

## Analyzing the structure of economic growth using the mathematical model used – product

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### Abstract

Economics needs determinants and simultaneous equations that help solve a set of multivariate equations in a way that helps solve mathematical economic models by finding a solution to these mathematical economic models that ensure understanding of the relationships between more than one change at the same time. Therefore, this study came to identify the analysis of the structure of economic growth using the mathematical model used - the product. To achieve the objectives of the study, the used mathematical model was adopted. The study concluded that there is a positive and insignificant effect of economic growth, which means that the increase in spending leads to an increase in the rate of economic growth very slowly, and this result supports the results of all previous applied studies presented in this study. But taking into account the rate of economic growth using the mathematical model used - product.

**Keywords: (the structure of economic growth, the mathematical model used product).**

تحليل هيكل النمو الاقتصادي باستخدام النموذج الرياضي المستخدم - المنتج

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### المخلص:

يحتاج الاقتصاد إلى محددات ومعادلات متزامنة تساعد في حل مجموعة من المعادلات متعددة المتغيرات بطريقة تساعد في حل النماذج الاقتصادية الرياضية من خلال إيجاد حل لهذه النماذج الاقتصادية الرياضية التي تضمن فهم العلاقات بين أكثر من تغيير واحد في نفس الوقت. لذلك جاءت هذه الدراسة للتعرف على تحليل هيكل النمو الاقتصادي باستخدام النموذج الرياضي المستخدم - المنتج. ولتحقيق أهداف الدراسة تم اعتماد النموذج الرياضي المستخدم. وخلصت الدراسة إلى وجود أثر إيجابي وغير معنوي للنمو الاقتصادي، مما يعني أن الزيادة في الإنفاق تؤدي إلى زيادة معدل النمو الاقتصادي ببطء شديد، وهذه النتيجة تدعم نتائج جميع الدراسات

التطبيقية السابقة المقدمة في هذه الدراسة. . ولكن مع مراعاة معدل النمو الاقتصادي باستخدام النموذج الرياضي المستخدم - المنتج.  
الكلمات المفتاحية: (هيكل النمو الاقتصادي ، النموذج الرياضي المستخدم للمنتج).

## Introduction:

The Iraqi economy is one of the most important economies that are characterized by scarce resources and small size in the region. Iraq is also classified among the poorest countries in the world, although it is surrounded by the world's resources and reserves of crude oil, but it does not have any source of crude oil. Therefore, crude oil imports are one of the most important sources of foreign exchange depletion for the Iraqi economy (Sonia,2019). It is worth noting that Iraq owns large quantities of oil imports that are refined and crude oil, but these products, like other raw materials, are subject to price fluctuations and significant restrictions that restrict their use, and Iraq faces a severe shortage of water sources, and this in turn affects the agricultural economic aspect and makes it vulnerable to being affected. Drought from time to time, in addition to not exploiting all arable lands due to lack of natural resources and weak industrial capabilities in Iraq, the productive sector is considered the leading sector in the Iraqi economy, where the share of the service sector represents the largest percentage in terms of contribution to the GDP among the sectors of the economy (Davnis & Tinyakova,2006).

The economic and political developments that occurred in the region in general and Iraq in particular led to the increasing requirements of economic and social development and the population increase resulting from the increasing forced migration and the growth of their needs over time, and in light of the scarcity of financial resources, Iraq has relied heavily on

external debts, aid and gifts to meet the requirements of development (Golovanova,2015).

Accordingly, the growth rate of available resources appears to be actually comparable to that of more than population growth, reflecting the process of economic progress, which is equivalent to the total improvements in economic and social fields, and for economic development, it is economic progress towards predetermined targets, either quantitative, such as product increase, or quality, for example, a better distribution of inputs within the State. (Petukhova & Petukhova, 2000).

The concept of economic growth refers to the process of change and dynamic movement, and can often be used especially to indicate the economic situation of a country or sector, where there can be economic development provided that it is compatible with structural changes as well as the full mentality that contains and includes continuity and regularity in this development (Posypanova, 2012).

