introduction

The United Nations' Sustainable Development Goals (SDGs) comprise seventeen goals that guide the world to a greener economy, a more equal society and better governance. The United Nations Environment Programme (UNEP, 2011) defines a "green economy" as an economy that is low carbon, resource efficient and socially inclusive. A green economy emphasises sustainable economic growth (SDG 8) created under the conditions of low carbon (SDG 13) is resource efficient (SDG 7) and prioritises environmental preservation (SDGs 14 15). Social inclusiveness mostly focuses on income equality (SDG 10) but also encompasses issues of poverty (SDG 1), hunger (SDG 2) and gender equality (SDG 5). Good governance is commonly linked to peace and justice (SDG 16) and institutional effort and partnership to achieve sustainable development (SDG 17). In a larger perspective, these nexus of green economy, equality and governance are also important in building a sustainable city and communities (SDG 11) and cultivating responsible consumption (SDG 12) towards a holistic sustainable development. There are many challenges to achieving the SDGs, especially in reducing inequality. Income inequality has been a social and economic issue for decades, yet it stubbornly remains unsolved. Policies and research on reducing income inequality are aplenty. Research on inequality must be refined to incorporate the context of sustainable development, like the green economy and good governance. Hence, an important contemporary issue is whether countries can achieve the sustainability trinity of a green economy, good governance and low levels of income inequality.

The classic school of thought believes reducing income inequality together with

achieving a green economy and good governance is possible if the free competitive market is upheld. When the global trend is heading towards a green economy, competition can push businesses and production to the use of environmentally friendly technologies, renewable energy, and clean production. The benefits of a green economy will trickle down fairly on everyone, hence reducing income inequality, if the classic school of thought is valid. Yet, this may not be the case. The green economy may come with additional costs such as pollution abatement, development of green technology and costlier environmentally friendly energy sources and production methods. These costs could pose a bigger burden to the lower-income group rather than the higher-income group due to the latter having more political and economic power over the former. Good governance will ensure the free-market mechanism works competitively towards social goodness, including decreasing inequality (Shafique *et al.,* 2006; Abd Elalim, 2020). Higher control of corruption and upholding the rule of law are deemed helpful to fair competition and equality. The institutional economics school of thought also has the same belief that better governance will lower income inequality. However, the Keynesian and political economy schools of thought do not believe that economic growth will automatically bring about income equality. Political will is needed and it becomes critical if the government must make a political choice to pursue green growth against income equality due to limited resources and ability. There is doubt on whether a greener economy and better governance are helpful (reduced inequality) or harmful (increased inequality) towards different levels of income equality. In addition, the issues of inequality, green economy and governance are not being viewed collectively nor is the possibility of different relationship nexuses in different levels (quantiles) of income inequality. These are valuable research gaps that motivate this paper to examine the quantile relationship between the green economy, governance and income inequality.

The remaining paper is arranged as follows: Section 2 reviews related literature, Section 3 explains the methodology, Section 4 interprets the results, Section 5 is the discussion and lastly, Section 6 covers the conclusion.

Literature Review

Income inequality is an evergreen issue for policymakers and academic research but has only recently been linked to a green economy in terms of sustainable development. Despite continuous efforts to alleviate it, inequality stubbornly persists and inconclusive research findings are hardly agreeable on the best solution. Income inequality is the unfair distribution of income generated at a constant period among individuals, regions or social classes (Uzar & Eyuboglu, 2019). Past literature often focused on the negative impacts of income inequality on society (Zhang & Zhao, 2014; Buttrick & Oishi, 2017) as well as the associated economic problems (Dabla-Norris *et al*., 2015; Graafland & Lous, 2018; Norhana & Noreha, 2021). For example, Buttrick and Oishi (2017) underlined that persistent income inequality can cause psychological burdens, lower social cohesion, mistrust, social status anxiety and health problems. Norhana and Noreha (2021) highlighted the importance of the sustainability aspect in foreign labour policy as it has a spillover impact on human capital, productivity and politics. Freistein and Mahlert (2016) interestingly stressed the importance of alleviating income inequality to achieve sustainable development. They elaborated lengthily on the conceptualisation of inequality, an increase of focus on inequality from the Millennium Development Goals to SDGs and the challenges to achieving an inclusive society within the context of sustainable development.

