

# The effects of economic sanctions on Iran's employment and economic growth according to the Markov switching model

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## Abstract

The improvement of employment and economic growth is an important economic goal of any country but its achievement is a big challenge without considering the effects of economic sanctions on Iran's economy. Therefore, the present research estimated the direct effect of economic sanctions on employment and economic growth of Iran from 1984 to 2020 using the Markov switching method. The appropriate index was first calculated for sanctions, using the factor analysis method during the target period. After finding the quantitative values of sanctions in different periods, the employment and economic growth models were defined using the Markov switching method. In this regard, employment and economic growth could be divided into two regimes, including Regime (1) with low mean and high standard deviation and regime (2) with high mean and low standard deviation. The results of estimating Markov switching models indicated that sanctions had negative effects on employment but they had no significant effect on economic growth. The results also indicated stable employment in the low regime and economic growth in the high regime.

Keywords: economic sanctions, employment, economic growth, Markov switching models

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## 1 Introduction

Economic sanctions have affected Iran's economy for more than four decades in a way that the analysis of Iran's economy does not lead to correct results without considering its destructive effects. Economic sanctions can be classified into two phases: trade and financial sanctions. Trade sanctions are accompanied by limiting or cutting off different kinds of import and export relations, and financial sanctions impose restrictions, prohibitions, and pressures on the financial relations of the target country, in other words, put pressure on the investment, financing, and financial transactions of the country. Imposing sanctions on banks or the central bank is a type of financial sanction. However, most of the sanctions are a combination of trade and financial sanctions, and the sanctioning countries have a greater tendency to impose financial sanctions [18].

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Iran's sanctions were imposed by the West, especially America, during the victory of the Iranian Revolution in 1978 and subsequently during the imposed war. The procedure of the Islamic Republic of Iran after the Iranian Revolution and not following the plans of the West caused the US and its allies to impose more sanctions to make Iran surrender as the US imposed unilateral sanctions against Iran until 2006. Since the sanctions did not bring higher benefits for the United States, the economic and technological restrictions of the United States against Iran were repaired and provided in the world markets, and it started to pass laws from 2006 onwards to restrict the cooperation of other companies and countries with Iran in the atmosphere of economic punishment and banned any cooperation with American economic companies.

The sanctions imposed against the Islamic Republic of Iran can be classified into six main periods, each of which has its own features [10]:

- 1- Sanctions during the hostage period (1979-1981);
- 2- Sanctions during the Iran-Iraq war (1981-1988);
- 3- Sanctions during the reconstruction period (1989-1992);
- 4- Sanctions during Clinton's presidency, bilateral containment (1993-2001);
- 5- Sanctions after September 11, 2001;
- 6- Sanctions after Security Council resolutions.

An important and noteworthy point is the effect of sanctions on the status of the sanctioned country, including the economic status and macroeconomic variables. This issue has become more important in the case of Iran owing to the number of sanctions in recent years. The supporters of sanctioning Iran's economy have a consensus in the US and to some extent in the West that excessive dependence on oil foreign exchange rates is the weak point of Iran's economy [28].

It is worth noting that the variables affected by the sanctions are at the first layer of economic sanctions; in other words, they have a high sensitivity to international economic sanctions and are often considered by the sanctions as the main reasons for the effect of sanctions on the key variables of the country's economy. The research variables at the first layer included the prices of imported and exported goods, the exchange rate, Iran's share of global crude oil production, Iran's share of crude oil export production, Iran's share of foreign direct investment, the US share of Iran's foreign trade, exchange rate changes, the exchange rate variance, the ratio of the non-oil trade balance to the GDP, Iran's share of air travel in the world, and the ratio of Iranian air passenger casualties to the world [15].

Economic sanctions have negative effects on the economy of the sanctioned country. Therefore, it can be expected to have a negative effect on the economic growth and employment of the industrial sector in Iran. Since no sanction appears to have targeted employment, the effect of sanctions on employment cannot be considered a direct effect but sanctions directly target the import of raw materials and machinery, as well as investment and currency exchange which are also done to affect production; hence, sanctions have direct effects on production and economic growth. Since employment is directly affected by production, the effect of sanctions on production is indirectly transferred to employment and it clarifies the effect of sanctions on employment.

