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Measuring and Analyzing the Impact of Income Inequality on Sustainable Development in Iraq from 2000-2023

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ABSTRACT

The problem of income inequality, both within and between countries, is one of the major challenges that face the attainment of sustainable development. This paper looks at how income inequality has influenced the economic and social pillars of sustainable development in Iraq between 2000 and 2023. The problem is that increasing income inequality hinders the realization of sustainable development, especially in Iraq's peculiar socioeconomic context. The hypothesis is that income inequality paces a negative impact on key sustainable development indicators, such as GDP growth and HDI. Further testing of such a hypothesis was done by estimating both short-run and long-run effects through the ARDL model. It was observed that income inequality significantly impacts economic growth and human development. The findings strongly indicate the need for comprehensive policies to be enacted in the realm of lessening income inequality, cutting unemployment rates, and raising standards of living across the board while controlling population growth. In fact, this research has pointed out the alarming increase induced by the financial crisis and the COVID-19 pandemic in income disparities within Iraq. Such policies would be very instrumental in ensuring economic stability in the long term and meeting the required paradigms of sustainable development for Iraq. It therefore provides valuable lessons that could be applied by policymakers in their attempt to devise a strategy that enhances the possibility of achieving economic growth with social equity and environmental sustainability for a more stable and prosperous future in Iraq.

Keywords: Income Inequality, Sustainable Development, Economic Growth, HDI, ARDL.

1. INTRODUCTION

Income inequality is now being perceived as one of the major issues in countries worldwide, particularly in developing countries, whose economic disparities seem to worsen day by day. Iraq itself squeezes into a paradox where its rich oil country's core combines with a sizeable income disparity. The economy, while growing in key sectors, has not succeeded in ensuring a fair distribution of benefits among its citizens. This disparity indeed has multiple far-reaching ramifications, which include issues not only of economic performance but also of the social fabric and environmental sustainability of the country.

These have constituted a very critical barrier to the attainment of SDGs relevant to poverty reduction, social equity, and environmental protection. While the world has made great strides in understanding the interrelationships between income inequality and sustainable development, the specific dynamics in Iraq are still not well explored. One of the most popular measures of income inequality, represented by the GINI coefficient, has also reflected a rather disturbing trend of deepening disparities that threatens to jeopardize the nation's development prospects in the long run. (Kubiszewski et al., 2024).

Income inequality in Iraq is multi-dimensional in its impact. Economically, it results in a situation where growth is stifled due to a cutback on access to means and

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opportunities by the majority of the people. Socially, it polarizes parties, leading to instability and the loss of social cohesion needed for development. According to Wilkinson & Pickett (2012), environmentally, income inequality is said to be linked with unsustainable practices because a rich person or group applies disproportionate pressure on natural resources, leading to environmental degradation. (Chen & Costanza, 2024).

The study is an attempt to overcome these shortcomings by analyzing the impact of income inequality on the dimensions of sustainable development in Iraq during the period starting from 2000 to 2023. Therefore, the problem will be based on setting up the relationship between income inequality and economic growth and human development. Thus, it is expected that income inequality negatively impacts the understudied variables, mainly the economic growth, as echoed in the levels of GDP and HDI.

In this study, the ARDL model is used, which lets a more in-depth look at the short- and long-term connections between income inequality and indicators of sustainable development. The use of this model is particularly pertinent given the complexity and dynamism inherent in the Iraqi economy and its social-political context. The findings from this study are expected to provide valuable insights on how income inequality particularly constrains the attainment of sustainable development in Iraq. Such insights would be important to policymakers in formulating strategies that cater not only to economic growth but also to social equity and environmental sustainability. By addressing the root causes and consequences of income inequality, Iraq can take a serious step toward its development goals, with increased stability and prosperity for all its citizens.

The following sequence organizes the rest of the paper. Section one provides the context, problems, and objectives of the study. Section two presents the theoretical framework and reviews related literature with regard to income distribution and sustainable development. Section three delineates the study's methodology, elucidating the ARDL model and its data sources and properties. Section four presents the results of the empirical test. This paper concludes with policy recommendations on how to reduce income inequality and enhance sustainable development in Iraq.

1.1 Problem statement

Iraq is one of the countries plagued by excessive individual income inequalities that impede its sustainable development. While resources are aplenty, this inequality contributes to economic instability, social disparities, and environmental degradation. Understanding how income inequality relates to sustainable development is important for conceptualizing policies that will also be helpful in solving these issues and giving Iraq a better, more sustainable future.