One of the main aspects of sustainable development is the green economy which also incorporates issues of environmental degradation (pollution), environmentally friendly technology and renewable energy. Li (2017) claimed that the demand for a green economy complicated classical economic

theories, including Kuznets' hypothesis on growth and inequality. Green growths need to consider the cost to the environment and sustainability, thus, having a different impact on welfare (Vaghefi *et al.,* 2015; Stjepanović *et al.,* 2019). Hardt and O'Neill (2017) and Bildirici and Özaksoy (2018) emphasised that ecological and green economic growth need to be associated with inequalities in wealth and income distribution. However, D'Alessandro *et al.* (2020) claimed otherwise due to higher trade-off costs with income inequality and unemployment. The relationship between green economic growth and inequality may also be different at different levels. Ali *et al.* (2013) and Aguilar-Rivera (2021) highlighted that in middle-income countries, high green economic growth will raise inequality if the level is low but will decrease income inequality if the level is high. These relationships are similar to the Environmental Kuznets Curve (EKC) which was originally hypothesised by Simon Kuznets (1955). The EKC hypothesis has been replicated in various studies such as Thornton (2001) and Shahabadi *et al.* (2018) but there have been no conclusive findings.

Litina *et al.* (2016) revealed that the adoption of green technology will be affected by intergenerational transmissions and cultural orientation. Thus, the development of environment-related technologies is closely linked to the socio-economic conditions of the market, such as education level, population, income level and habitation. This has brought a perspective that there is a significant nexus between the development of environment-related technologies and income inequality. Mantovani *et al.* (2017) observed that a high level of income inequality leads to the decrease in the adoption of environment-related technologies. This is because environmentally friendly technology or "green technology" is often relatively costly to produce and therefore, has a higher selling price than common technology. High-income inequality will dampen the willingness to pay for costlier but cleaner technology. This opinion is supported by Napolitano *et al.* (2020) who revealed that excessive income inequality will jeopardise the development of environment-related technologies. Rahman (2015) stated that in the rural area of Bangladesh, the development of environment-related or so-called "Green Revolution", technologies reduce income inequality. Yet, Aghion *et al.* (2019) contrasted this finding and argued that there is a significant positive correlation between the development of environment-related technologies and top income inequality in the United States. They argued that the innovation of environment-related technologies stimulates entrepreneurship by enhancing the country's income inequality.

Nevertheless, based on the study by Ding *et al.* (2011), the green innovation adopted by middle-income countries cannot affect the unequal income distribution issues. The relationship between income inequality and environmental degradation using carbon dioxide (CO_2) as a proxy can be positive (Liu *et al.,* 2019; Uzar & Eyuboglu, 2019) or negative (Demir *et al.,* 2019; Asongu & Odhiambo, 2021) while Hailemariam *et al.* (2020) proved that different methods yield different results. Very little literature studied the direct link between renewable energy and income inequality. Al-Mulali *et al.* (2013) explained that the development and utilisation of renewable and clean power supply can reduce the unemployment rate, which in turn brings a decline in income inequality by narrowing the income gap between the richest and poorest. On the contrary, Foellmi and Zweimüller (2017) found no significant relationship while Lee (2013) and Leung (2015) found a positive relationship between renewable energy supply and income inequality. This is because renewable energy supply development will boost technology-intensive foreign capital inflows and raise the demand for high-skilled labour and wages. Thus, the income levels for skilled labour increase and the income gap between skilled and unskilled labour is broadened.

Good governance has been identified as an important element in increasing income (Kaufmann *et al.,* 2002) and inequality (Shafique *et al.,* 2006; Abd Elalim, 2020). Acemoglu and

Robinson (2000) found that income inequality declines when governance effectiveness increases. Chong and Calderon (2000) found good governance is only significant for richer countries, Lambert (2017) found no significant relationship, and Huang and Ho (2018) claimed inequality in income distribution is conditional on the economic, ideological and societal conditions of the nation. Hence, there is ample past literature on income inequality but they are either inconclusive or lack coverage of the relationship between the green economy and governance, which this paper aims to examine.