Iran's economy shrank by almost 20% from 2011-2015 but Iran could grow by 7% annually in 2016-2018 owing to the reduction of JCPOA-related sanctions. According to the report of the International Monetary Fund (IMF), Iran's economy shrank by about 8% from March 2019 to March 2020, and further contraction was expected from 2020-2021. The estimates covered the effects of the COVID-19 pandemic and US sanctions [19].

The manuscript is organized as follows. The second section presents the theoretical bases and research background. The third section is about the research methods, the fourth section estimates the effects of sanctions on employment and economic growth, and the fifth section presents conclusions and suggestions.

## 2 Theoretical foundations

### 2.1 Sanctions and employment

Owing to the correlation of employment with other macroeconomic variables such as economic growth, inflation, fair distribution of income, investment, and production, it is considered a key index in the policies of each country. Therefore, there is high sensitivity in evaluating the performance of governments towards the employment change

and development process. Iran's labor market has been facing an increasing unemployment problem in the last two decades [5].

Sanctions can cause exchange rate fluctuations and a gap between the nominal exchange rate and the free market. The real exchange rate fluctuations and its deviation from the equilibrium path are reflected in various ways in many economic activities, especially in the production sector because these fluctuations indicate great instability and uncertainty in relative prices, higher risk, and shortening of the investment horizon, high adjustment costs owing to the transfer of production between commercial and non-commercial sectors, and the instability of financial markets due to the effect of exchange rate change expectations in interest rate fluctuations. The deviation of the real exchange rate from its equilibrium path leads to the inappropriate distribution of resources, the destruction of the performance of various economic sectors, the increase of capital flight, the reduction of economic efficiency, the reduction of production, and finally, the reduction of employment. The market structure strongly affects the reaction of labor demand to exchange rate changes. Under monopolistic competition with zero profits, an increase in the exchange rate enhances production and thus increases job demand but its reasons are completely different in the multilateral monopoly market. Considering that prices of manufactured products may change owing to changes in exchange rates in the market of the multilateral monopoly of industries both in domestic and foreign markets, the reaction of production and employment to exchange rate changes is more limited in this type of market and the major redundancies appear in the firms' profit margins. Therefore, the severity of the affectability of the reduction of employment by the exchange rate has an inverse relationship with the degree of market monopoly [4].

The types of exchange rate changes and shocks affect the intensity of redundancies. Since the adjustment is costly, companies do not make labor adjustments when facing a temporary currency shock. When the exchange rate is exposed to high and continuous fluctuations, firms cannot distinguish whether these changes are temporary or permanent; hence, the labor adjustment is postponed until the stability of the exchange rate market. Therefore, uncertainty in the exchange rate market increases the effect of the exchange rate on employment [20].

Therefore, exchange rate changes directly affect employment and unemployment rates through two channels, namely substitution and production effects. A situation, where there is a significant difference between the official exchange rate and the exchange rate in the free market for various currencies and also there is a low-interest rate of bank deposits, facilitates the deviation of bank deposits and productive economic capital towards the currency market. Therefore, the real exchange rate deviation from its equilibrium path leads to improper distribution of resources, increases rent seeking, destructs the performance of various economic sectors, increases capital flight, decreases economic efficiency, and ultimately decreases the creation of job opportunities, and decreases employment [22].

## 2.2 Sanctions and economic growth

Economic growth is considered a symbol and index of progress and is particularly important in economic literature in any country. Economic growth refers to a financial increase in the total domestic income or gross domestic product of a society in a certain period, and generally, the "quantitative increase in production in a certain period compared to a similar period" [25].

Economic growth models are theories that have been presented to interpret and explain the facts observed in the field of growth at the global level. Endogenous growth models reject the neoclassical and classical hypotheses about ideal markets and decreasing returns of factors, especially capital. The term "endogenous" entered economics in a diverse set of theoretical and experimental works in the 1980s. Endogenous growth separates itself from neoclassical growth by emphasizing that economic growth is the outcome of the economic system, not the result of external forces. It considers business-oriented innovation-based activities in response to economic stimuli as the main driver of technological progress and economic growth. The main figures of this process are Arrow, Lucas, Grossman, and Helpman [13].

