

Measuring the Impact of the Interrelationship between the Population Growth Index and the Human Development Index (HDI) in Iraq during the Period (2004-2024)

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Abstract. *This study aims to determine the causal relationship between the population growth index and the Human Development Index (HDI) in Iraq during the period 2004–2024, using the Toda-Yamamoto causal test. The study concluded that there is no statistically significant causal relationship between population growth and human development in Iraq. Therefore, we accept the null hypothesis, which states that population growth does not cause human development. However, the study also concluded that there is a significant causal relationship transferring from human development to population growth in Iraq. Therefore, we reject the null hypothesis, which states that population growth does not cause human development, and accept the alternative hypothesis, which states that population growth does cause human development. This study aims to determine the causal relationship between the population growth index and the Human Development Index (HDI) in Iraq during the period 2004–2024, using the Toda-Yamamoto causal test. The study recommended that social sectors, particularly education and health, continue to support these sectors, given their pivotal role in improving the Human Development Index, raising living standards, diversifying national income sources, and reducing reliance on oil revenues to ensure the sustainable funding of human development programs in light of changing economic conditions. The study also recommended developing infrastructure and public services to keep pace with ongoing population growth, thereby mitigating the pressure this growth places on available resources and enhancing investment in human capital by improving the quality of education, training, and healthcare, increasing the efficiency of human resources, and promoting opportunities for sustainable development.*

Keywords: *Population Growth Index, Human Development Index (HDI), Toda-Yamamoto Causality Test.*

I. INTRODUCTION

The relationship between population growth and human development is an important topic that has received wide attention in the economic and social literature, due to its direct effects on the path of economic development and social welfare levels. Population growth is one of the demographic variables that affects the amount of resources available and the ability of a country to provide basic services to the population, while human development is the process of expanding people's choices and improving living standards through the development of education, health, and income [1].

with population growth being a positive factor in supporting human development when combined with effective investment in human capital, job creation, and improved public services, increasing productivity and boosting economic growth. In contrast, rapid population growth may become a burden on economic resources and basic services, which will negatively impact human development indicators, especially in developing countries that suffer from limited resources, weak infrastructure, and high rates of unemployment and poverty [2].

At the same time, human development is a tool to address many of the problems of the population, as improved education and health care and increased incomes contribute to reducing poverty rates, improving demographics, and enhancing the efficiency of human resources. Therefore, modern development policies have become focused on achieving a balance between population growth and the requirements of sustainable human development, by adopting strategies aimed at investing in human beings as a main axis and goal of the development process, and highlighting the importance of studying the relationship between population growth and human development in developing economies. including Iraq, as a result of the continuous increase in population and the accompanying challenges related to the provision of employment opportunities, health services, education and housing, which require the development of economic and social policies capable of transforming population growth into a force that supports development rather than being a burden on the national economy [3].

Research Problem:

The research problem is centered on population growth, and thus the nature of the relationship between population growth and human development in the Iraqi economy, and does the continuous increase in population support human development by enhancing human capital and workforce, or has this caused an increase in pressure on economic resources, health services, and education? Has this been reflected in the level of human development in Iraq?

Research Hypothesis:

The research is based on the hypothesis that there is a mutual causal relationship between population growth and human development (HDI) in Iraq during the period (2004-2024).

Research Objectives: The research aims at the following:

1. Explain the conceptual framework of population growth and human development and its most important determinants.
2. Analysis of the development of both the Population Growth Index and the Human Development Index in Iraq during the period (2004-2024).
3. Measuring the causal relationship between the Population Growth Index and the Human Development Index during the period (2004-2024).

Importance of the research:

The importance of the research stems from the importance of the topic of population growth and its repercussions on human development, especially in Iraq, which is witnessing a continuous increase in the population and the economic, social and service challenges associated with it, and the importance of the research in explaining the nature of the relationship between population growth and human development and the extent to which the Iraqi economy is able to absorb the subject. Supporting and dedicating population growth to the service of human development. Development aims to improve human development indicators and enhance the efficiency of human resources investments in the Iraqi economy [4].