Methodology

This paper covers a period of 11 years, from 2009 to 2019 in more than 30 countries, of which 18 countries are grouped as high-income economies and 12 countries as middle-income countries. The Gini coefficient index (GINI) represents income inequality. Its values range from "0", being most equal to "1" being most unequal. The Worldwide Governance Indicator (WGI) is a proxy for institutional quality or governance, where a higher value means the better institutional quality or good governance. WGI is an index of an equally weighted average of the six dimensions of governance which are "Voice and Accountability", "Political Stability and Absence of Violence/Terrorism", "Government Effectiveness", "Regulatory Quality", "Rule of Law" and "Control of Corruption". Both the Gini coefficient and WGI are sourced from the World Bank. Green economic growth (GGDP) is an economic growth index taking into consideration the environmental consequences, sourced from Mendeley Data and developed by Skare *et al.* (2021). The Development of Environment-Related Technologies (DET) is the percentage of environmentally friendly technology to total technology and innovation. There are various pollutant elements to use as a proxy for environmental degradation and this paper has chosen the emission of carbon dioxide gas (CO_2) due to its vast impact on climate change and relatedness to energy consumption (Cai *et al.,* 2018; Caglar *et al.,* 2022). Renewable energy supply (EN) is the percentage of energy from sources that are naturally replenishing to total energy supply. DET, CO_2 and EN are sourced from the OECD database. Together with GGDP, they represent a green economy.

This paper used the advantages of quantile regression with bootstrap replications to capture different relationships in different quantile levels of income inequality. The possibility of data clustering in different quantile and not normally distributed data add incentive for the selection of the quantile regression method. Scatter plots and the Shapiro-Wilk tests are respectively used to observe the data clustering and test the normality of data. The former is based on visualisation while the latter is the common and most powerful statistical inference test for normal distribution. The equations for quantile regression are as follows:

$$GINIi,t\,(\tau|X_{i,t}) = \beta_i + \beta_{1,\tau}\ln(GGDP)_{i,t} + \beta_{2,\tau}\,DET_{i,t} + \beta_{3,\tau}\ln(CO_2)_{i,t} + \beta_{4,\tau}\,EN_{i,t} + \beta_{5,\tau}\,WGI_{i,t} + \varepsilon_i \quad \text{(Equation 1)}$$

In Equation (1), the $\beta(\tau)$ represents the coefficient at the respective quantile τ level of income inequality and $\boldsymbol{\varepsilon}_i$ is the unobserved individual effects. The dependent variable is GINI while the independent variables are GGDP, DET, CO_2, EN and WGI, as explained in earlier parts of this section. GGDP is expected to have a negative relationship with GINI to imply that green economic growth does play a role in decreasing income inequality through an automatic trickling-down effect as espoused by the classic school of thought. It is interesting to know whether environmentally friendly endeavours are compatible with the reduction of income inequality where if yes, DET and EN are expected to have a negative relationship with GINI and CO_2 has a positive relationship. Better governance is expected to help reduce income inequality, hence, implying the expected negative relationship between WGI and GINI.

Results

Scatter plots of income inequality (GINI) (on the y-axis as a dependent variable) against the independent variables (x-axis) are shown in Figure 1. Generally, the distributions of independent variables have clustering patterns, where different trend lines can be drawn to represent the different relationships in different quantiles of inequality. For example, the possible trend lines for the lower inequality levels between the 20th and 30th quantile are likely to be flatter than the trend line for the higher inequality levels between the 40th and 50th quantile. The results of the Shapiro-Wilk tests as shown in Table 1 imply that the data is not normality distributed. All the variables in Table 1 are statistically significant at either a 5% or 1% level.