1.2 Significant of the study

This study is an important contribution to the literature by examining in detail how income inequality affects economic growth and social development and giving insight into how addressing income inequality can actually engender a more inclusive and sustainable development strategy. This study helps academics understand things better by using rigorous quantitative analysis that is specific to Iraq. It also gives policymakers ideas that they can use to make the area more stable economically and environmentally in the long term.

1.3 Objectives of the study

1. Measuring and analyzing the impact of income inequality on economic indicators, specifically GDP growth.
2. The process involves measuring and analyzing the impact of income inequality on social indicators, with a focus on the change in the Human Development Index.

1.4 Hypothesis of the Study

Ho: Income inequality is not a statistically significant factor in the models of sustainable development indicators.

H_1: There is a statistically significant relationship between income inequality and the indicators of sustainable development.

1.5 Methodology

The present study has selected the Autoregressive Distributed Lag model (ARDL) as the fundamental econometric tool. This model works effectively under fixed conditions, for example, when the variables are integrated into different orders, i.e., I(0), I(1), or their combination, with or without the same order of integration (Pesaran, Shin, & Smith, 2001). The ARDL model is especially useful for looking at the short- and long-term relationships between the variables that are being studied. This is because these relationships are important for looking at how income inequality affects sustainable development indicators like CO2 emissions, HDI, and income distribution.

Economic and econometric factors, among others, support the selection of an ARDL model.

To give an economic explanation of the study's purpose, it looks into how changes in the distribution or inequality of income streams affect the signs of sustainable development in both the short and long term. The ARDL model leads to the detail in the analysis of the relationship, catching the dynamic nature of economic indicators in time, which is an important case for policy

implications. This helps in identifying whether changes in income inequality have an immediate or delayed effect on sustainable development goals.

2. Econometric Reasoning: The ARDL model is strong enough to deal with the issue of variables that are not fully integrated, which happens a lot when you look at macroeconomic data that spans several years, like this study's data from 2000 to 2023. One more thing is that it lets you include lagged dependent and independent variables that help fix problems like endogeneity and an omitted variable bias.

The ARDL model is chosen because it analyzes the given relationships among the variables, allows for mixed integration properties, and enables the study to make meaningful inferences about the impact of income inequality on sustainable development indicators.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

One can distinguish between various theories of income distribution, including those based on voluntary choices, institutional roles, and fatalistic theories. The former emphasizes how voluntary choices, inheritance, and institutions explain income inequalities. The latter category includes explanations based on genetic abilities and chance, luck, and life cycle effects on earning capacities. For instance, Milton Friedman's individual choice theory posits that risk-taking behavior leads to individual income inequalities. Empirical evidence disproves this argument by demonstrating that risky investments are not exclusive to the wealthy (Gallo, 2002).

More specifically, the most relevant theories related to the present study are the Kuznets Hypothesis, the Environmental Kuznets Curve Hypothesis (EKC), and Human Development Theory. These theories provide additional understanding of the interlock between economic growth, income inequality, and environmental sustainability.

2.1 Kuznets Hypothesis

The Kuznets Hypothesis was first proposed by Simon Kuznets in 1955 and postulates that the inequality of income rises for the duration of the primary stages of economic growth. However, it subsequently decreases upon reaching the critical average income level (Kuznets, S., 1955). The Kuznets Curve, a graphical inverted U-shaped relationship between income inequality and economic development, illustrates this theory. This provides a framework for dynamic interaction between growth in GDP and income inequality, as provided by the Kuznets Hypothesis. It is thought that as people move from farming to working in factories, income inequality rises at first and then goes down as workers move from farming to working in factories and agricultural productivity rises over time (Soava et al., 2020).

2.2 Human Development Theory

Rather than just focusing on economic growth, Human Development Theory, which is often linked to Amartya Sen's Capabilities Approach, aims to improve people's well-being and make their choices and abilities better. It emphasizes protecting and promoting human capabilities and ensuring a fair opportunity for every individual on earth. This has formed the basis of numerous research works that incorporate social indicators like HDI (Wells, T.R., 2012). It is in conformity with the broader goals of sustainable development that economic growth translates into better well-being and the possibility of equal opportunities for every segment of people. This will also show how income inequality can restrain the capabilities and opportunities of some people, hence affecting overall human development (Comim & Hirai, 2022).