Temporal and Spatial Limits:

Time Limits: The duration of the research is (2004–2024).

Spatial boundaries: Spatial boundaries represent the Iraqi economy as a spatial field for analyzing and measuring the relationship between population growth and human development.

Previous Studies:

1. A study entitled (Human Development Index (HDI) Determinants: Regression Analysis of Economic and Social Indicators), aims to study the factors affecting the Human Development Index (HDI), and five variables (GDP per capita, health expenditure, education expenditures, infant mortality rate (per 1000 live births), and average years of education) were analyzed to develop a regression model that evaluates its effect on the skin index high. The results indicate that the study found a positive relationship between GDP per capita and average years of schooling are associated with a high human index, while infant mortality is negatively correlated with the human development index [5].
2. A study in their study titled “The Impact of Population Growth on the Human Development Index: A Comparative Analysis of Middle Eastern Countries,” examined the relationship between population growth and the determinants of the Human Development Index (HDI). The study sought to identify the factors contributing to population growth by analyzing key HDI components and reviewing relevant theoretical and empirical literature. Furthermore, it investigated whether population growth significantly influences human development outcomes across Middle Eastern countries. The findings indicated that population growth does not have a statistically significant effect on the main dimensions of human development, particularly life expectancy and education. Based on these results, the authors emphasized the importance of strengthening human capital through educational reforms and ensuring closer alignment between educational systems and labor market requirements [6].
3. A study with the help of (Demographic Dividends: Determinants of Development or Just Windows

of Opportunity), the study aims to measure the impact of demographic shifts and changes in the age composition of the population on economic development, focusing on the concept of the first and second demographic gains resulting from the demographic transition. The study relied on the demographic and economic analysis of the stages of population transition and the effects of declining fertility and population aging, and concluded that the changes in the structure recommended the need to invest the demographic dividend through the development of education, in addition to raising the productivity of the workforce and enhancing job opportunities to ensure sustainable economic and human development.

II. METHODOLOGY

First. Concept of Population Growth: Population growth is a basic concept in demography and analysis as well as in macroeconomics and refers to the quantitative change in the size of the population over a specific period of time, as a result of the interaction of the main factors affecting the movement of the population: birth rates, death rates, and migration, and it is defined as the net increase in the population over a specific period of time, and is often measured annually to determine demographic trends and changes in society over a period of time, and can also be defined as The relative change in population size over a specific period of time, as a result of the interaction of three main demographic components: fertility, births and deaths, and net migration, and as an increase in population resulting from the difference between births, deaths and migration, a study indicated that population growth directly affects the demand for public resources and services, while showed that the difference in growth rates between countries leads to significant variation in age structures and levels of development, while the United Nations reports confirmed that population growth is a key factor in planning sustainable development and achieving economic and social well-being.

III. RESULT AND DISCUSSION

J There are many determinants of population growth, and they can be summarized as follows [7]:

1. Demographic characteristics include fertility rates, mortality, migration, population density, and population age composition, which directly affect the size and rate of population growth.
2. Economic and social conditions influence population growth through the level of education, income, job opportunities, wages, and unemployment, as regions with better economic conditions tend to attract residents and achieve higher growth rates.
3. The natural environment is one of the important factors in determining population growth, and includes climate, natural resources, vegetation cover, proximity to coasts and water bodies, as areas with favorable environmental conditions are more attractive.
4. Transportation and accessibility contribute to the growth of the population through the availability of roads, airports, public transportation, and easy access to economic and service activities.
5. Land use and urban development affect population growth through the availability of buildable land, urban planning, and geographical characteristics, which determine the ability of regions to accommodate population expansion.

