The Scientific Journal of Cihan University – Sulaimaniya **PP: 289-304**
Volume (9), Issue (1), June 2025
ISSN 2520-7377 (Online), ISSN 2520-5102 (Print)

Measuring and Analyzing the Impact of Income Inequality on Sustainable Development a Panel Study of Selected Countries (2000-2023)

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Abstract:

The objective of this study is to investigate the impact that income inequality has on sustainable development and pinpoints economic and social indicators that are usually an indication of the poverty rate in a country. This study applies GMM/DPD estimation to analyze how income inequality affects economic and social sustainability, with special attention given to poverty rates in the selected countries. The results indicate that income inequality-as represented by the Gini coefficient-is positively influenced by aspects such as poverty, population, and unemployment rate; therefore, whenever there is an increase in these variables, inequality widens. The HDI, , in contrast, is considered to decrease income inequality. On top of that, the COVID-19 pandemic has increased inequality in the countries under observation. The study's findings underscore the critical need for redistribution policies to reduce inequality and support sustainable development. In practical terms, governments in countries like Iraq, Iran, and Turkey could face challenges implementing progressive tax systems that target wealth redistribution. This study contributes to academic knowledge and provides valuable policy insights by applying a rigorous quantitative analysis-a panel data estimation-which can devise strategies that will help the region attain socioeconomic stability in a sustainable manner in the long run.

Keywords: Income inequality, Gini coefficient, Poverty, Panel data estimation, Sustainable development.

الملخص:

الهدف من هذه الدراسة هو التحقيق من تأثير عدم العدالة في توزيع الدخل على التنمية المستدامة ، و وتحديد المؤشرات الاقتصادية والاجتماعية التي عادة ما تكون مؤشرا على معدل الفقر في بلد ما. من اجل تحقيق اهداف الدراسة، تم استخدام نموذج (GMM/DPD) لتحليل كيفية تأثير عدم المساواة في توزيع الدخل على الاستدامة الاقتصادية والاجتماعية، مع إيلاء اهتمام خاص لمعدلات الفقر في البلدان المختارة. تشير نتائج الدراسة الى أن التفاوت في توزيع الدخل، و الذي يعبر عنه بمعامل جيني، يتأثر إيجابًا بعوامل مثل الفقر، السكان، ومعدل البطالة؛ وبالتالي، كلما زادت هذه المتغيرات، اتسع نطاق التفاوت. في المقابل، يُعتبر مؤشر التنمية البشرية عاملًا في خفض تفاوت الدخل. علاوة على ذلك، أدت جائحة كوفيد-19 إلى تفاقم التفاوت في الدول قيد الدراسة. وتؤكد نتائج الدراسة على الحاجة الماسة إلى سياسات إعادة توزيع الدخل للحد من التفاوت ودعم التنمية المستدامة. ومن الناحية العملية، قد تواجه حكومات دول مثل العراق وإيران وتركيا تحديات في تطبيق أنظمة ضريبية تصاعدية تستهدف إعادة توزيع الدخل. تساهم هذه الدراسة في المعرفة الأكاديمية وتقدم رؤى سياسية قيمة من خلال تطبيق تحليل كمي صارم " تقدير البيانات اللوحة" والذي يمكن أن يساهم في ابتكار استراتيجيات من شأنها أن تساعد المنطقة على تحقيق الاستقرار الاجتماعي والاقتصادي بطريقة مستدامة على المدى الطويل.

الكليمات المفتاحية : التفاوت في توزيع الدخل، معامل جيني، الفقر بيانات اللوحة، التنمية المستدامة .

DOI: http://dx.doi.org/10.25098/9.1.40

The Scientific Journal of Cihan University – Sulaimaniya **PP: 289-304**
Volume (9), Issue (1), June 2025
ISSN 2520-7377 (Online), ISSN 2520-5102 (Print)

پوختە:

ئامانجی ئەم توێژینەوەیەی بریتییە لە تاووتوێ کردنی کاریگەری نایەکسانیی داهات لەسەر گەشەپێدانی بەردەوام و دیاریکردنی پێنوێنە ئابووری و کۆمەڵایەتییەکان کە زۆرجار ڕێژەی هەژاری لە وڵاتێکدا دیاری دەکەن. ئەم لێکۆڵینەوەیە پێوەری خەمەڵاندنی MM/DPDی بەکارهێناوە بۆ شیکردنەوەی چۆنیەتی کاریگەری نایەکسانیی داهات لەسەر گەشەپێدانی ئابووری و کۆمەڵایەتی بەردەوام، بە تایبەتی سەرنج خراوەتەسەر ڕێژەی هەژاری لە چەند وڵاتێکی دیاریکراودا. ئەنجامەکان دەریدەخەن کە نایەکسانیی داهات - کە بە پێوەری گینی دەنوێنرێت- بەشێوەیەکی ئەرێنی کارتێکراوە بە هەندێک لایەنی وەک هەژاری، ژمارەی دانیشتوان، و ڕێژەی بێکاری؛ بۆیە هەر کاتێک ئەم گۆڕاوانە زیاد دەکەن، نایەکسانی داهات فراوانتر دەبێت. لە بەرانبەردا، وا دادەنرێت کە پێوەری HDI کە نایەکسانیی داهات کەم بکاتەوە. سەرەڕای ئەوە، پەتای کۆڤید-١٩ نایەکسانیی داهاتی لە وڵاتانی جێی باسدا زیاد کردووە.

ئەنجامەکانی لێکۆڵینەوەکە ، پێویستیی گرنگ بۆ سیاسەتەکانی دووبارە دابەشکردنەوەی داهات دەردەخەن بۆ کەمکردنەوەی نایەکسانی و پشتگیری گەشەپێدانی بەردەوام. لە ڕووی کردارییەوە، دەشێ حکومەتەکانی وڵاتەکانی وەک عێراق، ئێران و تورکیا ڕووبەڕووی ئاڵەنگاری ببنەوە لە جێبەجێکردنی سیستمەکانی باجی پێشکەوتوودا کە ئامانج لێی دووبارە دابەشکردنەوەی سامانە. ئەم لێکۆڵینەوەیە هاوبەشی دەکات لە زانینی ئەکادیمی و ڕێنمایی گرنگی سیاسەت پێشکەش دەکات لەڕێگەی پیادەکردنی شیکردنەوەیەکی چەندایەتی- خەملاندنی داتای پانێڵ- ، کە دەتوانێت چەند ستراتیجییەک گەلاڵە بکات بۆ یارمەتیدانی ناوچەکە تا بگات بە سەقامگیری ئاسایشی ئابووری و کۆمەڵایەتی بە شێوەیەکی بەردەوام لە ماوەی درێژخایەندا .

کلیلە وشە: نایەکسانی ئابووری، پێوەری گینی، هەژاری، خەملاندنی داتای پانێڵ، گەشەپێدانی بەردەوام.

1. Introduction

Income inequality is a serious issue around the world which has a powerful effect on societies and individuals. It prevents social mobility, leads to economic instability, and encourages social tension. This type of inequality at high levels can exclude individuals from good opportunities such as access to employment and education, which in turn causes restrained potential and slow social progress. The rise of global income inequality has become a priority for policy makers in developed and developing countries likewise (Assouad et al., 2021).

Income inequality affects sustainable development as it influences people's living standards and their human capital development which are fundamental to sustainable economic progress. According to Tabash et al., (2024), the widening gap between wealthy individuals and impoverished people stands as a substantial barrier to achieving the Sustainable Development Goals (SDGs) since inequality limits inclusive economic progress and fair resource availability. Many policymakers have become increasingly concerned about this issue while they recognize that decreasing inequality leads to sustainable economic growth over the long term.

Income inequality has shown a pronounced increase since the 1980s. Research from Piketty (2014) and Piketty & Zucman (2014) reveal that wealth accumulation favors high-income individuals particularly in developed nations because of an increasing capital-to-income ratio. The inequality between rich and poor populations has expanded. This rising inequality has social implications. The work of Stiglitz (2012) highlights how inequality undermines social unity and leads to economic mismanagement followed by corruption and favoritism which destabilize economies further.
The United Nations' 2015 SDGs demand that nations reduce inequality within their own borders as well as between different nations by the year 2030. The complex connection between inequality and sustainable development shows that unequal access to opportunities and income levels causes reduced

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The Scientific Journal of Cihan University – Sulaimaniya **PP: 289-304**
Volume (9), Issue (1), June 2025
ISSN 2520-7377 (Online), ISSN 2520-5102 (Print)

social mobility, reinforces poverty and increases social expenses. The principle of sustainable development by design aims to achieve widespread growth and enduring prosperity. If inequality remains unaddressed it may weaken institutions and destabilize governance structures thus hindering the achievement of SDGs. The reduction of income inequality must happen because it forms an essential requirement for achieving sustainable development beyond its role as a matter of justice.