2.3 Environmental Kuznets Curve Hypothesis

The Environmental Kuznets Curve hypothesis applies the Kuznets Curve idea to environmental degradation and says that it rises at first with economic growth but starts to fall as an economy matures and starts using more environmentally friendly methods (Grossman & Krueger, 1995). This hypothesis is important in understanding the relationship between economic growth, income inequality, and environmental indicators like CO2 emissions. It infers that environmental degradation is high during the early phases of economic growth but begins to decline as income rises and, consequently, also the resources used toward protection. The framework places emphasis on the fact that true economic maturity with sustainable business-friendliness at its core will reduce the impact on the environment (Usenata, 2018).

Overall, these theories need to be integrated in explaining how income inequality can affect sustainable development in Iraq during the period 2000-2023. The Kuznets hypothesis explains the relationship between economic growth and income inequality, thereby giving insight into how any change in the economy structure could result in inequality. Human Development Theory is focused on how to enhance well-being and broaden human opportunities; it is, therefore, crucial to emphasize broader implications of income inequality for other social indicators, such as HDI. The EKC hypothesis added a view of how economic growth affects environmental quality, which is important in assessing the sustainable development of Iraq.

2.4 Literature Review

The most important area of study, especially in developing countries like Iraq, is the relationship between income distribution and sustainable development.

Despite the explicit link between income equality and economic fairness, social justice, and environmental sustainability, it is surprising to find that very few analyses have been conducted specifically to shed light on these issues within the context of Iraq. This review would look at the literature concerning income distribution and sustainable development, emphasizing the need for more integrated studies in this area.

Income Distribution and Economic Development in Iraq

Shihab and Ahmed (2010) It can be recognized that the point of analysis has therefore been based on using the Gini coefficient as the measure of inequality to examine the effect of economic development on income distribution in Iraq. The results confirmed that as economic development increases, the distribution of income in Iraq becomes increasingly unequal over the analyzed period. The conclusion suggests that Iraq can achieve proper economic development by ensuring fair and equal income distribution and correcting the existing disparities.

Habib and Shahab (2019) The authors focused on income inequality in the Iraqi Kurdistan region, drawing on data from the 2018 household survey on income and expenditure conducted for 2351 households in Erbil. All in all, the research found that large income inequality takes place, which heavily affects the low-income classes of the population and accordingly exerts negative effects on social and economic stability. Considering all these effects, one may recommend the use of active policies on income redistribution, along with economic reforms.

Omed (2023) analyzed the impacts of financial policies on income inequality in Iraq and wage distributions among political elites by analyzing their privileges. Through deductive analysis, this study has identified that a small number of political elites within state institutions earn extremely high wages compared to regular employees, while a smaller minority commands the majority of wages. This study posits that policy reforms are required to reduce such fissures.

Sustainable Development and Iraq's Progress

Adidi and Aldhalemi (2024) This paper assesses the progress Iraq has made so far in achieving SDGs against the rest of the Arab world. Using SDG data from United Nations publications for Iraq and statistical processes through t-tests as a means of comparing Iraq's indicators of each goal versus the world and Arab averages, it was found that Iraq is far below the achievement average among Arab nations. The authors, through their argument, call upon Iraq to take even more aggressive measures to bridge such gaps and achieve sustainable development.

Awad et al. (2024) The authors applied the ARDL model in order to investigate the long-term relationship between sustainable development indicators and GDP per capita in Iraq during the period 2004–2020. Their results provided evidence of a strong relationship indicated in the long run, as in the case of indicators of sustainable development with health and educational expenditure to show economic growth. The study calls for the need for Iraq to implement policies friendly toward sustainable development to help achieve the long-term trajectory of economic growth.

Synthesis of the Literature and Gaps

In essence, the reviewed studies all point toward severe income inequalities in Iraq because of the uneven nature of the country's economic development, financial policies that have favored the political elite, and regional disparities. These have serious dampening effects that have been instituted on the social and economic stability of Iraq, a factor further compounded by the slow pace of movement toward the attainment of SDGs when put against other Arab countries. While available literature provides immense learning on either specific areas of income distribution or sustainable development, little or no research is found that encompasses both the issues in an integrated manner. This deficiency forms the basis for future research that merges these aspects in order to guide policy actions toward equitable and sustainable development in Iraq.

3. METHODOLOGY

This section includes variable descriptions, data collection, sources of data, and measurement of the impact of income inequality on sustainable development in Iraq during 2000–2023.