The Human Development Index (HDI) is a comprehensive measure of the basic dimensions of human development in the country and is a summary of three basic factors, namely (Health Index, Education Index, and Income Index) [8]:

The concept of the Human Development Index (HDI) extends beyond traditional measures of economic performance and national income. According to the UNDP Human Development Report, human development focuses on establishing conditions that enable individuals to expand their capabilities, achieve their potential, and lead productive and fulfilling lives. The report emphasizes that people constitute the most valuable asset of any nation, and that sustainable national prosperity is ultimately driven by the development of human capacities. From this perspective, human development serves as a fundamental pathway toward achieving a wide range of social, economic, and developmental objectives, as follows [9]:

1. Working to achieve an adequate standard of living by raising the average income of an individual and improving his ability to meet his basic needs.
2. Working to provide opportunities to obtain appropriate education that contributes to the development of human capabilities and skills.
3. Ensure access to health care and nutrition services that adhere to the required health standards.
4. Working to provide decent job opportunities that achieve a stable income and improve the economic level of the community members.
5. Ensuring living in a safe and healthy environment free from various sources of pollution and environmental hazards.

The Human Development Index (HDI) is one of the most important indicators used to measure the level of human development, and has been adopted by the United Nations Development Programme (UNDP) since 1990 to measure the progress made by countries in improving human well-being [10].

The Human Development Index consists of three sub-indicators that can be summarized as follows [11]:

1. Health Index: Measured by life expectancy at birth.
2. Education Index: Measured by the average years of study achieved and expected.
3. Income Index: Measured by the real gross national income of an individual.

The Human Development Index is calculated by the geometric average of the three sub-indicators according to the following formula:

$$HDI = (I_{Health} \times I_{Education} \times I_{Income})^{1/3}$$

The value of the index ranges from zero to true, and the closer the value is to one, the higher the level of human development in the country, while the lower the values indicate lower levels of human development [12].

Population growth and human development are among the most prominent indicators that reflect the nature of economic and social development in countries, as population growth is linked to the ability of the economy to provide basic necessities of life such as education, health, job opportunities, and an adequate standard of living. After 2003, the Iraqi economy moved towards a new phase characterized by an increase in oil revenues and a relative improvement in government spending on the service sectors, especially education and health, which contributed to the gradual improvement of the Human Development Index. On the other hand, Iraq has experienced rapid population growth as a result of high fertility rates, improved health care, and low mortality rates, which have increased pressures on public resources and services. and development.

Table 1: Evolution of the Human Development Index and Population in Iraq during the Period (2004-2024)

Years	Human Development Index (Radio Speed)	Annual Percentage Change	Population (million)	Annual Percentage Change
2004	0.604	-	27577878	-
2005	0.609	0.83	28407448	3.01
2006	0.611	0.33	28616515	0.74
2007	0.618	1.15	28391607	0.79-
2008	0.634	2.59	28971036	2.04
2009	0.644	1.58	30058206	3.75
2010	0.65	0.93	31045366	3.28
2011	0.656	0.92	32161424	3.59
2012	0.664	1.22	33654842	4.64

2013	0.668	0.60	35281989	4.83
2014	0.671	0.45	36550059	3.59
2015	0.675	0.60	37560535	2.76
2016	0.676	0.15	38469627	2.42
2017	0.681	0.74	39337353	2.26
2018	0.689	1.17	40265624	2.36
2019	0.693	0.58	41192171	2.30
2020	0.68	1.88-	42116605	2.24
2021	0.687	1.03	43071211	2.27
2022	0.695	1.16	44070551	2.32
2023	0.695	-	45074049	2.28
2024	0.712	2.45	46042015	2.15
Compound annual maturity ratio	%0.83	-	%2.6	-

1. United Nations Development Programme (UNDP), Human Development Reports, Iraq Country Data, Different Years.
2. World Bank, Population, Total – Iraq (Population: TOTL), World Development Indicators, Different Years.