There have been three growth waves in the last six decades. In other words, there have been many transformations in terms of determinants of growth, endogeneity, and exogeneity of variables such as human capital, the type of production function, the increasing or decreasing effects of inputs, the definition of capital, and its division into physical and human capital, and political variables over time from the era of Young, Harrod-Domar, Solow-Swan, Kaldor, Arrow, Romer, and Lucas to the 21st century [13].

The roles of two key factors, energy and exchange rate fluctuations, should not be neglected in examining the effects of sanctions on economic growth. In the theoretical framework, energy (oil) is considered a production input in the economic production function. Assuming the constant nature of other conditions, the level of profit-maximizing output decreases when the price of an input increases but from the point of view of different economic schools, capital, and labor, including experts and non-experts, are the most important determinants of economic growth; however, the

energy factor is also included in the model in new theories of growth but its importance is not the same in different models. Some ecological economists believe that energy is the main factor and the only effective factor in production, and labor and capital are intermediate factors that require energy. Neoclassical economists believe that energy is not an important factor in economic growth, and it indirectly affects economic growth through its effect on labor and capital. If energy is a production input, the increase in its price raises the cost of production and the price of products and reduces employment.

Currency fluctuations also affect the demand of the entire economy through imports, exports, demand for money, and the supply of the economy through the cost of imported intermediate goods. The outcome of these two effects on production and prices depends on the initial economic conditions of countries. Most developing countries have extensive foreign debts due to receiving foreign loans. The devaluation of the currency in these countries has increased their debt in terms of the domestic currency. The increase in the pressure of these debts has resulted in the loss of necessary resources in production and reduced GDP [26].

### 2.3 Research background

Amadeh et al. [5] studied the effects of economic sanctions on the employment level in Iran [5]. Therefore, they investigated the effects of economic sanctions on the employment sector of Iran from 1969-2012 using the OLS method. Based on a combination of existing classifications, they studied the effects of economic sanctions in extensive unilateral and multilateral sanctions using two virtual variables. Their findings indicated the existence of a negative and significant relationship between extensive unilateral economic sanctions and the total employment level of Iran, while extensive multilateral economic sanctions did not have any significant effect.

In their study, Ezzati and Salmani [13] studied the “direct and indirect effects of sanctions on Iran’s economic growth”. Their research model was based on endogenous growth models and was analyzed with the two-stage least squares (2SLS) method. Their findings indicated that the sanctions did not directly affect Iran’s economic growth. However, sanctions indirectly reduced the economic growth by limiting total imports, capital goods imports, intermediate and primary goods imports, and exports.

Garshashi and Yousefi [15] studied the “effects of international sanctions on Iran’s macroeconomic variables”. In the first step, a new index was created for sanctions from 1968-2000. In this regard, twelve variables with high affectability from sanctions were used in the process of indexing the sanctions, and then the three-stage least squares method with a small macroeconomic model was used to evaluate the implications of sanctions on important macroeconomic variables such as economic growth, trade, investment, and employment. Based on the findings, the direct effects of sanctions were significant only in terms of economic growth and exchange rate [15].

Nademi et al. [22] studied the “econometric modeling of the effects of sanctions on the foreign exchange market and the mechanism of its transfer to the variables of Iran’s macroeconomics”. Therefore, a variety of econometric models were used, including ARIMA, GARCH, and Markov switching models. The results of estimating research models by Markov switching models indicated that sanctions have an increasing indirect effect on inflation and unemployment rates through the currency market [22].

Abbaschian et al. [1] conducted an article titled “Comparative study of the effects of sanctions on Iran’s macroeconomic variables and providing solutions to deal with them” and analyzed the impact of sanctions on Iran’s economy from the perspective of the general budget and the government’s financial status, currency market, foreign trade, and inflation. Their results indicated that the effects of sanctions on various economic fields led to a decrease in economic growth, oil revenues, and foreign exchange revenues from oil exports, a decrease in imports, and an increase in prices of imported goods, non-oil exports, inflation, and input prices [1].