3.1 Variables description

Table 1: Variables description and Data sources

Variables	Description	Source
	Dependent variables	
GDP Gross domestic product constant (LCU)	These are "total market values of all final goods and services produced in a country in a year".	World Bank (WDI)
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
	Independent variable	
Gini (Gini coefficient)	This index processes the income distribution. It ranges from 0 (perfect equality) to 100 (perfect inequality).	Macrotrends
UN (Unemployment rate)	The percent of the "labor force that is without work and actively seeking employment".	World Bank
POP (Population)	Total number of persons inhabiting Iraq	World Bank
	Dummy variables	
D1 (Iraq financial crisis)	It accounts for the impact of the financial crisis in Iraq in 2014; it takes 1 for 2014-2018 and 0 otherwise.	Brooks, C., 2019. *Introductory econometrics for finance*. Cambridge University Press
D2 (COVID-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.	

The analysis covers a period from 2000 to 2023. This period shall be selected so as to identify the main economic, social, and environmental changes that have been taking place in Iraq.

The selected variables will provide an all-rounded view of the dimensions of development related to economics, social factors, and the environment. An attempt will be made to analyze the trends in relationships between income inequality, measured by the Gini Index, and some important economic indicators, like GDP and unemployment, some social indicators, such as HDI and population, and some environmental indicators, like CO2 emissions. The inclusion of the financial crisis and COVID-19 dummy variable accounts for the unique effects of the pandemic and financial crisis on the Iraqi economy.

3.2 Model specification

The ARDL model is applicable for conducting analyses for both short-run and long-run relationships between variables. Presented below are the models:

1- GDP model:

Shot-Run estimation:

$$D(Ln(GDP)_t = \alpha_0 + \alpha_1 (GDP)t + \alpha_2(Gini)_t + \alpha_3 (UN)_t + \alpha_4 (pop)_t + \alpha_5 D_{2t} + \epsilon_t \dots\dots\dots\dots (1)$$

Long –Run estimation: The long run relationship implied by Error correction model (ECM)

$$EC = \beta_0 + \beta_1 Gini_t + \beta_2 ln(UN)_t + \beta_3 ln(pop)_t + \beta_4 D_{2t} + \varepsilon \dots\dots\dots\dots\dots\dots (2)$$

2- HDI model:

Short-Run estimation

$$D(ln(HDI)_t = \alpha_0 + \alpha_1(Gini_t) + \alpha_3 ln(POP)_t + \alpha_4 ln(UN)_t + \alpha_5 D_{1t} + \alpha_6 D_{2t} + \epsilon_t \dots\dots\dots\dots (3)$$

Long-Run estimation

$$\boldsymbol{EC = HDI + \beta_1 Gini + \beta_2 Pop + \beta_3 LGDP + \beta_4 UN + \beta_5 D_1 + \beta_6 D_2 + \varepsilon} \dots\dots\dots\dots\dots\dots\dots\dots (4)$$

Long-Run estimation

$$EC = \beta_0 + \beta_1 Gini + \beta_2 (ln(GDP) + \beta_3 (ln(UN) + \beta_4 (ln(Pop) + \beta_5 D_1 + \beta_6 D_2 + \varepsilon \dots\dots\dots\dots (6)$$

4. RESULTS AND DISCUSSION

4.1 Unit root Test

The stationarity of data series and variables is a basic assumption underpinning any econometric theory. This makes the testing of time series for stationarity an obvious concern in any econometric analysis. The Augmented Dickey Fuller test is one of many procedures used to check stationarity. Table 2 enlists the results of ADF testing that allow determining whether the data is stationary.

Table 2:
Unit root test

Variables	ADF (1st difference) –Intercept	1st Difference- Trend and Intercept
Gini	0.0428	0.0035
Poverty rate	0.0001	0.0006
Unemployment	0.0127	0.0424
Population	0.0402	0.1383
GDP	0.0001	0.0004
HDI	0.0002	0.0004

Table two displays the result of the ADF test: If the p-value is less than 0.05, we can reject the null hypothesis regarding the presence of a unit root, indicating non-stationarity. According to this result, all variables have stationarity at first difference and with an intercept and 1st difference trend, except for the population variable when a trend and intercept are considered. This therefore

implies that for most of the data, the null hypothesis of a unit root can be rejected, confirming the stationarity of the data.

Table:
Unit root test (Phillips-Perron) test

Variables	PP test **(1st difference)** **Intercept**	**1st difference** **Trend & intercept**
Gini	0.0004	0.0031
Poverty rate	0.0037	0.0149
Unemployment	0.0001	0.010
Population	0.2752	0.4972
GDP	0.0003	0.0018
HDI	0.0036	0.0131

Table 3: PP unit root test results Table 3 shows that all the variables are stationary at first difference, with both intercept and trend & intercept, excluding the population (POP) variable, which is non-stationary in both conditions. However, when using the ADF test, it is stationary at the 1st difference—intercept.