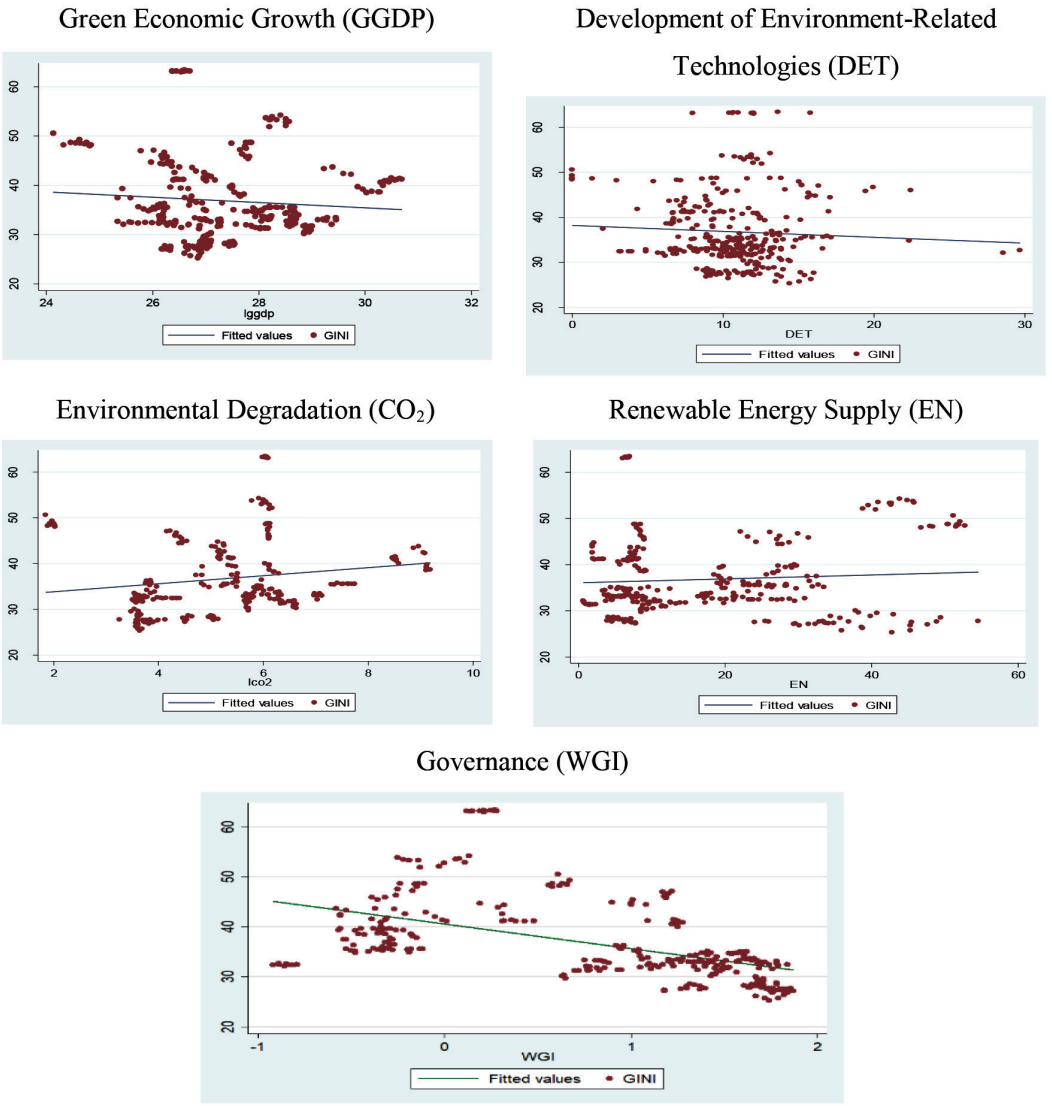

Figure 1: Scatter plots for income inequality (GINI)

Table 1: Shapiro-Wilk test results

Variable	All Countries	High-income	Middle-income
GINI	0.8791	0.8782	0.8938
(z-score)	(7.8600) ***	(6.6490) ***	(5.4150) ***
ln GGDP	0.9775	0.9353	0.9778
	(3.8990) ***	(5.1920) ***	(1.8910) **
DET	0.9350	0.9667	0.9181
	(6.3980) ***	(3.6660) ***	(4.8300) ***
ln CO_2	0.9649	0.9081	0.9058
	(4.9470) ***	(6.0010) ***	(5.1460) ***
EN	0.8852	0.8620	0.9066
	(7.7390) ***	(6.9360) ***	(5.1280) ***
WGI	0.8998	0.9512	0.9563
	(7.4180) ***	(4.5440) ***	(3.4180) ***
Observation	**330**	**198**	**132**

Note: *, ** and *** indicate significant at 10%, 5% and 1% levels, respectively

Figure 2 shows the quantile regression results for all countries in a graphical format which is preferred to the table format to analyse the changing patterns from lower quantiles to higher quantiles. The x-axis shows the quantiles or level of inequality as quantified by the Gini coefficient. The y-axis shows the coefficient values of the independent variables corresponding to the respective quantiles. The shaded areas covering the coefficient line represent a 95% confidence level and thus should not consist of zero value to be considered statistically significant. Except for DET, the three proxies for the green economy, namely EN, CO_2 and GGDP are significant at higher quantiles but not at lower quantiles. There is a decreasing trend in the WGI coefficient line from the higher quantiles to lower quantiles.