Ezzati et al. [11] investigated “the effects of economic sanctions on the production and employment of Iran’s industrial sector”. The data of the Central Bank and the Statistics Center of Iran were used from 1966-2016 and were analyzed using the 3SLS simultaneous equations. Their findings indicated that economic sanctions decreased the employment level in the industrial sector by reducing industrial production [11].

Oxenstierna and Olsson [23] investigated “the economic sanctions against Russia” in 2014. Their results indicated that sanctions had negative economic effects on both sides. The imposed sanctions caused a decrease of \$150 billion in the capital of the Group of Eight (G8), a 13% reduction in the stock market, a 25% reduction in tourism, a 7% increase in inflation, and a negative growth of 3% in the Russian economy [23].

Afesorgbor and Mahadevan [2] investigated “The impact of economic sanctions on income inequality of 68 countries” from 1960-2008 using the generalized method of moments (GMM). Their results indicated that the imposed trade and financial sanctions had adverse and different effects on income inequality in these countries, and their effectiveness

increased as the duration of the sanctions increased [2].

Yelena and Faryal [27] studied “the impact of oil prices and sanctions on the Russian economy” using the quarterly data of 1999-2015 and the vector autoregressive method. In this study, the virtual variable was assigned a value of 1 in the seasons where EU and American sanctions were applied, and a value of 0 in other seasons. Their results indicated that the Russian economy was highly affected by oil price fluctuations and sanctions because oil price changes and sanctions had effects on the inflation rate, real exchange rate, and gross domestic product [27].

In an article entitled “The Effect of Economic Sanctions from the Banking Channels (Monetary) on the Industrial Production of Iran”, Ezzati [10]. and Kazemi Mehrabadi [12] used the simultaneous equation system model and concluded that sanctions had negative effects on banks and industrial growth.

### 3 Research method

#### 3.1 The model specifications

Since some economic variables have a non-linear nature, the present research investigated the effects of economic sanctions on macroeconomic variables, using the Markov switching model to consider periods of economic prosperity and recession and take into account high and low fluctuations in Iran's economy.

This section specifies the employment and economic growth models.

##### Model 1: Employment

Inspired by the study of Alfalih and Hadj. [3], employment can be considered a function of gross domestic product (GDP) and foreign direct investment, oil rent, and human development index as follows [3]

$$\text{EMPL} = F(\text{RGDP}, \text{FDIGDP}, \text{OILRENT}, \text{HDI})$$

We use the following model to estimate the effects of sanctions on employment:

$$\begin{aligned} \text{EMPL}_t = & \alpha_0 + \alpha_1 \text{RGDP}_t \\ & + \alpha_2 \text{FDIGDP}_t + \alpha_3 \text{OILRent}_t + \alpha_4 \text{HDI}_t + \alpha_5 \text{SAN}_t + \epsilon_t \end{aligned} \quad (3.1)$$

The variables used in equation (3.1) are as follows:

EMPL: The logarithm of the total number of employees in Iran

RGDP: The logarithm of gross domestic product

FDIGDP: The ratio of foreign direct investment to GDP

OILRENT: Oil rent to GDP

HDI: Human development index

SAN: The logarithm of the sanction index

$\epsilon$ : Error term

In the above model, the employment rate was extracted from the Iran Statistics Center database, foreign direct investment, gross domestic product, and oil rent from the World Bank, and the human capital index was extracted from the FRED database [17].

##### Model 2: Economic growth

A model by Rahman et al. [24] was used to specify the economic growth model. In this study, economic growth was a function of fixed capital formation ( $K$ ), employment ( $L$ ), financial development (FD), and per capita energy consumption (EC).

$$Y = F(K, L, \text{FD}, \text{EC}).$$

Therefore, we used the following logarithmic model to estimate the effects of sanctions on economic growth:

$$\text{LY}_t = \delta_0 + \delta_1 \text{LL}_t + \delta_2 \text{LK}_t + \delta_3 \text{LFD}_t + \delta_4 \text{LEC}_t + \delta_5 \text{LSAN}_t + \theta_t. \quad (3.2)$$

The variables in the above model are as follows:

Y: GDP per capita

L: Number of employees

$K$ : Fixed capital formation (2010 price)  
 $FD$ : Ratio of credits to private sector credits (financial development)  
 $EC$ : Per capita energy consumption  
 $SAN$ : Sanction index  
 $\theta$ : Error term

In this model, the data about the energy consumption per capita were extracted from the “ourworldindata” database and other variables from the World Bank database.