Economic growth models based on the traditional Harrod / Domar equation saw that the growth rate is determined in terms of one productive element, which is "capital accumulation". The assumptions implied by such a model have been severely criticized both in theory and in practice. These criticisms crystallized in what the "new classics" formulated a growth model that became bearing their name. The increase in national income is not due to the accumulation of capital - and technical progress that leads to an increase in the productivity of the factors of production. The production function that explains the increase in output by changing the various factors of production, such as the famous Cobb-Douglas function, has been formulated and measured(Bakheet & Fathallah,2007).

The dynamic Cobb-Douglas function includes two types of influences on the growth rate of output: quantitative influences, that is, a change in the volume of labor or capital, which leads to a change in the function itself (the volume of output), and qualitative factors that lead to the transfer of the function. Various studies assume that the two types of necessary influences are not related (Alhaj & Hassan, 2000). The rate of growth of output may increase as a result of an increase in the amount of labor or capital (or both) as well as thanks to technical progress, which includes all the qualitative changes that the economy may witness such as new inventions, and the increase in technical knowledge and skills (umaida & Youssef, 2006). Some believe that these changes are not related to the increase in the use of capital, and this is why it is known as technical progress that is not accompanied by an increase in capital. And when this function was used to measure the contribution of the factors of production and technical progress to the increase in output, especially in the advanced industrial countries. It was found that the high rate of growth attributed to technical progress has spread the belief that the role of capital accumulation in achieving growth is negligible, and investment is no longer the strategic element in the process of economic growth (Qureshi, 2005).

However, the instability that the region is going through has led to the continuous accumulation of both external and internal indebtedness, and that the Iraqi economic crises are caused by the lack of financial and economic resources that are considered very scarce, as Iraqi revenues are limited and their expenditures are very large (Al-Sawa'i and Daoud, 2013), hence this study came to identify the Analyzing the structure of economic growth using the mathematical model used – product.

## Research problem:

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The problem of the study is to analyze the structure of economic growth using the mathematical model used - the product. Where economic growth is one of the primary goals of all governments; because it represents the financial summation of the economic, social and political efforts exerted in their societies. One of the necessary conditions for improving the standard of living of societies is the mathematical economic model used - the producer, which revolves around "what is the level of production that each sector of the national economy must reach in order to be completely sufficient to satisfy the aggregate demand for that production". Hence this study came to answer the main question (What is the level of analysis of the structure of economic growth using the mathematical model used - the product?)

## Importance of research

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The importance of the study lies in the importance of economic growth, which is represented by a set of economic factors that contribute to strengthening the country's economy, and is considered as creating a suitable climate for development. Measuring economic growth is not only a total measure of the increase in the trade process, which is between goods and services produced in a specified period of time compared to previous experience, since economic progress is the real increase from time to time in the average so-called real output, real average income, as well as average consumption and real population.

### **Research Methodology:**

Through this chapter, the researcher addressed the definition of the optimal approach that will serve the study, in addition to defining the economic variables that are selected and the reason for their selection with reference to their sources, clarifying the statistical tests that serve the requirements of the study and which have been included, and finally clarifying the obtained results and conclusions to be drawn in the last set of recommendations.

#### Information gathering sources:

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Data collection was referred to the following sources:

- **Secondary sources:** related to covering the theoretical framework of the study, which were collected from books, periodicals, refereed scientific journals, theses and previous studies on the subject of the study.
- **Primary sources:** related to the data obtained from the annual economic report bulletins in Iraq.

#### Theoretical framework:

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##### ***First: Economic growth:***

The issue of economic growth represents a quantitative basis for increasing production in the long run, as researchers defined economic growth as the long-term increase in a country's production. Hence, it should be noted that economic growth is accompanied by a circumstantial increase in production, in other words that it is a station for the successive expansion of the economy, and since growth expresses the increase in production, it takes into account the growth rate of individual income (Debla,2004).