Besides economic and social fields, income inequality has also been a matter of concern politically in countries like Iraq, Iran, and Turkey. Despite differences in institutions and historical aspect, these countries share a common problem in rising inequality. Political fragmentation as well as ethnic and sectarian tendencies in Iraq has led to a shortage of equal distribution in resources and incomes, heightening social tensions and instability. Likewise, economic liberalization in Turkey, which has existed since the 1980s, has led to capital concentration in the hands of business elites, especially those with close ties to the ruling party. This concentration has increased the gap between elites and society at large, and has resulted in social discontent (Gradín et al., 2021).

Part of the income inequality in Iran has been attributed to Iran's rentier economy, with oil revenues passing into the hands of a privileged few. This unequal concentration, combined with poor governance, has resulted in massive disparities between rural and urban populations, and between social classes. Sadeghi (2023), Mozaffari & Vaysi (2023) and Assouad (2020) have further shown about the critical consequences of the former on community health, and the latter on long-term economic growth, in stifling the prospects of sustainable growth for the nation. Similar to Iraq and Turkey, lowering income inequality in Iran matters as much for economic growth as it does for social and political stability.

Greater gap between poor and rich affects sustainable development negatively in economies such as Iraq, Iran and Turkey. In these economies, income inequality has been a key barrier to progress towards the SDGs contributing to limited progress of economic growth, social cohesion, and environmental sustainability. It is critical for inequality to be addressed in order that everyone has a stake in development and in broader sustainability goals.

This study, supposes that economic inequality has a powerful influence in affecting social sustainability in these countries negatively.

This study investigates the nexus between sustainable development and income inequality in Iran, Iraq, and Turkey during the period 2000–2023. By the means of social sustainability the study investigates the effect of income inequality on social indices influencing poverty, education and employment in these nations. The findings will also provide new evidence about how inequality undermines wider sustainable development outcomes and practical lessons for policy makers wishing to advance inclusive and sustainable development in those countries. Through policy recommendations grounded in evidence, the research will empower these nations to tackle income inequality in a way that promotes socio-economic stability and sustainability in the long term.

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2. Theoretical framework and literature review

Income inequality and sustainable development each has a very complex relationship. This divergence of growth may induce inequality in the distribution of income, which may impede social and ecological advancements of development. This part of the study will discuss different theories based on sustainable development and income inequality.

1. Theoretical framework

2.1.1. The Kuznets Hypothesis

Kuznets, in his 1955 work, thinks that in early economic growth stages, income inequality rises and then declines as countries transform from agrarian economies to industrialized economies. Kuznets, (2019), it's a relationship in the form of an inverted U now referred to as the Kuznets Curve. According to theory, in the process of development, labor will shift from a low-productivity to a high-productivity sector, e.g. from agriculture to industry, and thus a relationship in the form of an inverted U. It suggests that inequality in incomes increases in early stages of growth and then declines with economic maturity Soava et al., (2020). The Kuznets Hypothesis accounts for how, in sustainable development terms, economic growth and structural transformation bear influence on the distributional nature of incomes. Transformation phase would be critical in capturing how growth-oriented policies would increase inequality in early stages before social and redistributive policies come into effect.

2.1. 2. Human Development Theory

This theory is developed by Amartya Sen and focuses on improving the capabilities and well-being of individuals, rather than just economic growth. Sen (1999). This theory emphasizes equal opportunities for all, underlining the importance of social indicators of health, education, and standard of living in measuring human progress Kuhumba (2019). It can seriously hamper human development by restricting access to education and health, thereby leading to long-term social inequalities. Income inequalities, according to Comim & Hirai, (2022), are harmful to human development. The Human Development Theory goes to the extent of saying that such inequalities need immediate rectification and a new path of growth should be achieved which is both inclusive and sustainable.

2.1.3 Environmental Kuznets Curve Hypothesis (EKC)

The EKC extends the Kuznets Curve to environmental issues, citing that with a growing economy, environmental degradation worsens and then improves at higher levels of income as countries adopt more environmentally friendly practices. Grossman & Krueger, (1995). This hypothesis, within the framework of sustainable development, utilizes evidence that early growth within an economy is what causes environmental damage; however, as economies progress and move up to times of being industrialized the more they get to invest in environmental protection. With this prospect, environmental degradation reaches a turning point. This also involves income inequality whereby the rich may be able to afford the means of guarding themselves against the harm posed by certain ecological degradation, while poorer populations face full exposure Usenata (2018).

