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# Investigating the causal relationship between consumption of energy carriers and economic growth in all provinces of Iran (Granger-Hsiao, Toda and Yamamoto causality approach in panel data)

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**Abstract**

The main purpose of this study is to investigate the causal relationship between consumption of energy carriers and economic growth in all provinces of Iran over the period 2011-2018 using Hsiao's Granger, and Toda and Yamamoto causality approach in panel data. In this regard, variables including gross domestic product, labor force, investment, unemployment rate and consumption of energy carriers (Oil, Gas, Petrol and Gasoline) have been used in the regression model. According to the estimation results, there is a unidirectional causality running from consumption of energy carriers to economic growth, so with an increase in consumption of energy carriers, economic growth increases. This one-way causality is confirmed in both approach. Therefore, according to the results of the research, the policy recommendation is that the government create jobs in the society by giving part of the development credits to the banks in case of the consumption of energy carriers, and cause the labor force employment in the society. The practical benefit of granting such an option is that the more people involved in the production of goods and services, the greater the economic growth.

**Keywords:** Consumption of Energy Carriers, Economic Growth, Granger causality, Hsiao's Granger, Toda and Yamamato causality.



## 1. INTRODUCTION

Energy is the most important strategic factor that governments need to achieve economic growth and development. Therefore, the availability of significant energy in the society is not only necessary but also very important for achieving sustainable economic development [1].

Since energy is considered as one of the important inputs in the production of goods and services, it has always had a special place in the economies of countries. In this regard, providing the required energy for the activities and economic sectors of the country is important and the study of the relationship between energy inputs on production and growth of economic sectors is worth considering [2].

Therefore, this study is to investigate the causal relationship between consumption of energy carriers and economic growth in all provinces of Iran Also, the main issue of the effect of increasing the consumption of energy carriers on economic growth on the one hand and the effect of increasing economic growth on the consumption of energy carriers on the other hand has been raised as the main concern of this study. Therefore, given the growing need to use energy carriers to meet the demands, countries such as Iran should put a basic approach to the use of energy carriers in their agenda, because Iran, like other developing countries with There are important challenges in economic policies, increasing production and social factors.

This study intends to study the causal relationship between energy carrier consumption and economic growth in the provinces of Iran for the first time using the Granger, Granger-Hsiao, Toda and Yamamato causality methods during the years 1390 to 1397. Tests the following hypotheses: 1- There is a positive and significant causal relationship between energy carrier consumption and economic growth 2- Using the Granger, Granger-Xiao, Toda and Yamamato causality method, a one-way causal relationship on consumption Energy carriers are growing, which shows that with the consumption of energy carriers, economic growth increases, and this one-way causal relationship is confirmed in both causal approaches.

The variables used include GDP, labor force, construction investment, unemployment rate and consumption of energy carriers (kerosene, liquefied petroleum gas, gasoline and diesel). The research will be organized in this way, which first examines the introduction and the causal relationship between energy consumption and economic growth, then reviews the theoretical foundations and research background, then introduces the Granger causality approach, Granger-Xiao, Toda, and Yamamato extract the model results in the panel data, and the conclusions and suggestions are presented in the final part of the article..

## 2. MATERIAL AND METHOD

In this section, Granger-Hsiao (1981) and Toda and Yamamato (1995) causality tests are briefly introduced [3, 4]. The Granger-Hsiao causality test is performed in two stages. In the first step, a set of autoregressive regressions on the dependent variable is estimated. In the first regression equation, the dependent variable will have an interval, and in subsequent regressions, an interval will be added, respectively. The estimated regression will be as follows:

$$Y_t = a + \sum_{i=1}^{m} \beta_i Y_{t-i} + \varepsilon_{1t} \quad (1)$$

In the next step, the appropriate number of interruptions is determined based on Akaike and Schwartz statistics, and then for each regression equation, the final prediction error (FPE) is calculated as follows:

$$FPE(m) = \frac{T+m+1}{T-m-1} * \frac{ESS(m)}{T} \quad (2)$$

Where T is the sample size and ESS is the sum of the squares of the waste. The optimal interval length (m *) will be the interval length that creates the minimum measure of the final prediction error. In the second step, when m * is determined, the regression equations are estimated as follows with intervals applied to the other variable:

$$Y_t = a + \sum_{i=1}^{m} \beta_i Y_{t-i} + \gamma_j X_{t-j} + \varepsilon_{2t} \quad (3)$$

Then, the final prediction error criterion for each regression equation is calculated as follows:

$$FPE(m^*.n) = \frac{T+m^*+n+1}{T-m^*-n-1} * \frac{ESS(m^*.n)}{T} \quad (4)$$

The optimal interval length of the variable X is the interval length, which is the minimum measure of the final prediction error. Now to compare Granger causality, we compare $FPE(m^*)$ with FPE $FPE(m^*.n^*)$. If $FPE(m^*) < FPE(m^*.n^*)$, then X is not the cause of Y gangrene. But if $FPE(m^*) > FPE(m^*.n^*)$, X is the cause of Y Granger.