As economic growth is a prerequisite for raising the standard of living, but it is not sufficient to raise the standard of material life for individuals; It is necessary to take into

account the method of distributing the achieved increase to individuals, which is a thorny issue linked to the nature of the economic and political systems in each country (Al-Masoudi, 2010).

On the other hand, Simon Kaznet defined economic growth as referring to the high level of possibilities in order to offer increasingly diverse economic goods to the population, and this growing potential is based on advanced technology and the institutional and ideological adaptation required for it (Al-Sharqawi, 2016).

This is because the process of economic growth is effectively the result of policies and institutions that bring about changes to a series of scientific structures in their policies, and therefore it is not just an automatic process, as was known or prevalent in classical literature. Other researchers have pointed to The gradual transformation of the economy, i.e. through the way production or well-being is increased, is so that the situation we are trying to reach is often one-way towards increasing the latter, more seriously or accurately,

Gross domestic income is the country with each increase in income, i.e. earned by real income. (Walt, 2020).

According to Kuznets, the U.S. economy has a combination of factors and influences that continue to increase material wealth production. Investment also affects physical and human capital — as well as works on technical progress and the efficiency of economic systems — and therefore the two main sources of economic growth. Physical and human capital has a positive impact on the labour productivity system and the development of the labour force in terms of training as well as qualification to the extent that it increases the

percentage of economically active forces. As for technical progress (Al-Sharqawi, 2016), The use of technical methods, whether new through invention or innovation, and with the risk factor in production facilities. As for economic systems, they always demonstrate their efficiency by transferring and delivering resources to areas that are achieved and working on volume and production that reach the optimum size. conditions (Shaheen, 2018).Hence, economic growth is characterized by a set of features, namely:

- Increasing the volume of production, with the increase in the individual community income accompanying the increase in production, during a period of time, compared to previous periods.
- Changes occurred at the level of the party organization, with the aim of facilitating the dynamism of work and the easier circulation of production elements, and the search for less costly and more profitable production elements.
- Economic progress.

As indicated by (Nebridrick and Abu Amsha, 2002) As for the benefits of growth, the most important of them can be summarized as follows:

- Increasing the available quantities of goods and services to the people of the community.
- Increase the welfare of the people; By increasing production, raising wages, profits, and other incomes.
- It helps to eradicate poverty, and improves the health and educational level of the population.
- An increase in the national income allows for an increase in the state's resources and enhances its ability to carry out all its responsibilities; Such as providing security, health, education, building basic facilities, and

the optimal distribution of national income, without negatively affecting private consumption levels.

- Alleviation of unemployment.

Accordingly, the researchers put forward several models to measure economic growth, including:

- **The Classical Model of Economic Growth:**

The classic growth theory includes Adam Smith's views on growth, as well as traders' views on one of the most important sources of foreign trade wealth: the adoption of destinations that also belong to John Stewart, who dealt with a mill around the markets, as well as Robert Malthus on the population component as mentioned (Dipla, 2004):

The policy of economic freedom includes: individual freedom, in addition to full freedom of competition, as well as a move away from the concept of any interference by any State in economic life.

2. Profit means a process that stimulates investment: the higher the profit rate, the higher the rate of capital formation and investment

- **The Keynesian Model of Economic Growth in Keynesian Theory:**

This theory represents the ideas of economist John Maynadir Keynes (1883-1946), who was effectively able to provide appropriate solutions to the global economic crisis of the period (1929-1932). theory, and therefore it is linked to the growth of national income in the theory of multiplier as the national income increases by a multiple of the increase in investment spending, and through the marginal propensity to consume (Al-Masoudi, 2010). According to this theory, there are three rates of growth, which are:

A - Actual rate of growth, which is the ratio of change in income to income.

b - Warranted rate of growth, which represents the rate of growth when the production capacity is at its maximum.

C - Natural growth rate (GN), the maximum rate of growth that can result from the increase in technical progress, capital accumulation and the labor force at the level of full employment.