It is clear from Table (1) and Figure (1) that the population of Iraq increased from (27.57) million people in 2004 to about (46.04) million people in 2024, with a compound growth rate of 2024. to (2.6%), which is a relatively high rate that reflects the continuation of the natural increase in the population and the high fertility rates in Iraqi society. It is worth mentioning that the highest population growth rate recorded in 2013 (4.83%), as a result of improved security, health conditions, high birth rates, as well as the relative improvement in economic stability at that time [13].

Figure (1) Population in Iraq during the period (2004-2024)
Source: The researcher's work, based on the data of Table (1).

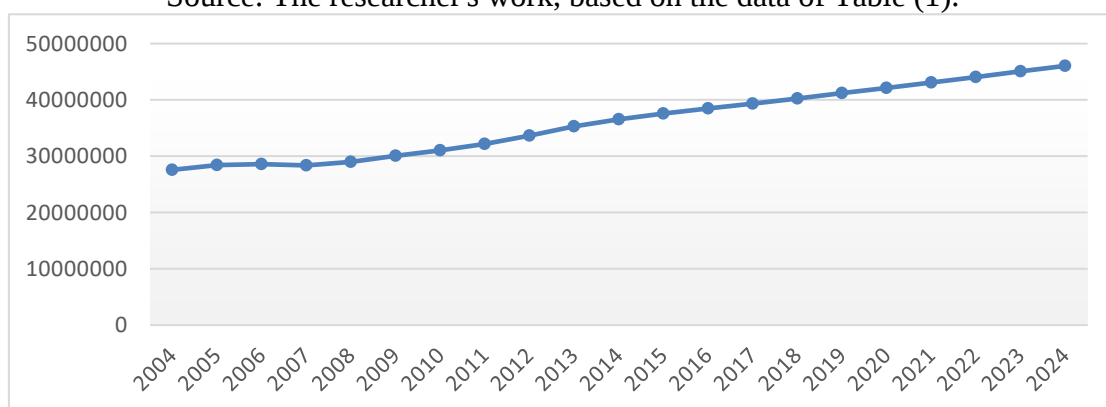
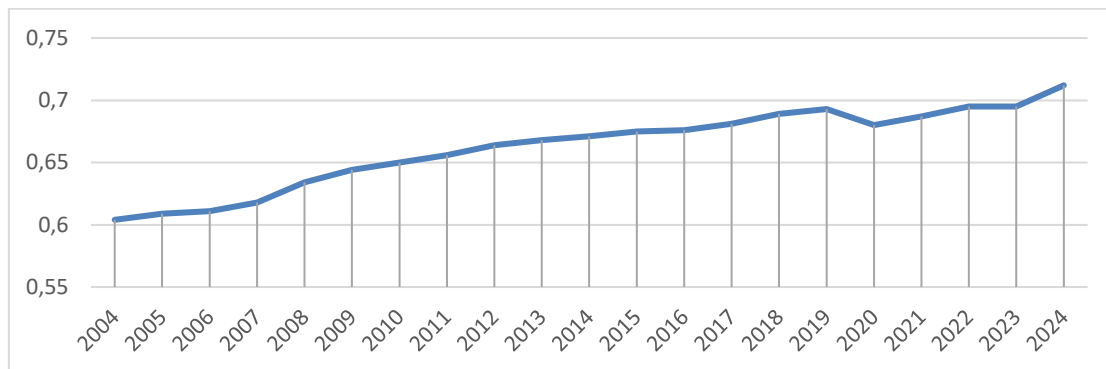


Table (1) and Figure (1) also show that the Human Development Index in Iraq has witnessed an upward trend in general, as it increased from (0.604) in 2004 to (0.712) in 2024, with a compound growth rate of 0.83%, indicating a relative improvement in education, health, and income indicators during the study period, and this improvement is attributed to the increase in government spending after 2003. Improved oil revenues, as well as the expansion of health, education, and social protection programs, are factors that are confirmed by numerous studies on human development in rentier economies [14].

Figure (2) Human Development Index (HDI) in Iraq during the period (2004-2024)
Source: The researcher's work, based on the data of Table (1).



