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An Investigation into Dynamic Relationship Between Economic Growth and Fluctuations in Macroeconomic Variables in Iran (MRS-GARCH)

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Abstract:
Risk and uncertainty are inherent characteristics of economic activities. This study aimed to investigate how fluctuations in macroeconomic variables affected the economic growth of Iran, in the period 1989-2021. To this end, fluctuations in macroeconomic variables were measured using EGARCH method, and then Iran's economic growth equation was estimated based on the Markov Regime-Switching GARCH. The MRS(2)-AR(2) model was estimated. The model estimation results revealed two regimes of prosperity and recession in Iran's economy, the latter was more durable than the former in the studied period. The different effects of OPEC oil price fluctuations in the two regimes, indicating the asymmetric effects of this variable on Iran's economic growth. In other words, the effects of this uncertainty on Iran's economic growth are smaller during a period of recession than a period of prosperity. The results on real exchange rate fluctuations showed that fluctuations in this variable had similar destructive effects on Iran's economic growth. The results revealed the positive and negative effects of inflation rate fluctuations on Iran's economic growth during periods of recession and prosperity, respectively. The IQI[1] coefficient showed the positive effects of this variable on Iran's economic growth; higher institutional quality increases physical capital and, thereby, economic growth. Based on the model estimation results, it is impossible to propose a single solution to control fluctuations in macroeconomic variables in Iran during different periods. economic policymakers should adopt and implement the best policies considering the periods of recession or prosperity as well as the development priorities.

[1] institutional quality index

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1- Introduction:

One of the most important goals of any economic system is to achieve a high economic growth rate. The realization of this goal requires the adoption of appropriate and stable economic policies and the identification of the factors affecting economic growth. It is generally accepted by economists that economic stability is a prerequisite for high economic growth and economic instability is a major factor that restricts the horizons of economic growth (Dehghan Menshadi and Rahimpour, 2013: 172). The economic structure of countries like Iran is very fragile due to the export of basic and unprocessed goods or a few processed goods of low value-added, instability of foreign exchange earnings, heavy dependence on the import of intermediate goods and technologies, reliance on foreign loans and funds, and constant fluctuations in prices and exchange rates. As a result, such countries are further affected by global shocks and crises, have failed to keep pace with the global development process, and also face many economic, social, and cultural problems (Amiri and Bashkhor, 2017: 128).

A world Bank report in 2007 stressed the importance of economic stability. Fluctuations in macroeconomic variables and economic instability have traditionally been among the interesting topics of economists. However, the 1991 World Bank report was a turning point in debates on these economic issues. This report indicated that more economically stable countries that adopted and implemented more appropriate policies outperformed other countries.

A review of GDP and other macroeconomic variables of countries indicates that these variables are always fluctuating either positively or negatively. A country's value of produced goods and services in a certain period depends on many factors such as wars, revolutions, oil price shocks, monetary and financial policies, and productivity rate. Accordingly, these factors influence economic growth and cause different phases of the business cycle in an economy (Mousavi et al., 2018: 14-15).

Macroeconomic stability increases national savings and private investment and also improves the balance of payments (BOP) by enhancing export competitiveness (EC). It can be hence considered a basis for sustainable economic growth because it requires the free and competitive fluctuations of prices and also a secure economic environment to encourage private sector investment (Dhonte *et al*., 1997). Moreover, macroeconomic stability can contribute to the efficient economic management of the private sector in line with economic policies adopted by monetary and financial authorities (Fischer, 1993: 117). Macroeconomic stability is also the prerequisite to the success of any liberalization and financial reform plan and economic adjustment policies (Turtelboom, 1991: 13).

Considering the importance of economic growth in the development of societies, it is necessary to identify and investigate the factors affecting the economic growth of countries. A review of the literature on economic growth indicates that several factors affect economic growth, the most important of which are capital,

labor force, and the quality of existing institutions. On the other hand, fluctuations in the exchange rate, oil prices, inflation rate, etc. cause fundamental problems in developing countries because they affect the process of economic growth and development differently. Therefore, the effects of macroeconomic variables on economic growth should be investigated to clarify different aspects of the relationship between these two phenomena in Iran's economy. This study hence aims to determine how fluctuations in macroeconomic variables affect Iran's economic growth under different economic regimes.

2- Theoretical foundations:

Kenneth Joseph Arrow published her first comprehensive scientific book on the concepts of risk and uncertainty in economic activities more than four decades ago. In addition to proposing a precise and comprehensive scientific-mathematical method for explaining the concept of risk in economic activities for the first time, he sent the message to future economists and finance specialists that risk and uncertainty are inherent characteristics of economic activities in a production system relying on free market forces. Recognizing the importance of information, information asymmetry, and personal behaviors and traits of individuals in economic decisions in the market system much earlier than many schools of new macroeconomics, Kenneth J. Arrow presented a conceptual framework of risk and uncertainty that was later used extensively in almost all fields of economic knowledge, especially in financial ones. Since the concept of "uncertainty" currently has a special place in economic sciences as an inevitable phenomenon, risk and uncertainty analysis accounts for a major part of theoretical economic knowledge and empirical financial and economic decision-making (Cameron, 1978: 677).