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2.1.4 Stiglitz's Theory on Inequality and Development

Extreme inequality renders impossible the achievement of sustainable development as witnessed by the threat that it poses on social and economic stability. According to Stiglitz (2016) hypothesis, inequality diminishes the pace at which development is achieved due to the limiting of access to education, healthcare, and innovation, previously held as drivers of development. High inequality suppresses demand, diminishes total economic activities, underinvests in human capital, which in turn leads to widening inequality and deprivation of longer-term growth.

Another important explanation of the implications of inequality is presented by Stiglitz's theory, that the wealthy protect themselves from environmental degradation, while poorer communities are the ones that will bear the adverse impacts of environmental destruction. The reduction of income inequality, therefore, becomes an integral factor in economic and environmental viability.

2.1. 5 Raworth's Doughnut Economics

It provides a model for attaining sustainable development through the balance of income distribution and environmental limits. This is the "doughnut" that allows for a safe and just space for humanity where development can happen within the bounds of a social foundation-basic needs-and an environmental planetary limits Raworth (2012).

Raworth argues that economic systems are supposed to work within the distribution of incomes in a way that ensures all people have access to the resources most in need, such as health care, education, and housing. While this is happening, economic activities must stay within environmental ceilings that prevent the unsustainable use of resources. This provides a clear framework from which to explore how income inequality contributes to pushing communities outside the "safe and just space" through either the deprivation of basic needs or through environmental degradation Fanning et al. (2022).

2.1.6 Post- Growth Economics

Post- Growth Economics dares contest the dominant obsession of economists with economic growth in GDP as the Holy Grail of development. This theory says that if sustainable development has to be affected, it needs to shift away from growth-centric models toward equitable distribution of wealth and resources. Thierry et al. (2023). Some major propositional stances are the ecological constraint regarding infinite economic growth and reductions in income inequality for a more sustainable model of development. In this respect, the model of this study is highly relevant to Post-Growth Economics, related to income inequality through the Gini index. According to the theory, decreasing inequality is important not only in terms of attaining economic justice but also within the context of solving the unsustainable consumption spree that aggravates environmental degradation.

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2. Literature Review

This subsection reviews the income inequality-sustainable development nexus in Iraq, Iran, and Turkey. As follows:

2.2.1 Income Inequality and Economic Growth

Income inequality's role in the effect on economic growth is amply documented in Iraq, Iran, and Turkey. Shihab and Ahmed (2010) investigate income inequality in Iraq by applying the Gini coefficient and find that economic development has further increased the level of income inequality. The findings support the fact that growth should be achieved with equity. Likewise, Daly et al. (2018) investigate the Iraqi situation with regard to the level of poverty by showing that unevenly distributed income was a cause of retardation in growth, leading to poverty.

For instance, Buğra et al. (2016), in analyzing regional income inequality in Turkey, concluded that there was marked inequality in some of the regions such as the Mediterranean and Central East Anatolia. Most importantly, these regional inequalities reduce national development and economic stability as a whole. Destek et al. (2020) also investigated the kind of financial development that affects income inequality in Turkey, finding a U-shaped relationship whereby early financial sector growth increases inequality then reduces it later in the maturity of the sector.

In Iran, a similar picture unfolds. Hussain et al.(2023) investigated the income inequality role of acting as a moderator to economic growth in Iran. The results indicated that sustained inequality would negatively affect sustainable economic development. This calls for policy measures to reduce income inequality and simultaneously address long-term economic growth in the region.

2.2.2 Sustainable Development and SDGs Progress

Income inequality is one of the major hindrances in the pursuit of attaining the SDGs, particularly among Iraq, Iran, and Turkey. Adidi & Aldhalemi (2024) assessed Iraq's progress on the SDGs, indicating that Iraq significantly lags behind its Arab peers in the areas of health and education performance. The paper goes further to develop an argument that such gaps necessitate aggressive policy measures for sustainability.

In Iran, this has been integrated into the updating of national policies and frameworks on progress toward the SDGs. Iran pursued progress in areas like clean energy investment, quality education, access to healthcare, and reduction of poverty by targeted subsidies and mechanisms for social support. However, formidable challenges remain regarding environmental resilience, gender equality, and employment rates in the context of regional conflicts, climate-related issues, and economic constraints. VNR on SDGs, 2017.