It is also noted that the highest annual growth rate of the Human Development Index was achieved in 2008, where it reached about (2.59%) when the index increased from (0.618) to (0.634), which explains the rise in oil prices globally during that period, which positively reflected public spending and government investments in the social and service sectors. While the index witnessed a decrease in 2020 by (-1.88%) to (0.680) compared to (0.693) in 2019, the main reason is due to the repercussions of the Corona pandemic, the economic crisis, and the decline in oil prices that affected income levels, health services, and education, which was directly reflected in the value of the Human Development Index [15].

The data in Table 1 indicate a relatively direct relationship between the improvement of the Human Development Index and population growth during most of the study years, with improved health services and higher living standards contributing to reduced mortality and increased life expectancy, leading to an increase in the population. However, continued population growth at high rates may put pressure on public resources and services, especially as the Iraqi economy is dependent on oil revenues, potentially limiting the country's ability to achieve higher levels of human development in the future.

The data also show that the development of the Human Development Index was slower compared to population growth, with the CAGR of (2.6%) compared to (0.83%) for the Human Development Index, suggesting that the improvement in development was not at a sufficient level to keep pace with the increasing population expansion. This is consistent with the economic literature that asserts that high population growth in developing countries may erode the effects of development if it is not accompanied by real economic growth, diversification of sources of income, and improved distribution efficiency. Overall, Iraq made gradual progress in human development during the study period. But it still faces significant challenges such as rapid population growth, rent-based dependence on oil, poor economic diversification, and the impact of political, economic, and health crises that have directly impacted human development indicators.

Through this topic, the trend of the causal relationship between the Population Growth Index and the Human Development Index in Iraq during the period (2004-2024) is shown through the Toda-Yamamoto causality test, which is considered one of the modern standard methods used in the analysis of causal relationships between economic variables, as the importance of this test is highlighted in its ability to deal with time series with different degrees of integration without the need to require a common integration between variables.

First, unit root tests are performed to determine the degree of dwell of the variables and determine the highest degree of integration between them (d_{max}), then the optimal deceleration period (k) is determined based on statistical information criteria, and then the vector self-regression model (VAR) is estimated with a number of decelerations equal to ($k+d_{max}$). Finally, the modifier parent test was applied to reduce the causal trend between population growth and human development.

First. Sleep Test:

Initially, the hibernation of the variables is tested to determine the degree of dormancy of each variable, as shown in Table (2):

Table 2: Module Root Test Table (ADF)

Source: Prepared by the researcher, based on the results of the (evIEWS12) program

<u>In the level</u>			
		Human Development Index	Bob
With Fixed	Statistic t	-1.0689	0.3085-
	.Maybe	0.7068	0.9035
		n0	n0
With Constant & Trend	Statistic t	-1.7598	5.9691-
	.Maybe	0.6856	0.0009
		n0	***
Without Stability & Direction	Statistic t	3.8719	2.5243
	.Maybe	0.9998	0.9946
		n0	n0
<u>From the beginning the difference</u>			
		d(HDI)	D(Pop)
With Fixed	Statistic t	-3.7078	3.4814-
	.Maybe	0.0129	0.0231
		**	**
With Constant & Trend	Statistic t	-3.6430	3.3334-
	.Maybe	0.0528	0.0965
		*	*
Without Stability & Direction	Statistic t	-2.1365	3.8592-
	.Maybe	0.0346	0.0121
		**	**

Table 2 shows that both population growth (POP) and human development (HDI) were not constant at the level and became constant in the first group, because their probability in all three cases was higher than 5% in the level and less than 5% in the first group.

Second. Optimal Cooldown Period:

The optimal deceleration period is a major step in time series models and causation testing, as it represents the number of previous time periods that affect the current values of the variables studied. Choosing an inappropriate slowdown leads to biased or inaccurate results, so it is determined based on a set of statistical criteria.