### 3.2 Data analysis

The evaluation of the effects of economic sanctions on employment and economic growth requires statistical data about sanctions. To this end, the index was calculated and the time series of the index was created from 1984-2020 using the exploratory factor analysis method. In this regard, twelve variables with high affectability from sanctions were used in the process of indexing sanctions. In this study, the exploratory factor analysis (EFA) was used to extract the sanctions index based on research by Garshasbi and Yousefi [15], and examine its effect on employment and economic growth.

For sanction indexing, it is better to introduce variables that are inherently sanction variables. Achieving a single variable is much more appropriate than the existence of several variables. The factor analysis is a method based on which this single index can be extracted [15].

The basic issue of factor analysis is whether a set of variables can be described in terms of several factors less than the number of variables, and what attribute or characteristic is represented by each factor. Exploratory factor analysis within the framework of orthogonal factors, used in deriving the sanctions index, describes the covariance structure (correlation) between numerous variables, and it is done using *unobserved* random values that are called factors.

If it is assumed that the variables are grouped according to their correlation in a way that all variables in a certain group have a strong correlation with each other but have relatively little correlation with the variables of other groups, and each group of variables has its own basic structure. In other words, a factor expresses its characteristics for each group.

#### 3.2.1 Measurement of sanction index

The sanctions index is first calculated to estimate the target model to estimate the effects of sanctions on employment and economic growth. The variables affected by the sanctions are at the first layer of the affectability from economic sanctions; in other words, these variables have a high sensitivity to international economic sanctions and are often considered by the sanctioners as the main bases of the impact of sanctions on the key variables of the economy. The variables, namely the prices of imported goods, the prices of export goods, exchange rate, the country’s share of global crude oil production, the country’s share of crude oil export production, the country’s share of foreign direct investment, America’s share of Iran’s foreign trade, exchange rate premium, the variance of exchange rate, the ratio of the non-oil trade balance to GDP, the country’s share of air travel in the world, and the ratio of the country’s air passenger casualties compared to the world, were used to index the sanctions.

Table 1 presents the sanctions index values according to an article by Zamani et al. [29].

#### 3.2.2 Markov switching method

Engel and Hamilton [8] conducted the first study on exchange rate behavior using the Markov switching model [9]. They proved that the Markov switching model provided a good estimation model for finite data and they utilized the quarterly exchange rate data. Cheung and Lai [7] conducted a study on the Markov switching model to describe the behavior of eighteen exchange rates, and their results indicated that the Markov switching model was a sufficient model for forecasting exchange rates. Engel and Hakkio used the Markov switching model to compare the daily exchange rates of three countries with the US dollar [8]. Their study indicated that the data were well estimated by the model; however, the out-of-sample prediction was very weak owing to parameter inconsistency.

Many variables have sections where the behavior of the series changes drastically. Any macroeconomic variable or financial data is subject to many failures over a long period. Such obvious changes in time series may be resulted from the war, a general fear in financial markets, or significant changes in government policies [16]. It should be noted that



Table 1: Calculated values for the sanctions index

Year	Sanction index	Year	Sanction index
1984	17.12	2003	4365.24
1985	101.04	2004	6850.96
1986	2486.76	2005	3277.95
1987	2004.76	2006	1252.95
1988	16914.73	2007	819.31
1989	2163.79	2008	67591.94
1990	504.65	2009	2075.56
1991	523.79	2010	36548.33
1992	1794.29	2011	4226005.82
1993	3034.1	2012	32032513.24
1994	11069.8	2013	3278384.34
1995	56572.06	2014	817994.59
1996	31102.98	2015	802195.53
1997	4669.85	2016	1503820.53
1998	476521.7	2017	5761296.68
1999	51209.88	2018	2565122003
2000	15488.79	2019	63344980.49
2001	57.58	2020	973944354.1
2002	400.07		

Source: Researcher's calculations

if a process underwent changes in the past, these changes may occur in the future and this issue should be considered in the forecasts. Changes in the regime should not be considered a predictable and definite issue, and the change in the regime is a random and exogenous variable. In Markov switching models, the desired time series process is assumed to be a function of an unobserved random variable ( $S_t$ ).