This also aligns with Fartash et al. (2021), which, in the Iranian context, employs the ISM and MICMAC analysis to assess the relative importance and interlinks of the SDGs by finding the SDGs 4-and 12, respectively, on Quality Education and Responsible Consumption and Production, foundational goals that will help reach the rest of the SDGs. Therefore, it needs to be implemented with a tailored approach, taking into consideration Iran's specific challenges and capacities. The contribution of this study is important in the light of prioritizing SDGs in terms of local contexts that

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may be helpful for effective mobilization of resources and strategies concerning sustainable development.

The Türk approach to SDGs shows both ambitious progress and pending challenges in aligning national objectives with global sustainability targets. Tahsin (2024) assessed the coherence of the Turkish poverty reduction policy with the goals of SDGs and also analyzed synergies and trade-offs by using PCA. The results show that Turkey reached several achievements pertaining to poverty eradication, but also significant inconsistencies regarding rural/urban and gender gaps have occurred, along with the burden linked to Syrian migrant integration in poverty measures and welfare systems. These countries serve as an example of the fact that income inequality slows down the progress achieved in several SDGs, especially those pertaining to environmental sustainability and social welfare.

2.2.3 Policy Recommendations for Addressing Inequality

Recommendations toward income inequality for the attainment of sustainable development abound in various research studies. Doyle & Stiglitz, (2014) emphasized that extreme inequality must be tackled through policy measures like progressive taxation to have equal economic growth. They recommend the use of the Palma Ratio since it is more precise compared to the conventional measures of inequality.

Chancel et al. (2018) felt that, even as the SDGs have given a broader framework toward addressing inequality on a global scale, countries such as Iraq, Iran, and Turkey must frame policies so that they would address only domestic problems. With regard to Iran, Hussain et al. (2023) cite the need to have redistributive policies. This is because inequality of income has a negative moderating effect on sustainable economic growth.

In Turkey, Destek et al. (2020) suggest that financial reforms should be proposed in order to decrease the income gap, especially in the underdeveloped regions, as a means of facilitating both economic and social sustainability.

2.2.4 Gaps in the Literature

Despite the fact that the reviewed literature informs on the two important issues of income inequality and sustainable development, gaps still remain. First, there is scant research integrating social and economic dimensions in the analysis of income inequality. In other words, most studies either focus on economic outcomes or stand-alone environmental impacts, and few investigate how income distribution influences multiple dimensions of sustainable development. Future research should explore such linkages in a more holistic way, especially in Iraq, Iran, and Turkey.

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3. Methodology

This study applied GMM/DPD estimation to analyze how income inequality affects economic and social sustainability, with special attention given to poverty rates in the selected countries. The application of GMM is strongly suitable for this analysis due to several crucial reasons. First, it resolves problems of endogeneity, which is a pervasive issue with panel data analyses when independent variables may be correlated with the error term. The most important feature of the GMM is that this allows the use of the lagged values of dependent and independent variables as instrumentals, which, on its part, increases accuracy in the parameter estimates.

3.1. Variable description

Data from 2000 to 2023 are analyzed here. The volatility of the selected variables gives an all-rounded view on the dimensions of development related to economics and social factors. This is an analytical attempt of the trend in the relationship of income inequality to sustainable development.

Table 1 - Variables description and Data sources

Variables	Description	Source
Dependent variable		
Po (Poverty rate)	Poverty headcount ratio at national poverty lines (% of population)	Macrotrends World Band
Independent variables		
Gini (Gini coefficient)	Accordingly, this index processes the income distribution, hence reaching from 0 (perfect equality) to 100. (optimal inequation).	Macrotrends
HDI (Human development index)	A composite index measuring average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living.	Arab,development portal ,World bank
UN (Unemployment rate)	The share of the labor force that is unemployed but actively seeking employment.	World bank
POP (Population)	Total number of persons inhabiting Iraq	World bank
Dummy variables		
D (Covide-19)	This is an indicator of severe economic disruption caused by the covid-19 pandemic. It takes the value of 1 for the years affected by the pandemic, 2020-2022, and 0 otherwise. For all three countries.	(Brooks, C., 2019)

Source: Author ‘s own collaboration.

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3.2 Model specification

First-difference transformation is used here to wash away unobserved heterogeneity and focus on the dynamic change in the variable of interest over time.