- **Marx's Model of Economic Growth:**

In his theory of economic growth, Karl Marx refuted the views of the capitalists, and his theory in this regard was based on a set of assumptions related to the nature of the function performed by production in society, as well as the type of innovation and invention prevailing, and the method of capital accumulation, as well as assumptions related to wage rates and profits prevailing (Al-Sharqawi, 2016).

The model considers surplus value the actual basis of the Marxist theory of growth, and defines surplus value as the excess of production over the need for consumption, that is, what is dedicated to investment. Optimum natural resources and labor force.. Marx believes that the correct measure of the behavior of individuals is the prevailing method of production (Nebridrick and Abu Amsha, 2002); that is: there is a specific organization of production in society that includes:

- Organizing work through cooperation and a fruitful division between labor skills, and through the legal status of workers in terms of freedom and slavery.
- Geographical environment and knowledge of ways to use existing wealth resources.

- Scientific and technical means applied in production, and the state of science in general.

- **The modern model of economic growth:**

This theory focused on economic growth in the long term, as a result of the continuation of The development gap played a key role between developed

Developing industrialized countries have been able to focus on self-transformation and qualitative transformation, as exemplified by the Paul Romer model as well as the Robert Lucas model of 1986, so the field of knowledge and technical progress of Manki and Difi Rumi in 1992 adopted in their scientific research a new formulation, the function of production in cooperation with a continuous series of special statistics on growth in developing countries. (Al-Masoudi, 2010).

The model focused on several points and focused on the importance of technical progress in economic growth through discoveries, inventions and innovations. According to the above, at the same time, this function allows human capital to make any expansion that contributes to the production process; Because there are all the flexibility transactions, i.e. the three elements, which is equal to one, or equal to the correct number. (Nebridrick and Abu Amsha, 2002).

**Second: the mathematical model used - product**

Let us first get acquainted with the concept of mathematical economics, which is the science that specializes in formulating economic theories in a mathematical style and expressing the relationships between economic variables not by description, as is the case with traditional economic analysis, but by using mathematical symbols(Chiang, 1984).

The use of the mathematical method in economics results in many advantages, including avoiding implicit assumptions that are difficult to discover and making them more explicit, shortening and accuracy in presenting the relationships between economic variables, and dealing with a large number of variables and not being limited to a specific number of them(Al-Jawari, 2010).

The relationship between mathematical economics and econometrics can be clarified through economic theory in mathematical formulas or in the form of equations that take different functional forms, as is the case in the consumption function, for example ( $c = a + by$ ). Variables that cannot be measured in mathematical form, as it is considered that these relationships are not completely accurate(Bakhit, 2000)

Strictly, and they are called random variables, and this means that the random variables ( $u$ ) is the element that characterizes econometrics and mathematical economics as in the following function: ( $c = a + by + u$ ).

Where these equations were applied in economic models, The economic model is intended to simplify the economic reality in a way that is free of complications, and it refers to a set of relationships between economic variables, but in a brief form, and this is the goal of developing the model and aims to predict or evaluate a particular economic policy or analyze the economic structure(Al-Jawari, 2010).

Where scientists suggested solving the economic model mathematically through the equations of demand, supply and equilibrium, the model can be solved mathematically:

$$Q_d = a - b_p$$

$$Q_d = c - d_p$$

$$Q_d = Qb_s$$

By the equilibrium condition we get the following equation:

$$a - b_p = -c + d_p$$

$$a + c = p(b + d)$$

$$p = \frac{a + c}{b + d}$$

In the end, the mathematical model used - produced helps in asking the right questions, as it paved the way for building models that involve extremely complex mathematical ingenuity, while at the same time providing recognition of basic economic principles. themselves, i.e., the sheer enthusiasm for the mathematical formulation worked mostly to hide the essential content of the subject behind a huge front of algebraic signs, and the scientists pointed out that mathematics had come out of its mission to help economics to prove mathematical theorems and to address special problems because they are motivated towards proving theories The task is more mathematical than economic(Jacques, 2006).