4.2 Co-integration

After stationarity testing, the cointegration test between variables in the model should be done. Such tests are considered important because they provide information regarding the extent of integration among variables under study. It is necessary that at least one relationship from the independent and dependent variables turns out significant enough for model estimation to carry on.

Table 4:
Co- integration test

1st model Gini index

	Unrestricted co-integration Rank test (Trace)			**Unrestricted Co-integration Rank test (Maximum Eigenvalue**		
Hypothesized No. of CE(s)						
Variables	**Trace statistic**	**0.05Critical value**	**Prob.****	**Max.Eigen Statistic**	**0.05Critical value**	**Prob.****
GDP	285.51	125.61	0.0000	153.41	46.231	0.0000
GINI	132.09	95.753	0.0000	53.964	40.077	0.0008
PO	78.132	69.818	0.0093	28.520	33.876	0.1905
UN	49.611	47.856	0.0339	23.286	27.584	0.1616
POP	26.325	29.797	0.1193	15.003	21.131	0.2886
D1	11.3215	15.494	0.1925	11.016	14.264	0.1534
D2	0.3046	3.841	0.5810	0.3046	3.841	0.5810
Trace test indicates 4 co-intgration eq(s) at the 0.o5 level				**Max-Eigen value test indicates 2 co-integration e1(s) at the 0.05 level**		

Second model HDI

Variables	**Trace statistic**	**0.05 Critical value**	**Prob.****	**Max.Eigen Statistic**	**0.05 Critical value**	**Prob.****
HDI	222.9596	125.6154	0.0000	59.95739	46.23142	0.0010
GINI	163.0023	95.75366	0.0000	49.85928	40.07757	0.0029
GDP	113.1430	69.81889	0.0000	41.53495	33.87687	0.0050
UN	71.60803	47.85613	0.0001	28.91408	27.58434	0.0336
POP	42.69395	29.79707	0.0010	23.27439	21.13162	0.0246
D1	19.41956	15.49471	0.0121	15.78965	14.26460	0.0285
D2	3.629906	3.841465	0.0567	3.629906	3.841465	0.0567
Trace test indicates 6 cointegrating eqn(s) at the 0.05 level				**Max-eigen value test indicates 5 co-integration eq(s) at the 0.05 level**		

Table 4: Results of Co-Integration Test From the results, there is strong evidence of co-integration in all models where co-integration tests were conducted, much more in GDP, HDI, and CO2. It simply means that these variables move together in long run.

4.3 Estimation of the model

The current study estimated these relationships using the ARDL model in order to achieve the study's objectives and test the study's hypotheses. Further, a bound test was conducted to confirm the presence of long-term impact of the independent variables on. As follows:

Test Statistic	Value	K
F-Statistic	100.6774	4
Critical Value Bound Test		
Significant Level	I(0)	I(1)
	Lower	Upper
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

Table 5:
F-Bounds Test result

Table 5 presents the result of the bound test where the statistical value of F-test is 100.6774; it is bigger than the critical values at (1%, 5% and 10%) level of significant, thus supporting to conduct short- and long-run estimations using the ARDL model.

Table 6:
Optimum lag

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-729.6196	NA	4.03e+26	69.77330	69.92252	69.80569
1	-656.4809	118.415*	9.08e+2*	63.66485	64.2612*	63.7943*
2	-651.3777	6.804294	1.40e+24	64.03597	65.08050	64.26266
3	-636.7268	15.34857	9.74e+23	63.4977*	64.98997	63.82163

The results of the VAR Lag Order Selection Criteria are presented in Table 6. These depict the optimal lag length presented for a model with endogenous variables GINI, POP and GDP. The lowest AIC value, which was 63.66485 at lag 1, supported by other criteria such as LR (Likelihood Ratio), FPE or Final Prediction Error and HQ or Hannan-Quinn Criterion. Where the asterisks (*) are alongside the values of the lag 1's in the respective LR, FPE, AIC, and HQ. That is to say, this lag length is optimal according to these selection criteria. From this, one may conclude here that the model should be specified with one lag as the length in the case of balancing between model complexity and goodness of fit.