The following model is estimated through the use of GMM/DYD:

$$\Delta LPO_{it} = \beta_1 \Delta LGINI_{it-1} + \beta_2 \Delta LHDI_{it-1} + \beta_3 \Delta LPOP_{it-1} + \beta_4 \Delta LUN_{it-1} + \beta_5 D_{it} + \epsilon_{it} \ldots . (1)$$

Where

ΔLPo_{it} = the change in log of the poverty rate for country i at time t.
$\Delta LGINI_{it-1}$= change in the log of the Gini index one period lagged.
$\Delta LHDI_{it-1}$= Change in log of the Human Development Index lagged for one period
$\Delta LPOP_{it-1}$ = is the change in the log of the population lagged one period,
ΔLUN_{it-1}= change in the log of the unemployment rate lagged one period,
D_{it}= is a dummy variable (COVID-19),
ϵ_{it}= is the error term.

4. Results

This section shows the results obtained through the use of EViews-13 in detailing all the statistical analyses through model estimations and interpretations concerning the variables of the study. The results outline the relationships and levels of significance between independent and dependent variables while testing the goodness of fit for explanation of the trend in view. Discussions will then present comparisons of the obtained findings with prevailing literature on the subject, identify the main patterns, and point out unique findings or unexpected results arising from data analysis.

Table 2: Descriptive statistics for the study variable the figures show the central tendencies of mean, median, and dispersion of maximum, minimum and standard deviation.

	LPO	LGINI	LHDI	LPOP	LUN	D
Mean	2.9572	3.6034	-0.3326	4.0555	2.3669	0.1285
Median	3.0201	3.6888	-0.3382	4.2533	2.3639	0
Maximum	3.6375	3.8022	-0.1566	4.4905	2.7831	1
Minimum	2.3886	3.3534	-0.5041	3.2027	1.8710	0
Std. Dev.	0.2698	0.1705	0.0903	0.4164	0.1876	0.3371

"**Source:** Research finding."

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Table 3-Correlation

	PO	GINI	HDI	POP	UN	D1
PO	1					
GINI	0.9365	1				
HDI	0.9554	0.9940	1			
POP	0.8892	0.9812	0.9678	1		
UN	0.9443	0.9736	0.9831	0.9429	1	
D	0.3914	0.3658	0.3794	0.3924	0.3998	1

"**Source:** Research finding."

Table 3 shows the correlation matrix, describing the strength and direction of linear relationships between the variables in the study. Among key observations from this table is that most of the variables have strong positive correlations, indicating that they tend to move together.

It is highly positively correlated with the Gini index, HDI, POP, and UN. More precisely, the poverty and income inequality correlation ~GINI is 0.936, reflecting that when income inequality increases so does the rate of poverty. The relationship of poverty and human development ~HDI is 0.955, hence inferring that poorer human development is very highly associated with increased poverty.

With a Gini index of 0.994, there is almost a perfect correlation with HDI, which indicates that to a great deal, income inequality and human development go together; in other words, with increased income inequality, human development tends to worsen. The dependence is very strong on population and so is the unemployment as both record high correlations with Gini and HDI to indicate that larger populations and higher rates of unemployment are associated with heightened inequality and worse development outcomes.

The fact is that Covide-19, while being positively related to the core variables, still affects a comparison with strong interrelations observed among the primary economic and social indicators. These findings suggest a highly interconnected system in which changes in income inequality and unemployment, for example, are likely to be significantly transmitted both to levels of poverty and human development outcomes.

DOI: http://dx.doi.org/10.25098/9.1.40

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ISSN 2520-7377 (Online), ISSN 2520-5102 (Print)

Table 4- Panel Unit Root test

Variables	**LLC test (prob.)**	**IPS test (prob.)**	**CIPS test (prob.)**
Level			
Poverty	0.0170	0.0401	0.0287
Gini Coefficient	0.5033	0.7251	0.8551
HDI	0.0411	0.5074	0.5840
Population	0.0578	0.8861	0.9399
Unemployment	0.0063	0.1644	0.0481
Fist difference			
Poverty	0.0352	0.0035	0.0059
Gini Coefficient	0.0103	0.0177	0.0239
HDI	0.0415	0.0108	0.0141
Population	0.0096	0.0000	0.0001
Unemployment rate	0.0000	0.0002	0.0006

"**Source:** Research finding."

The results for the Panel Unit Root tests at the level and at the first difference are presented below. Most of these variables are non-stationary at their levels because, generally, the probabilities of LLC, IPS, and CIPS tests are above 0.05, with the exception of the variables poverty and unemployment that, at levels, present significant results in the few tests. However, after differencing the variables, the tests-that is, LLC, IPS, and CIPS-all yielded significant probabilities of less than 0.05 for each variable to be stationary on first difference. This suggests that the variable is integrated of order one. [I(1)].