- **Study models**

$$gro = \beta_0 + \beta_1 Fug + u_i \dots\dots\dots(1)$$

$$Q_d = a - b_p \dots\dots\dots(2) \quad (a, b > 0)$$

$$Q_s = c - d_p \dots\dots\dots(3) \quad (c, b > 0)$$

- **Variables and functions**

**Variables:** It is the thing whose amount is subject to change, that is, it is an unlimited number that takes multiple values instead of a specific number, for example, that differ from each other, so it can be symbolized by a specific symbol (the required quantity (Qd), revenue (R), Cost (C)).

**Functions:** The function is an expression of the relationship between two or more variables in the symbol, for example, when it is said that the variable (y) is a function of the variable (X) it means that the variable (y)

depends on the variable (X) and in this case) the independent variable and it can be expressed Mathematically, the variable (y) is called the dependent variable, and the variable (X) is called according to its function.

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From the foregoing, we find the largest possible number of economic growth test criteria that have been analyzed based on a number of equations:

$$\begin{aligned} \Delta GDP_t &= \sum_j^n \alpha_i * \Delta U_{t-i} + \epsilon_t \\ \Delta U_{t-i} &= \sum_j^n \alpha =_1 b_i * \Delta U_{t-i} + \epsilon_t \\ \Delta GDP_t &= \sum_j^n = 1 C_i * \Delta GDP_{t-i} + \sum_j^n = 1 * \Delta U_{t-i} + \epsilon_t \\ \Delta U_t &= \sum_j^n 1 e_i * \Delta U_{t-i} + \sum_j^n = 1 * \Delta GDP_t + \epsilon_t \end{aligned}$$

where ( $\Delta GDP_t$ ) expresses the first differential of the local product. ( $\Delta U_{t-i}$ ) expresses the variables of economic growth . By replacing the study variables with economic equations, we get:

$$\begin{aligned} Q_d &= Q_s \\ Q_d &= 27 - 4p \\ Q_s &= -3 + 2p \\ Q_s - 2p &= 0 \\ Q_s - 2p &= -3 \end{aligned}$$

$$\begin{array}{cccccc} 1 & -1 & 0 & & Q_d & 0 \\ 1 & 0 & 4 & * & Q_s & = 27 \\ 0 & 1 & -2 & & p & -3 \end{array}$$

$$Ax = D$$

$$|A| = 1 \begin{vmatrix} x1 & x3 \\ x2 & x4 \end{vmatrix} - (-1) \begin{vmatrix} x1 & x3 \\ x2 & x4 \end{vmatrix} + 0 \begin{vmatrix} x1 & x3 \\ x2 & x4 \end{vmatrix}$$

By replacing the study variables with economic equations, we get:

$$Y = C + I + G$$

$$C = 135 + 0.8y$$

$$I = I_0 = 75$$

$$G = G_0 = 30$$

$$T = 30 + 0.2y$$

$$Y - C = 105$$

$$-0.8y + C = 135$$

$$-0.2 + T = 30$$

$$1 \quad -1 \quad 0 \quad 105$$

$$-0.8 \quad 1 \quad 0 \quad 135$$

$$-0.2 \quad 0 \quad 1 \quad 30$$

$$|A| = 1(1 - 0) + 1(-0.8) = 0.2$$

$$105 \quad -1 \quad 0$$

$$135 \quad 1 \quad 0$$

$$\bar{Y} = \frac{|A_1|}{|A|} = \frac{30 \quad 0 \quad 1}{0.2} = \frac{240}{0.2} = 1200$$