Short-Run Estimation			**Long-Run estimation**	
Variables	**Coefficients**	**Prob.**	**Coefficients**	**Prob.**
GINI coefficient	-0.1583	0.0351	-0.4926	0.0058
Unemployment rate	-0.6647	0.0037	-1.0614	0.0000
Population	5.0219	0.0080	4.4137	0.0001
D1 (Iraqi Financial crisis)	0.0279	0.1751	-0.0001	0.0211
Coint Eq(-1)	-0.7892	0.0001		
Constant	33.9390	0.0000		

Table 7:
Estimation for GDP ARDL model

Table 7: Results for the short- and long-run estimates using the ARDL model regarding the effect of income inequality on sustainable development. Most of the results are in consistency with the theory and reality of the Iraqi economy. The negative coefficient for GINI in both the short and long run shows that income inequality will retard economic growth. It's also established that inequality does indeed limit access to resources and human capital, lowering productivity and eventually GDP growth (Aiyar & Ebeke., 2020; Mdingi & Ho., 2023). The coefficient for the UN takes a negative sign, which reflects the negative relationship between unemployment and GDP, as stipulated by Okun's Law (Abdull 2012). Political instability has heightened this unbending challenge of high unemployment rates over the years in Iraq and retarded economic growth (World Bank, 2019).

The positive coefficient of POP states that in the long run, population growth can have positive effects on GDP. It tends to increase the workforce and similarly provides ready markets for a number of goods because of the high demand caused by the population. However, this huge population should be managed properly so as to ensure that infrastructure and job creation match with the increasing populations (Abdulhussain et al., 2020).

Lastly, D1: Iraqi Financial crisis = –0.00015 with a p-value of 0.0211, which implies a very minute though statistically significant negative effect of the financial crisis on GDP in the long run (Askary H., 2021). The short-run impact of D1, however, turns out positive and statistically insignificant, thus conforming to the reality that significant effects of financial crises often manifest over long periods due to accumulated impacts despite short-run government borrowing to sustain the economy.

Table 8:
F-Bounds Test result

Test Statistic	Value	K
F-statistic	21.76784	6
Critical value Bound test		
Significant Level	I(0) Lower	I(1) Upper
10%	1.99	2.94
5%	2.27	3.28
2.5%	2.55	3.61
1%	2.88	3.99

The bound test result is depicted in Table 8. From the results, the statistical value of the F-test accounts for 21.76784, above its critical values at 1%, 5%, and 10% levels of significance. These results denote conducting an estimate in both the short and long runs using a model referred to as ARDL for this purpose.

Table 9:
Estimation of HDI, ARDL model

Short-Run Estimation			**Long-Run estimation**	
Variables	**Coefficients**	**Prob.**	**Coefficients**	**Prob.**
Gini index	1.0099	0.0517	-0.5457	0.0000
Population	0.5794	0.0820	-0.0080	0.0016
GDP	-0.0384	0.0045	0.0682	0.0012
Unemployment	-0.0011	0.0103	0.0103	0.0006
D1(Covide-19)	-0.0183	0.0613	-0.0266	0.7260
D2(Financail crisis)	-0.0224	0.0033	-0.0007	0.0006
Coint Eq(-1)	-1.55125	0.0000		
Constant	-3.3170	0.0002		

Table 9: Results of estimation of the impact of income inequality on social indicators of sustainable development. The table indicates an overall Gini index negative and statistically significant impact on HDI: a one percent increase in Gini leads to a .054 percent decrease in HDI. It therefore infers that higher income inequality is likely to negatively affect the long-term human development outcome for Iraq by reducing access to education, health care, and general well-being (United Nations Development Programme, 2023). Moreover, rising populations actually reduce HDI in the long run. This shows the difficulties of providing adequate infrastructure and services to large populations and thus sets a ceiling on the improvements in human development indicators over time (Yasin, F.A., 2024). One of the most significant challenges that human security in Iraq is facing during the present time and near future is the inflation of the population in Iraq. While on one hand, GDP has a positive and satanically significant impact on HDI; that is, 1 percent growth of GDP leads to a 0.06% increase in HDI in the long run. Economic growth can provide resources for investment in education, healthcare, and infrastructure, which are very essential and crucial for enhancing human development (Alfaraji & Hamad., 2021). In addition, it is suggested that low unemployment rates affect HDI positively in the long term, as employment opportunities are major drivers of better living standards and low poverty levels (Ali, M.K., 2022).

The effects of the COVID-19 pandemic on HDI and financial crisis are also negative in the long run. It might be an instant disturbance in health systems, educational institutions, and economic activities as a whole during pandemic conditions that will delay progress in human development indices. While the financial instability can be against employment, income distribution, and access to social services, therefore badly affecting outcomes of human development in both short- and long-term periods.