For the purpose of determining the optimal slowdown period between population growth and human development variables, the vector self-regression (VAR) model is used, and then the slowdown selection criteria are adopted, and Table (3) shows this as follows:

Table: (3) Criteria for selecting the order of VAR delay

Source: Prepared by the researcher, based on the results of the (evIEWS12) program

Delay	Headquarters	SC	AIC	FPE	LR	LogL
1	21.50375	21.67432	21.47646	.7293926	ON	189.2882-
2	*20.92103	*21.26218	*20.86646	*.4015975	*14.76223	179.7982-
3	21.02202	21.53375	20.94017	.4490073	4.448825	176.4616-

Table (3) shows the results of the selection of the optimal deceleration period, where all the selection criteria represented in (LR, FPE, AIC, SC, HQ) indicate that the optimal deceleration period was (2), and accordingly, the second deceleration was adopted in the estimation of the VAR model and subsequent benchmark tests.

Third. Toda-Yamamoto Causality Test:

In this test, the results of the causality test between the variables are remembered as follows:

Table 4: Toda-Yamamoto Causality Test

Source: Prepared by the researcher, based on the results of the (evIEWS12) program

Dependent variable: HDI			
Excluded	Chi-su	D.F.	Maybe.
Bob	2.316109	4	0.6778
Everyone	2.316109	4	0.6778
Dependent variable: POP			
Excluded	Chi-su	D.F.	Maybe.
Human Development Index	14.63459	4	0.0055
Everyone	14.63459	4	0.0055

Table (4) shows the results of Toda Yamamoto's causation test, which shows the following:

1. The probability of causality from population growth to human development is (0.6778), which is greater than (5%), and indicates that there is no significant causal relationship between population growth and human development in Iraq, so we accept the null hypothesis, which states that population growth does not cause human development.
2. The probability of causality resulting from human development is population growth (0.0055), which is less than (5%), and indicates that there is a significant causal relationship between human development and population growth in Iraq, so we reject the null hypothesis that says that population growth does not cause human development, and we accept the alternative hypothesis that population growth causes human development.

IV. CONCLUSION

The highest annual growth rate of the Human Development Index was achieved in 2008, when it reached about (2.59%) when the index increased from (0.618) to (0.634), which explains the rise in oil prices globally during that period, which reflected positively on public spending and government investments in the social and service sectors. The analysis shows that there is a relatively direct relationship between improved HDI and population growth during most of the study years, with improved health services and higher living standards contributing to reduced mortality and increased life expectancy, leading to an increase in population. However, continued population growth at high rates may put pressure on public resources and services, especially as the Iraqi economy is dependent on oil revenues, which may limit the country's ability to achieve higher levels of human development in the future. All selection criteria (LR, FPE, AIC, SC, HQ) indicate that the optimal deceleration period was (2), and accordingly, the second deceleration was adopted in the estimation of the VAR model and subsequent benchmark tests. There is no moral causal relationship between population growth and human development in Iraq, so we accept the no-nothing hypothesis that population growth does not cause human development. There is a moral causal relationship between human development and population growth in Iraq, so we reject the nothingness hypothesis that population growth does not cause human development, and we accept the alternative hypothesis that population growth causes human development.

Recommendations:

1. Continue to support the social sectors, especially education and health, given their pivotal role in improving the human development index and raising the standard of living.
2. Diversify sources of national income and reduce dependence on oil revenues to ensure sustainable financing of human development programs under changing economic conditions.
3. Work to develop infrastructure and public services to keep pace with the continuous population growth, which alleviates the pressures that this growth imposes on available resources.
4. Work to promote investment in human capital by improving the quality of education, training, and health care, increasing the efficiency of human resources and promoting opportunities for sustainable development.
5. Work to direct development policies towards improving human development indicators, in light of the results of the study, which showed that there is a close causal relationship between human development and population growth in Iraq during the study period.

V. DAFTAR PUSTAKA

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