Table 5-Johansen Fisher Panel Co-integration Test

Unrestricted Co-integration Rank Test (Trace and Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
Poverty rate	127.8	0.0000	67.96	0.0000
Gini coefficient	78.47	0.0000	51.51	0.0000
HDI	37.45	0.0000	27.75	0.0001
Population	15.45	0.0170	7.397	0.2856
Unemployment rate	13.67	0.0335	10.69	0.0985
D (covide-19)	12.65	0.0488	12.66	0.0488

"**Source:** Research finding."

The Johansen Fisher Panel Co-Integration Test indicates that there are relationships among the variables. In regard with the poverty rate, Gini coefficient, and HDI, the trace and maximum eigenvalue tests result in highly significant Fisher statistics with probabilities of (0.0000), which confirms strong evidence of co-integrations of these variables. Evidence for population and unemployment is weaker; trace test for a population is significant only, while for unemployment, trace test shows marginal significance but not for the maximum eigenvalue test. The COVID-19

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dummy variable shows borderline significance. Thus, there is some evidence of the key variables being co-integrated.

Table 6-Panel Data Estimation of Poverty rate by applying GMM/DYD Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGINI	1.5926	3.53860	-5.6552	0.0000
LHDI	-0.8278	1.3185	--2.8916	0.0054
LPOP	0.2780	0.5563	4.6659	0.0000
LUN	0.0156	0.1636	-2.6951	0.0092
D	0.0446	0.4424	2.2665	0.0272
Effects Specification				
Cross-section fixed (first differences)				
Mean dependent var	0.006486	S.D. dependent var	0.11944395	
S.E. of regression	0.02100630	Sum squared resid	0.80533906	
J-statistic	1.18475550 P-value = 0.9463	Instrument rank	5	

"**Source:** Research finding."

Results from the GMM/DYD model, as seen in Table 6, indicate significant associations of income inequality with human development, population, unemployment, and poverty in the selected countries.

It means that with a 1% increase in the Gini coefficient, that is, income inequality, poverty increases by 1.59%, which is supported by Shihab & Ahmed (2010) in Iraq, where they showed that increasing inequality accelerates grades of poverty especially when there is economic development. The same results have been witnessed in Iran, where Hussain et al. (2023) found that income inequality negatively impacts sustainable economic growth and fosters poverty. Buğra et al. (2018) also focuses on regional disparities, while proving that income inequality is one of the most contributing factors to poverty, especially in underdeveloped regions, in Turkey.

On the other hand, increased HDI by 1% reduces poverty by 0.83%, hence the need for an improvement in the social indicators of health and education, as well evidenced by studies done by Adidi & Aldhalemi (2024) in Iraq and Mozafarri & Vaysi (2023) in Iran. These studies have, however, indicated human development plays a crucial role in poverty alleviation through increased access to health and educational facilities.

Another important determinant is the population size, as a 1 percent increase in population brings about a upward change in poverty by 0.28 percent. This goes hand in hand with the study done by Destek et al. (2020) in Turkey, where it was realized that a population pressure translates to a higher level of poverty as the resources and services are further stretched to accommodate the extra head.

The initial positive relationship of unemployment with poverty may reflect safety nets available in those countries. As a result, high unemployment increases inequality and poverty, which again support findings by Stiglitz's (2016), as well as Destek et al. (2020) in Turkey.

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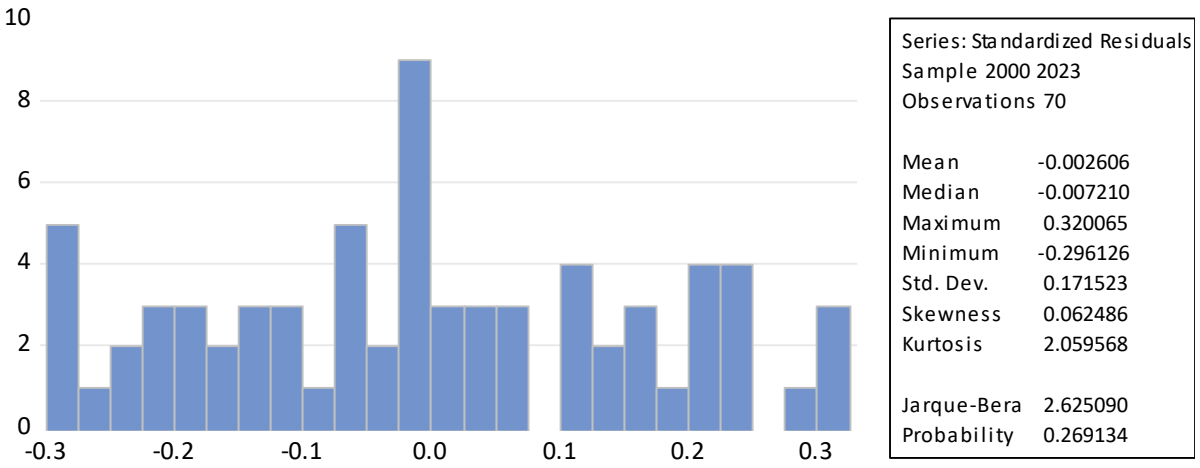
ISSN 2520-7377 (Online), ISSN 2520-5102 (Print)