$S_t$  is the regime or state in which the desired time series process is located during the period.  $S_t$  takes only integer values and the "Markov chain" is the simplest time series model for a discrete random value [16]. Assume that the probability, under which  $S_t$  is equal to a particular value of  $j$ , depends only on the past value of the previous period, then

$$P \left\{ S_t = j \mid S_{t-1} = i, S_{t-2} = k, \dots, S_{t-n} = n \right\} = P \left\{ S_t = j \mid S_{t-1} = i \right\} = P_{ij} \quad (3.3)$$

This process is a Markov chain with  $n$  regimes and transition probabilities  $P_{ij}$ , in which  $P_{ij}$  represents the transition probability from regime  $i$  to regime  $j$ . (Ibid)

$$P = \begin{bmatrix} P_{11} & P_{12} & \dots & P_{1n} \\ P_{21} & P_{22} & \dots & P_{2n} \\ P_{n1} & P_{n2} & \dots & P_{nn} \end{bmatrix} \quad (3.4)$$

The element of the row  $i$  and the column  $j$  of the  $P_{ij}$  probability matrix expresses the probability of having regime  $j$  after regime  $i$ . For example,  $P_{12}$  which is in the first row and the second column, shows the possibility of changing from regime 1 to 2 (ibid). The specification of Markov switching can also be written as follows [22]. The likelihood function of the model is maximized using numerical calculation methods. EViews12 was used to estimate the above Markov switching function.

## 4 Estimation of models

The necessary data for the research were collected from databases such as the Central Bank, Statistics Center of Iran, and the World Bank (WDI, 2021), and were then calculated and estimated in Excel and EViews12.

### 4.1 Reliability test

We examined the stationarity of the variables using the Augmented Dickey-Fuller Test. Table 2 presents the results of the Augmented Dickey-Fuller reliability test in the first difference of the variables.

As shown, all variables are reliable with one differentiation at a significant level of 5%. In other words, not all variables are reliable but they become reliable with one-time differentiation.

Table 2: Reliability test results in the first difference of the variables for the models

	Statistics value	Critical Statistics	Probability	Reliability test
Model 1: Employment				
DLEMP	-2.700256***	-3.632900	0.0841	Reliable
DLRGDP	-4.660355**	-2.948404	0.0006	Reliable
DLFDIGDP	-6.569356**	-2.948404	0.0000	Reliable
DOILRENT	-2.808029**	-2.948404	0.0000	Reliable
DLSAN	-6.927552**	-2.948404	0.0000	Reliable
DHDI	-4.657464**	-2.948404	0.0000	Reliable
Model 2: Economic growth				
DLY	-4.327490**	-2.948404	0.0016	Reliable
DL	-4.667580**	-2.948404	0.0006	Reliable
DK	-2.991883**	-2.948404	0.0455	Reliable
DFD	-2.971253**	-2.948404	0.0260	Reliable
DLEU	-6.961600**	-2.948404	0.0000	Reliable

\*\* : Significance level of 5%, \*\*\* : Significance level of 1%

## 4.2 Likelihood test

Table 3 presents the results of the model likelihood test. This test indicates that the variables of the models follow two regimes.

Table 3: Likelihood test results for models

	Test statistics	Probability	Test result
Model 1: Employment			
LEMP	14+ E36.9	0.0000	Confirmed two regimes of employment
Model 2: Economic growth			
LY	11+ E812.7	0.0000	Confirmed two regimes of economic growth

## 4.3 Estimation of models with the Markov switching method

Both models can be estimated with the Markov switching model despite two regimes. Table 4 presents the estimation of the models from 1984-2020.