Table 10:
Model Fitting

Models	R-squared	Adj- R squared	S.E of regression	AIC	SSR	F-statistic
GDP	0.90	0.87	0.120	-1,156	0.2304	25.7994 [0.0000]
HDI	0.98	0.96	0.072	-2.105	0.063	68.3802 [0.0000]

Table 11 summarizes the performance of the different models with respect to GDP and HDI, using some of the key statistical indicators such as R-squared, adjusted R-squared, standard error, Akaike Information Criterion, sum of squared residuals, and F-statistic.

Table 11: diagnostic check for the models

			GDP model			
Test	Multicollinearity VIF	Autocorrelation LM	**Heteroscedasticity ARCH**	Misspecification RESET Ramsey test	Normality Jarque-Bera	Stability CUSUM& CUSUM Square
F-statistic	4.46	0.0107	0.7518	0.2847	1.5747	Stable
Prob.	-	0.9893	0.3962	0.6033	0.4550	
HDI model						
F-Statistic	4.41	0.2576	0.80570	0.5467	0.955	Stable

Prob.	-	0.7763	0.3801	0.4704	0.6201

Diagnostic checks for the three regression models, that is, GDP, HDI, and CO2, are presented in Table 12. As Table 10 can prove, there are no serious problems of multicollinearity, autocorrelation, heteroscedasticity, or misspecification found in both the GDP and HDI models. The residual of the models seems also to be distributed like normal, and the models are time-stable. In a general sense, these results show that each of the three models adapts itself to the associated dataset very well, and most of the standard assumptions of the regression analysis are fulfilled adequately.

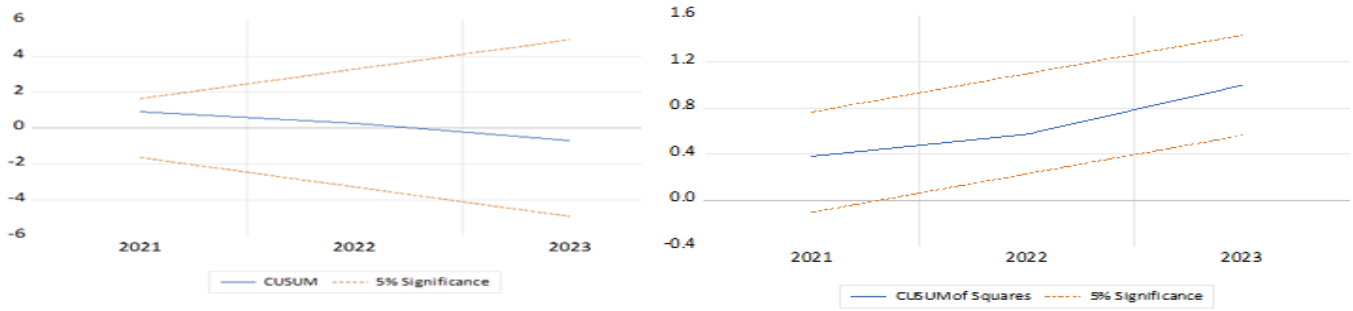

Figure1: The stability test for GDP model

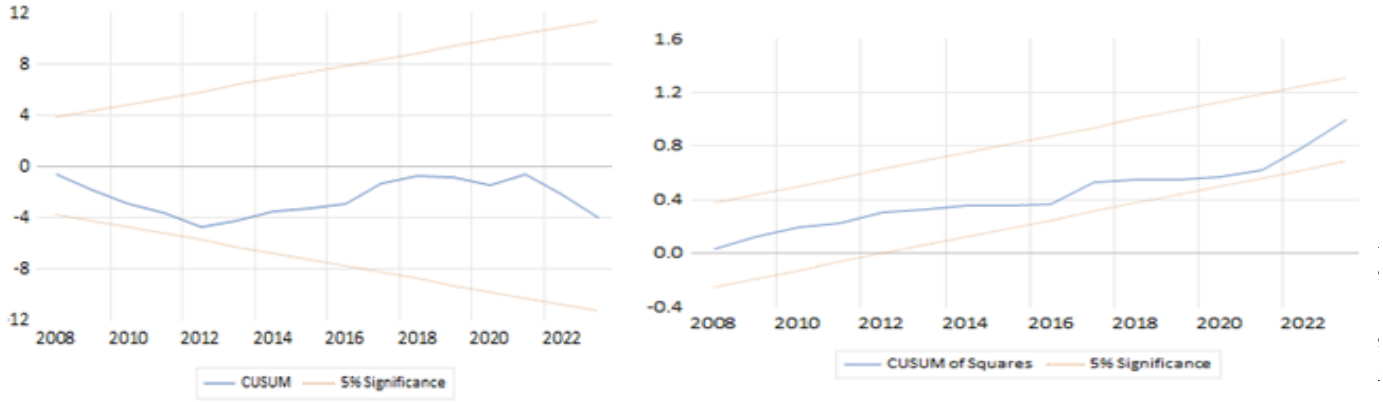

Figure 2: Stability test for HDI model

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In such a way, it measured and analyzed the multidimensional effects of the decrease in income inequality on various indicators: economic, social, and environmental. This comprehensive analysis returns several important findings:

1. Economic indicators, according to the study, show that income inequality wields great influence on GDP. Most often, high-level income inequality goes with a low level of GDP growth rate. This will then provide an explanation for the relevance of the equality of income towards long-term economic growth.

inequality was considered within the study. In both cases, these factors were seriously influential with respect to negative impacts on the distribution of income. The crisis had a long procedure for negatively influencing economic stability; hence it developed increased income inequality by reducing employment opportunities and social services. Secondly, COVID-19 has increased gaps in inequality since it was disproportionately affecting low-income populations and made wider gaps in income and social well-being.

5.2 Recommendations

Recommendations that can be made based on the findings are as follows:

1. Policy Interventions: These very first policies that any government must address need to bend towards more pro-equity and inclusive economic growth and result in a decrease in income disparities. This would include

progressive taxation, social safety nets, and invest-ments in education and healthcare.
2. Social Equity: The interventions targeted toward the improvement of social indicators, specifically the HDI, must involve a reduction in income inequity. This would be possible through a set of target-oriented interventions for the vulnerable groups—activities aimed at giving better access to quality education and health care services.
3. Monitoring and Evaluation: Trends in income distribution and their impacts on economic, social, and environmental indicators will have to be continuously monitored and evaluated. This will help in evidence-based adjustment of policies with a view to achieving more equitable and sustainable development outcomes.

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APPENDIX: The data used in this study for estimation

year	GDP (constant)	Unemployment	Gini	HDI	population	CO_2 emission
2000	1.12211E+14	8.155	28.6	0.608	24.6	75.22958563
2001	1.14188E+14	8.352	28.6	0.615	25.4	88.88125292
2002	1.04826E+14	8.65	28.6	0.616	26.3	90.97738903
2003	6.63989E+13	8.94	28.6	0.604	27.1	95.90754677
2004	1.01844E+14	8.708	28.6	0.628	27.9	120.4060947
2005	1.03547E+14	8.587	28.6	0.632	28.7	120.5336118
2006	1.09393E+14	8.436	28.6	0.637	28.9	103.4791825
2007	1.11456E+14	8.65	28.8	0.639	28.7	63.19496296
2008	1.20627E+14	8.475	28.9	0.646	29.2	94.94834308
2009	1.24703E+14	8.405	29.1	0.648	30.3	108.277866
2010	1.32687E+14	8.257	29.2	0.652	31.3	116.7636781
2011	1.427E+14	8.171	29.4	0.658	32.4	142.6671264
2012	1.62588E+14	7.96	29.5	0.662	33.9	162.4088081
2013	1.74991E+14	9.215	29.5	0.662	35.5	175.2960588
2014	1.75335E+14	10.59	29.5	0.662	36.7	176.4988938
2015	1.83616E+14	10.82	29.5	0.665	37.8	175.9676444
2016	2.08932E+14	10.82	29.5	0.672	38.7	199.3199471
2017	2.0513E+14	13.02	29.5	0.684	39.6	197.8882898
2018	2.10533E+14	13.449	29.5	0.689	40.6	215.8110101
2019	2.22141E+14	14	29.5	0.689	41.6	226.5889638
2020	1.95403E+14	15.746	30.2	0.674	42.6	229.9069045
2021	1.98497E+14	16.17	29.9	0.686	43.5	245.6565948
2022	2.12409E+14	15.322	29.9	0.673	44.5	256.1098365
2023	2.28493E+14	15.56	29.5	0.668	45.5	256.6478436

Source: Authors own collaboration depending on the data from (https://databank.worldbank.org/source/world-development-indicators https://www.arabdevelopmentportal.com/ and https://www.weforum.org/publications/fostering-effective-energy-transition-2023 https://www.macrotrends.net/global-metrics/countries/IRQ/iraq/poverty-rate'>Iraq Poverty Rate 1960-2024. www.macrotrends.net. Retrieved 2024-05-18.