The average Gini coefficient indexes for all countries, high-income countries and middle-income countries are 36.82, 32.65 and 43.07, respectively. On average, the income inequality in high-income countries is 10.42 index points lower than that of middle-income countries. This prompts further findings based on separate income groups of countries. The regression results for high-income countries and middle-income countries are shown in Figures 3 and 4, respectively. Based on Figure 3, GGDP does not have a significant relationship with income inequality (GINI) at all quantiles in high-income countries. Marginally significant relationships are also shown in other green economy proxies. For example, DET is only significant and negative at the 10^{th} quantile, EN is significant and positive at the 10^{th} to 20^{th} quantiles and CO_2 is significant and positive at the 10^{th} to 30^{th} quantiles. WGI has a significant and negative relationship with income inequality (GINI), aside from certain quantiles.

Middle-income countries (as shown in Figure 4) mirrored high-income countries for DET and EN. However, middle-income countries' GGDP has a significant positive relationship with income inequality (GINI) at lower quantiles (20^{th} to 50^{th} quantile) and a significant negative relationship only at the 90^{th} quantile. CO_2 has a significant negative impact on income inequality at lower quantiles (10^{th} to 50^{th} quantile) and a significant positive impact at the 90^{th} quantile. WGI has a significant positive relationship with income inequality at all quantiles. These results cause great concern as they imply green economy and good governance increase income inequality instead of reducing it.