$$1 \quad 105 \quad 0$$

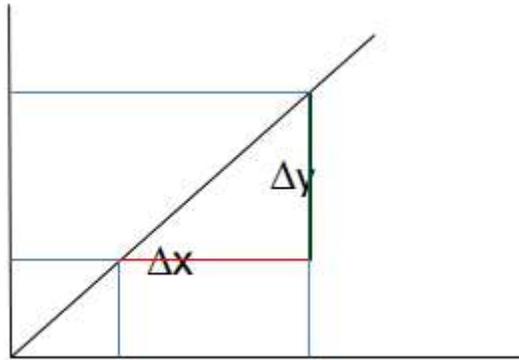
$$-0.8 \quad 135 \quad 0$$

$$\bar{C} = \frac{|A_2|}{|A|} = \frac{-0.20 \quad 30 \quad 1}{0.2} = \frac{219}{0.2} = 1095$$

$$1 \quad 105 \quad 0$$

$$-0.8 \quad 135 \quad 0$$

$$\bar{C} = \frac{|A_2|}{|A|} = \frac{-0.2 \quad 30 \quad 1}{0.2} = \frac{219}{0.2} = 1095$$



Using the mathematical model used - product:

input	INTERMEDIATE DEMAND	FINAL	TOTAL OUTPUT
I	$A_{11}, A_{12}, A_{13} \dots$	$a_{1n}, d_1 \dots$	X1
II	$A_{21}, A_{22}, A_{23} \dots$	$a_{2n}, d_2 \dots$	X2
III	$A_{31}, A_{32}, A_{33} \dots$	$a_{3n}, d_3 \dots$	X3

It is clear from the table that the total output of the sector is distributed between the median of other economic sectors and the sector itself, as well as the final demand, as shown in the following mathematical model:

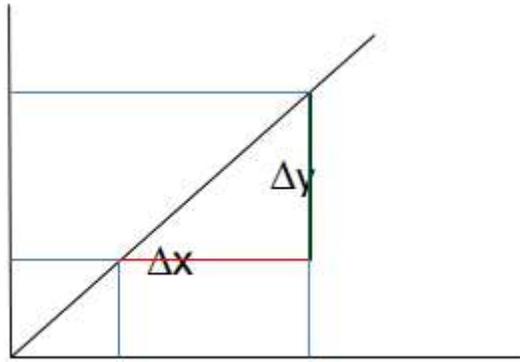
$$X_i = \sum_j^n = 1 \alpha_{ij} + d_i$$

*X* is the total output

*A<sub>ij</sub>*: inputs for production of sector (*j*) of sector (*i*)

*D<sub>i</sub>*: final request

input	INTERMEDIATE DEMAND	FINAL	TOTAL OUTPUT
A	15.50, 3.25	20	38.75
B	7.75, 9.75	15	32.50
C	38.75, 32.50	35.00	106.25



## Results:

### The results show the following:

It is clear from this table that:

1. There is a positive and insignificant effect of economic growth, which means that the increase in spending leads to an increase in the rate of economic growth very slowly, and this result supports the results of all the previous applied studies presented in this study. But taking into account that the rate of economic growth using the mathematical model used - the product.
2. There is a positive and moral impact of capital formation as a percentage of GDP, which means that increased investment leads to increased economic growth.
3. The presence of a positive and insignificant effect as the percentage of the size of the labor force participating in economic activity out of the total workforce, and this means that the workforce in the Arab countries under study has not yet reached the level that has a tangible impact on economic growth, so it needs a lot of training and development from by the Arab countries.

## Recommendations

Looking at the results, the researchers drew a set of recommendations, explaining the following:

- Work on coordination and harmonization between the structure of economic growth and the user-producer model due to the weakness of the coordination process between them
- Conducting studies and research related to the mathematical model used - the product and linking them to additional variables and factors, and this would contribute to enriching the theoretical and practical literature.
- Focus on plans and policies that support structuring economic growth because of their greater impact compared to other factors, especially on production processes that include supply and demand.
- Working on the existence of a strategy to promote economic growth at the level of Arab countries that works to direct scientific research to serve sustainable development issues.
- Encouraging work to establish research teams working in a team spirit in the field of scientific research to serve the study of economic growth using the mathematical model used - the product.

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