Table 4: Estimation of two models with the Markov switching method

	Coefficient	S.d	Z-statistic	Probability
Model 1: Dependent variable: Employment				
C in regime 1	8.441720	0.058898	143.3279	0.0000
C in regime 2	8.388214	0.060414	138.845	0.0000
LGDP	0.190131	0.001451	131.0226	0.0000
FDIGDP	0.037099	0.006744	5.500787	0.0000
OILRENT	0.001025	0.000611	1.678412	0.0933
LSAN	-0.005885	0.001250	-4.708234	0.0000
HDI	2.121444	0.079104	26.81831	0.0000
Model 2: Dependent variable: Economic growth				
C in regime 1	7.116903	0.163315	43.57769	0.0000
C in regime 2	7.031716	0.164503	42.74518	0.0000
LL	-0.831705	0.005067	-164.1271	0.0000
LK	0.314582	0.005570	56.47814	0.0000
LFD	0.113468	0.016938	6.698904	0.0000
LSAN	-7.37E-05	0.001365	-0.053971	0.9570
LEU	0.684169	0.011828	57.84251	0.0000



In model 1, the economic growth, foreign investment, oil rent, and human development index are positive and the sanctions index coefficient is negative. The positive coefficient of economic growth in the employment model is also consistent with the theoretical bases. Therefore, it is expected that the increase in economic growth can reduce the unemployment rate and increase employment through increasing demand for labor and increasing employment. The relationship between economic growth and the unemployment rate is known as *Okun's law* in the economic literature. *Okun's law* explains that the unemployment rate decreases by 1% in America for every two and a half percent of economic growth that continues for one year. In other words, continuous economic growth increases employment [21].

Foreign investment increases employment by creating new industries, and oil rent during the sanctions period prevents a sharp reduction in public expenditures of the government and thus prevents the drop in total demand of economy through the allocation of financial resources resulting from bypassing the sanctions, which in turn, can prevent the reduction of employment in the country by maintaining economic activities. Sanctions also have negative effects on employment. For reasons such as disruption in the banking system, reduction of oil exports, and reduction of imports of industrial goods, as an obstacle to economic development, sanctions can lead to a reduction in the loans granted by the banking system, a reduction in oil revenues and foreign exchange reserves, and an increase in inflation and economic distress, and limitation of opportunities for increasing the employment.

According to model 1 of employment, Iran's employment follows two regimes, including regime 1 with low mean employment and high standard deviation, and regime 2 with high mean employment and low standard deviation. The estimation of the Markov switching model leads to the measurement of the transition probability matrix that represents the employment transition, as shown below.

$$P = \begin{bmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \end{bmatrix} = \begin{bmatrix} 0.812 & 0.188 \\ 0.218 & 0.783 \end{bmatrix} \quad (4.1)$$

This matrix indicates that the probability of staying in regime 1 of low employment is 81.2% and the probability of staying in regime 2 of high employment is about 78.3%. The probability of transition from regime 1 to regime 2 is about 18.8% and the probability of transition from regime 2 to regime 1 is about 21.8%. These probabilities indicate that the probability of staying in regime (1) or the low employment regime is higher than the probability of staying in the high employment regime. Furthermore, the probability of transition from a low to high employment regime is less than the opposite probability due to the stability of low employment in Iran.

In model 2, the coefficients of sanctions and employment are negative and the coefficients of fixed capital formation, human development, and financial development are positive.

Sanctions have negative effects on economic growth because Iran's economy is not well prepared against sanctions. In other words, a country under sanctions not only does not consider it necessary to change its economic structure, but it is impossible owing to the inability to bypass vast sanctions [14].

In model 2 of economic growth, Iran's economic growth follows two regimes, including regime 1 with low mean economic growth average and high standard deviation and regime 2 with high mean economic growth and low standard deviation. The estimation of the Markov switching model leads to the measurement of the transition probability matrix that represents the economic growth transition, as shown below.

$$P = \begin{bmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \end{bmatrix} = \begin{bmatrix} 0.748 & 0.252 \\ 0.240 & 0.760 \end{bmatrix} \quad (4.2)$$

This matrix indicates that the probability of staying in regime 1 of low economic growth is 74.8% and the probability of staying in regime 2 of high economic growth is about 76%. The probability of transition from regime 1 to regime 2 is about 25.2% and the probability of transition from regime 2 to regime 1 is about 24%. These probabilities indicate that the probability of staying in regime (2) or the high economic growth is higher than the probability of staying in low economic growth. Furthermore, the probability of transition from a low to high employment regime is higher than the opposite probability due to the stability of high economic growth in Iran.