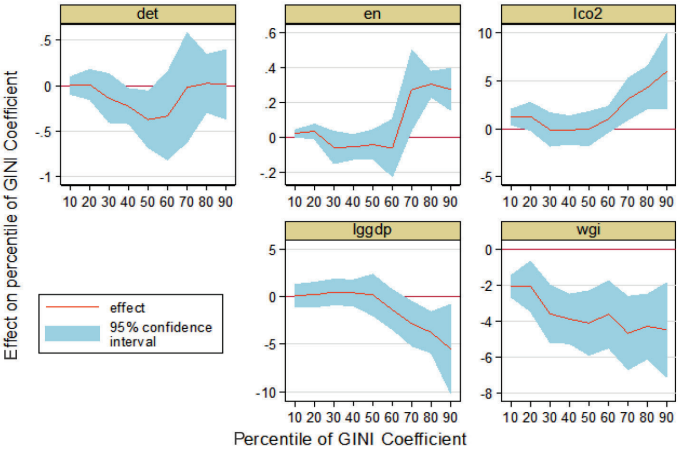

Figure 2: Quantile regression coefficient graphs for all countries

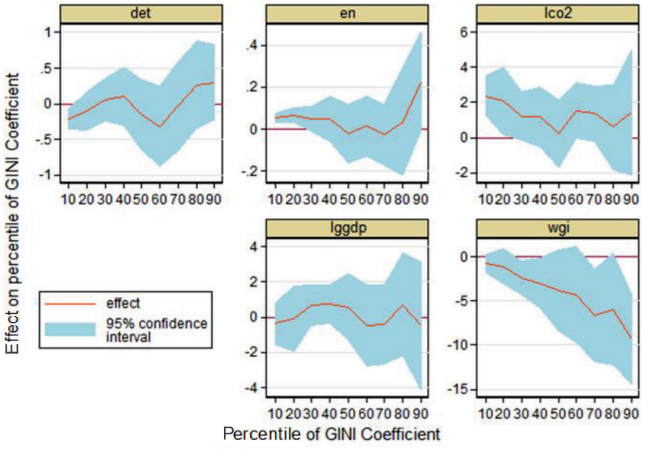

Figure 3: Quantile regression coefficient graphs for high-income countries

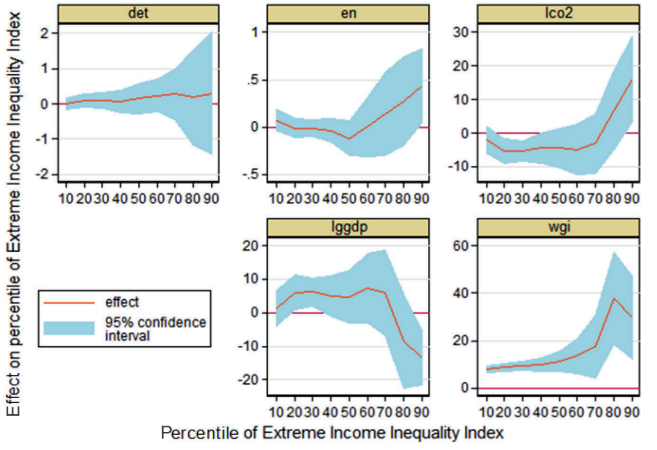

Figure 4: Quantile regression coefficient graphs for middle-income countries

Discussion

Overall Implication

This study and its findings encompassed various aspects of the SDGs. These include a green economy with sustainable economic growth (SDG 8), low carbon dioxide (SDG-13), environmentally friendly technology and renewable energy with resource efficiency for environmental preservation (SDGs 7, 14 and 15), income inequality with social inclusiveness (SDGs 1, 2, 5 and 10) and good governance (SDGs 16 and 17). The overall results imply that the relationship between green economy (which consists of green economic growth, the development of environment-related technologies, environmental degradation and renewable energy supply), governance and income inequality are not analogous between the different categories of countries' development status and between different levels (quantiles) of income inequality. These have justified the use of quantile regression on different groups of countries in this paper. Based on these results, policies and research focus should not apply a one-size-fits-all approach. This is highly applicable to international organisations such as the United Nations, World Bank, International Monetary Fund, monetary unions and trade blocks which should emphasise customized development policies, rather than generalised ones for inequality, green economy and governance.

High-income Countries

In high-income countries, green economy proxies are mostly not significant to income inequality. This result is consistent with Ding *et al.* (2011), only that their research involves middle-income countries. These results offer two implications. Firstly, high-income countries cannot rely on positive externalities from their efforts to engage in a green economy to help reduce inequality. In short, there is no "save two birds with one stone" scenario. Secondly, on the other hand, high-income countries may pursue a sustainable green economy without needing to be concerned about income inequality, which is only reduced with better governance. Any effort towards a green economy does not have a significant positive or negative impact on the effort to reduce income inequality. The quantile results imply that the higher the level of income inequality in high-income countries, the more important it is to have better governance. The magnitude of the negative relationship between better governance and lower income inequality increases from a lower level to a higher level of income inequality.

Middle-income Countries

Policies to achieve the sustainability trinity of income inequality, a green economy and good governance are extremely challenging for middle-income countries. At the highest level of income inequality, green economic growth and reducing environmental degradation (carbon dioxide emission) do help in reducing income inequality, which is consistent with Aguilar-Rivera (2021). When the income inequality gets lower to the level between the 50th and 80th quantiles, the green economy has no significant effect. However, continued efforts to lower income inequality to a level below the 50th quantile will meet with contradicting effects from the green economy. At these lower levels of income inequality, green economic growth and reducing environmental degradation will increase income inequality. Thus, there is an "income inequality-green economy trap" between the 50th quantile and 80th quantile levels. The findings for middle-income countries imply an EKC. The shape of the coefficient graph for green economic growth mirrors an inverted U-shaped curve. The coefficients for the green economy increase until the 60th quantile of income inequality and then decrease. This implies that the relationship between green economic growth and inequality has an increasing trend at the beginning, before having an opposite trend after the 60th quantile level. However, the turning point is too high and the impact of green economic growth is only significant at the 90th quantile level, making it difficult to overcome the mentioned "income inequality-green economy trap".