Finally, the COVID-19 pandemic's dummy variable heightened the states of poverty in the selected countries. The findings are consistent with the results of Adidi & Aldhalemi (2024) in Iraq and those of Grunewald et al. (2017) in Turkey that had significant economic and social disruptions associated with the COVID-19 pandemic.

Model fit and Validity : GMM/DYD estimation indicates that the fixed-effects cross-section model fits very well. The dependent variable has an average of 0.0064 and a low standard deviation of 0.1194; hence, poverty varies little around its mean level. The low standard error of regression of 0.0210 and the sum of squared residuals of 0.8053 means the model approximates the observed data very well. The high p-value of the J-statistic, 0.9463 and 1.1848, respectively, confirms that instruments are valid and there is no problem regarding over-identification. The overall model is robust at capturing the relationship between poverty and inequality along with other variables in Iraq, Iran, and Turkey.



"**Source:** Research finding."

Figure 1- Normality distribution Test: The Jarque-Bera test indicates that data lies on a normal distribution.

Table 7-Arellano-Bond Serial Correlation Test

Test order	m-Statistic	rho	SE(rho)	Prob.
AR(1)	0.9966979	0.096966	0.097287	0.3189111
AR(2)	0.5765238	0.052203	0.0905487	0.5642611

"**Source:** Research finding."

This can be officially verified in Table 6, where serial correlation is not a problem facing the model. That is to say, this result does have the guarantee of valid estimation results for GMM.

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5. Conclusion

The results of the tests indicate that the variables tested show significant relationships toward the model's effectiveness. The findings are consistent with theoretical expectations, key trends that support the hypotheses of the study. The conclusion of the study is on the following key points:

1. High poverty rates are caused by income inequality. The survey indicated that in Iraq, Iran, and Turkey, there was a strong positive relationship between increasing income inequality and soaring poverty levels within the time period considered, so policies that address income disparity must be pursued.
2. Human development has much to do with poverty reduction; a betterment in human development indicators like education and healthcare contributes much to poverty reduction, hence the need for social infrastructure investment.
3. Population size is one of the contributing factors to higher poverty, as it is understood that with a rise in population, so does poverty; thus, it hints at the need in population management as far as relieving poverty pressures is concerned.
4. Unemployment contributes to poverty due to inequality: Although unemployment relief measures do their best to try and alleviate the situation, unemployment creates a self-reinforcing vicious circle that worsens poverty, reinforces income inequality; therefore, there is an urgent need to employ sustainable employment strategies.
5. The COVID-19 pandemic accelerated the rates of poverty due to the fact that this investigation proves the pandemic increases the rate of poverty; for that reason, there is a need to create policies concerning building resilience among vulnerable people in crisis.

6. Recommendation

1. Redistribution policies should be implemented: Progressive taxation and the expansion of social welfare policies by governments in Iraq, Iran, and Turkey would reduce income inequality and its adverse effects on poverty.
2. Invest in human development: The government should increase access to education, healthcare, and social services in order to raise human development and create poverty reduction.
3. Develop strategies that ensure sustainable population growth. In this light, there is a need for supportive policies that favor family planning; resources should be equitably distributed with the view to controlling population growth and reducing its impacts on poverty.
4. Generate long-term job-creating opportunities: The government should focus on policy measures that create sustainable employment opportunities with job security, especially among the more vulnerable groups of the population, so that the negative impact of unemployment on poverty reduced.
5. Enhancing social safety nets in exceptional circumstances: The COVID-19 experience has to be used to reinforce social protection and build crisis-response mechanisms to safeguard vulnerable citizens from a potential future economic shock.

DOI: http://dx.doi.org/10.25098/9.1.40

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