Therefore, economic sanctions have negative significant effects on employment. However, the effect of economic sanctions is negative on economic growth, but its coefficient is not significant.

## 5 Conclusion

Iran's economy way that oil is not considered capital, but is still the main income. Sanctions cause all countries to distance themselves from economic cooperation with Iran and increase the risk of economic cooperation. Economic

sanctions have not destroyed Iran's economy, but have slowed down the speed of progress and development and drastically increased costs. The expenses, which should be spent for the development of the country, have been used to face sanctions. Unfortunately, US sanctions against Iran, which started at the beginning of the Iranian revolution and have increased under various pretexts, are still continuing with adverse effects on the economy.

Since there were US sanctions even before the nuclear program of Iran, if Iran's nuclear negotiations are successful, there is no guarantee that the US will not increase sanctions on Iran. Therefore, it can be concluded that the solution to neutralize the sanctions is not to remove them but to build a strong economy that minimizes the vulnerability of the economy.

Sanctions of 1984-2020 were first indexed in this study, and the factor analysis method was used to quantify the sanctions, and the values of sanctions were obtained for this period.

Due to the lack of econometric studies in the field of sanction modelling, the present study investigated the effects of sanctions on employment and economic growth variables, using the Markov switching method. To this end, two models were used, and they followed two regimes in Iran's economy, including regime 1 with the low mean employment and high standard deviation and regime 2 with high mean employment and low standard deviation, and regime (2), including regime 1 with low mean economic growth and high standard deviation and regime 2 with high mean economic growth and low standard deviation.

The results of these two models indicated that the probability of staying in regime (1) or the low employment regime was higher than the probability of staying in the high employment regime. Furthermore, the probability of transition from a low to high employment regime was less than the opposite probability owing to the stability of low employment in Iran. The probability of staying in regime 2 or high economic growth was higher than the probability of staying in the regime of low economic growth. The probability of transition from the low economic growth regime was higher than the probability of the opposite probability owing to the stability of high economic growth in Iran.

The results of the present study about the effects of sanctions on employment were consistent with research by Amadeh et al. [5] who believed that sanctions had negative effects on employment and inconsistent with research by Nademi et al. [22] who reported that sanctions had positive effects on employment. In addition to the determinants of employment level in this research, there were other internal factors all of which had a major effect on the current state of employment in Iran.

Sanctions had negative effects on economic growth, and this result was inconsistent with research by Amadeh [5], Ezzati and Salmani [13], Abbaschian et al. [1], and Ezzati et al. [11]. and was consistent with research by Avetisyan and Lektzian [6], Garshasbi and Yousefi [15]. who believed that sanctions had positive effects on economic growth. Sanctions cause problems and create restrictions on the import of raw materials, machinery, equipment, and production intermediate goods, and directly target production and decrease it. These sanctions make exports difficult, thereby reducing exports and production. The sanctions on the industrial sector affect the import of raw materials, advanced industrial devices, necessary materials, and technologies. Given Iran's industrial structure and dependence on imported parts and goods, the unavailability of these facilities means spending a lot of money and opportunity. Therefore, domestic producers and part manufacturers use low-quality devices, leading to lower quality of products, and thus the country plays inverse roles in the economic growth and development and its economic growth decreases in the field of capital and intermediate goods sector, and above all in domestic production, supplying raw materials, spare parts, and equipment, the technical knowledge and technology for the development and completion of domestic productions.

Employment is a goal that sanctions are trying to damage. Removal of infrastructure and process obstacles is a solution that can help reduce the destructive effects of sanctions on employment. Improving the business environment, preventing goods smuggling, economic and social development, policy convergence of government institutions, shrinking the government body, eliminating government economic outsourcing, reforming the laws of the banking system, and ensuring capital security are the most important solutions. Job stability should be taken into consideration more than anything else in creating employment, and the government should pay attention to the possibility of maintaining stable employment more than creating jobs under sanctions before planning for job creation in various economic sectors.

Solutions such as the expansion of political relations, multi-product economy and exports, reducing the dependence of imports on oil revenues, suitable monetary or currency policies to cope with sanctions, and planning to increase non-oil exports can be also very effective in economic growth under sanctions.

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