The positive results between institutional quality and income inequality mean better governance (higher WGI) leads to higher income inequality. The results directly imply that poor governance (lower WGI) is like a "helping hand" in lowering inequality (lower Gini coefficient). These results are shocking but they have also been reported in some past literature such as Chong and Calderon (2000) for income inequality and aggregated institutional quality and Li *et al.* (2000) for income inequality and corruption, which is one of the aspects of governance. Indirectly, the results hint at serious fundamental flaws in institutional structures or systems that produce such a disturbing relationship between governance and income inequality. A possible flaw, despite being debatable is pseudo-democracy which has persisted for a long time (Tonne, 1953; Herzog, 1993; Case, 2004; Foa & Mounk, 2021). In pseudo-democracy countries, the quality of governance appears to be good but is the opposite, hence, not helping reduce income inequality.

Conclusion

Sustainability is the theme shaping the contemporary world. Lowering inequality, a greener economy and better governance are important sustainability agendas that inform various SDGs, economic management, environmentally friendly innovations and politics. The trinity issues of inequality (SDGs 1, 5 and 10), green economy (SDGs 7, 8, 14 and 15) and governance (SDGs 16 and 17) are collectively part of the "Environmental, Social and Governance" holistic policy consideration but lack academic empirical research, especially in analysing the relationship nexuses within the quantile analysis perspective. This paper fills up these research gaps, which are (i) to see all three aspects of inequality, green economy and governance together and, (ii) doubting the different relationship nexuses in different levels (quantiles) of inequality and then proving them as statistically valid. Any "one-size-fits-all" regression model such as ordinary least squares, generalized method of moments, autoregressive-distributed lag and vector error correction model will provide one generalised relationship (coefficient) for all levels of income inequality. However, the impact of a green economy, governance and income inequality could vary between high levels of inequality and low level of inequality, thus giving quantile regression an advantage over the generalised regression methods. This paper hopes to provide more insights into the relationships between inequality, green economy and governance at different levels (quantiles) of income equality.

The findings of this paper reveal that achieving the trinity of low inequality, a green economy and good governance is a big challenge, especially in middle-income countries. Progress towards a green economy in middle-income countries has no statistical impact on income inequality from higher to middle quantiles but is harmful in the lower quantiles of income inequality. These findings imply that efforts to achieve SDGs, like SDGs 7, 8, 14 and 15 for a green economy, do not help achieve goals related to inequality such as SDGs 1, 5 and 10. The results estimate a green economy-income inequality trap between the 50th quantile and 80th quantile level of income inequality. Any effort to reduce income inequality below the lower boundaries of the 50th quantile level will face resistance and be incompatible with concurrent efforts to pursue a green economy. Higher green economic growth may not be helpful due to the high turning point in the EKC model. Making matters worse and shocking, good governance (as targeted in SDGs 16 and 17) is also harmful to income inequality in middle-income countries. This result should not encourage bad governance as a "helping hand" to lower income inequality but hints at serious fundamental flaws in institutional structures or systems that produce such a disturbing relationship between governance and income inequality. Perhaps, future research can focus on detailed aspects of governance that cause this shocking anomaly result. In high-income countries, the results reveal that the green economy mostly has no significant relationship with income inequality

while better governance can reduce inequality. High-income countries can still freely pursue a sustainable green economy despite reaping no significant spillover impact on income inequality which can be reduced only with better governance.

In conclusion, policy formulation regarding the SDGs towards achieving the sustainable trinity of lowering inequality, a greener economy and better governance is very challenging, and continuous research in the future is needed. This paper has three recommendations for future research. First, future research can add determinants from the UNEP's key focus areas for environmental issues that are rarely covered such as biodiversity, noise pollution, climate adaptation finance and environmental governance as well as the impact of shocks such as the COVID-19 pandemic, wars and drastic policy changes. Second, this paper found that better governance does not decrease income inequality in middle-income countries. Thus, further research on this aspect is recommended using individual components of governance such as control of corruption, voice and accountability, political stability, and rule of law. In addition, future research can analyse other related proxies such as the "Corruption Perceptions Index", "Global Corruption Index", "Global Integrity Index" and many others as listed in Malito (2014), as well as the Index of Economic Freedom by the Heritage Foundation. Third, it will be interesting if future research can measure and take into consideration the impact of the Fourth Industrial Revolution and the metaverse on the relationship nexus between income inequality, green economy and governance.

Acknowledgements

The authors wish to thank the reviewers for their suggestions to enhance this paper.

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