The important point in the causal test of shingles is that in this method, it is necessary for all variables to be stable and in case of instability, the variables must first be differentiated to be stable and then use their stable difference to perform the test [5, 6].

Toda and Yamamato in 1995 proposed a simple method to estimate a modified vector auto regression explanation (VAR) model to investigate the Granger causality relationship. They argue that this method is valid even if there is a synergistic relationship between the variables. In this method, first, the number of optimal interrupts of VAR model (k) and then the maximum degree of reliability (d) should be determined and a self-explanatory vector model with the number of interrupts (k + d) should be formed. The interrupt selection process is valid when k ≥ d.

$$Y_t = \sum_{i=1}^{k+d} \beta_i Y_{t-i} + \sum_{i=1}^{k+d} \theta_i X_{t-i} + u_t \quad (5)$$

$$X_t = \sum_{i=1}^{k+d} \gamma_i Y_{t-i} + \sum_{i=1}^{k+d} \delta_i X_{t-i} + \varepsilon_t \quad (6)$$

To test the hypothesis that X is not the cause of Granger Y, we test $\theta_i = 0$. If this hypothesis is not rejected, then X will not be the Granger causality of Y [7].

## 3. Results and Discussion

This research is methodological, causal-analytical and purposeful; the method of data collection is also a documentary-library type and an attempt has been made to use data related to GDP variables (GDP) as a dependent variable, labor force (LAF), capital. Construction (CI), Unemployment Rate (UR) and Consumption of Energy Carriers (Oil, Gas, Petrol and Gasoline) in the Provinces of Iran over the Years 2011-2018 Research hypotheses should be tested. The source used for data collection is the economic and financial database as well as the energy balance sheet during the mentioned years.

In addition, considering that the period studied in this research is 8 years and based on the provinces of the country, to test the standard causality of Granger, it is necessary to examine the long-term and collective relationship between the variables. Yamamata Information on the aggregate properties of the system is not necessary, so in this study, the Toda and Yamamato methods are used to investigate the Granger causality relationship between the variables. In order to reinforce the results, the causal causality method is also used to investigate the Granger causality relationship between the variables, and then the results of the two methods will be compared with each other.

## 4. Conclusions

The energy factor, as the driving force of most production and service activities, has a special place in economic growth and development. In this paper, we examine the causal relationship between the consumption of energy carriers (kerosene, liquefied petroleum gas, liquefied petroleum gas, gasoline and diesel) and economic growth in the provinces of Iran using the Granger, Granger-Hsiao, Toda and Yamamato causality approaches in the data. A painting was made for the years 2011-2018. For this purpose, the variables of GDP, labor force, construction investment and consumption of energy carriers (kerosene, liquefied petroleum gas, gasoline and diesel) were also used. The results of model estimation based on both studied approaches (Granger, Granger-Hsiao and Toda and Yamamato causality approach in panel data) show that there is a causal relationship between the variables of energy consumption and economic growth. On the one hand, there is an increase in the consumption of energy carriers in the provinces of the country. This means that with increasing consumption

of energy carriers, economic growth increases and this one-way causal relationship is confirmed in both causal approaches. The results obtained in this study, based on the positive and significant effect of energy carriers' consumption on economic growth in the provinces of the country, are in line with experimental research studies such as Apergis, N., & Payne (2009) and Tsani

reproduction of labor and capital can be used in the growth of various economic sectors and consequently It is an important factor for the growth of the whole economy and any restrictions on the use of this factor will have a negative effect on the sectors. However, this does not mean that energy consumption will be left to its own devices, but it can meet the needs of the country by adopting rational policies to improve the pattern of optimal energy consumption and take steps in the field of sustainable development. Then, by selling this type of energy carriers, it became possible to export energy and exchange currency within the country. Therefore, according to the results of the study, the policy recommendations are that the government, by giving a portion of development credits to banks in the event of increased consumption of energy carriers, at the same time creates employment in society to lead to employment in the workforce be a community.

The practical benefit of granting such an option is that the greater the number of people active in the production of goods and services, the greater the economic growth and the further problems such as rising inflation will be avoided.

In addition, the government can make the necessary reforms in the energy carrier market; reform is not the only thing that leads to price reform. Rather, there are several issues such as targeting subsidies in the energy carrier sector that need to be fundamentally reformed. In addition, given that Iran is one of the countries with abundant energy resources and its various economic sectors, including the industrial sector, enjoy energy subsidies, adopting unreasonable energy policies in the field. It may increase recession and unemployment in the country, so policymakers need to be very careful and coordinated in their implementation.

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