Instability and volatility are two common terms in the economic literature; although some researchers do not make a distinction between these two terms, the term "instability" usually conveys a broader concept. This term involves both economic shocks and unusual fluctuations in some economic variables such as the inflation rate. Various studies use the term "instability" to refer to economic shocks and crises, economic variables fluctuation and deviation, economic insecurity, etc. (Ramezanpour, 2000: 96).

Uncertainty is a condition in which it is not possible to fully explain a situation or a result due to low knowledge and imperfect or unknown information (Hubbard, 2007: 12). Accordingly, macroeconomic uncertainty can be defined as the inability of economic agents to accurately predict the outcomes of their decisions. Macroeconomic uncertainty makes economic activists to be doubtful about future developments and unable to clearly outline the future. Therefore, macroeconomic stability can greatly contribute to real economic growth by reducing economic

uncertainties and paving the way for long-term planning (Dehghan Menshadi and Rahimpour, 2013: 176).

Effects of exchange rate fluctuations on economic growth:

The exchange rate is the price of a currency by another currency. It can be also defined as the amount of a currency that is equal to an amount of another currency. As a result, the exchange rate can be considered a conversion factor. As the relative price of a foreign currency to domestic currency, the exchange rate has always been to the interest of the economic and financial community as a macroeconomic parameter. In fact, the exchange rate describes the economic status of a country and compares it with other economies (Aziznejad and Komijani, 2017: 125). Policymakers in each country adopt appropriate currency policies considering the economic context of that country. Since Iran's government and Central Bank have monopolized the supply of foreign currencies, the exchange rate is not determined based on a system of supply and demand in this country. Increased oil revenues increase the foreign currency income of the government; therefore, the exchange rate not only cannot indicate the real status of Iran's economy but also imposes a set of artificial prices on the economy of this country (Heidary, 2011: 2).

The effects of exchange rate fluctuations on the real sector of the economy and economic growth have been dealt with in theoretical studies. Nevertheless, these studies have reported different and even contradictory results. Previous studies have shown that the exchange rate fluctuations will be higher in more flexible currency systems (Baxter and Stockman, 1989; Yeyati and Sturzenegger, 2003).

Exchange rate fluctuations affect the overall economic demand through imports, exports, and demand for money as well as the overall economic supply through imported intermediate goods. The interactive effects of these two factors on production and price depend on the initial economic status of countries. The effect of exchange rate fluctuations on the overall economic demand can be investigated based on export and import elasticities. Based on the Marshall-Lerner Condition, if the sum of export and import elasticities is greater than 1, decreased national currency value (increased exchange rate) improves the trade balance and, consequently, GDP. If the sum of export and import elasticities is smaller than 1, increased national currency value (decreased exchange rate) improves the trade balance. It can be hence stated that the effects of exchange rate fluctuations on the overall economic demand depend on export and import elasticities (Souri *et al*., 2011: 132).

Investment reduction is another factor of the overall economic demand that can be affected by exchange rate fluctuations. Domestic investment is highly dependent on the import of capital goods in most developing countries; capital goods are intended to be utilized after integration with capital and internal resources. Under these circumstances, the increased exchange rate (reduced national currency value) increases the cost of imports and reduces the import of

capital goods, decreasing domestic investment and total demand (Qatmiri and Sharaftian Jahormi, 2007: 28). Moreover, most developing countries are deeply in foreign debts resulting from foreign loans. The reduced national currency value of these countries increases the value of their foreign debts, which leads to a reduction in production factors and GDP (Bahmani-Oskooee and Miteza, 2006: 72).

Positive exchange rate shocks in the goods market increase and decrease the price of imported and exported goods, respectively, and, as a result, increase the demand for domestic goods (Kazerooni and Rostami, 2017: 187). Regarding the overall domestic supply, it can be stated that positive exchange rate shocks (reduced national currency value) increase the cost and price of imported intermediate goods (production inputs), which can negatively affect GDP.

Real exchange rate fluctuations affect the real sector of the economy through uncertainty about the future prices of goods and services. Economic policymakers and officials make their production, investment, and consumption decisions based on the information provided by price systems. Unreliable and unpredictable prices caused by uncertainties about the exchange rate negatively affect the production and investment decisions (Abbasian *et al*., 2008: 167). The exchange rate uncertainty also increases the risks of economic environments and the interest rate, reduces the investment rate, and negatively affects production value. In addition, increased fluctuations in and uncertainties about the exchange rate increase the risk and cost of international trade and, consequently, reduce trade and production (Aliyu, 2009: 6).

Effects of oil price fluctuations on economic growth:

As the world's currently largest commodity market, the oil market has expanded from a basic production activity to a complex financial market. The crude oil markets have grown so remarkably over the last decade that the price risk of these markets affects a wide range of actors including producers, traders, companies, and consumers. Crude oil price shocks can occur as a result of abrupt changes in global oil demand, reduction in crude oil production and refining capacity, reduction in precautionary storage of oil and oil products, OPEC capacity changes, global economic crises, and even regional and geopolitical risks (Tansuchat *et al*., 2010: 11).

Oil is among the few commodities that are considered the cornerstone of most economic activities and many applied sciences. Oil is the main source of energy and one of the important factors promoting economic activities. It is now considered a basic necessity to produce and consume oil and its products as intermediate and final goods. Therefore, unconventional fluctuations in the price of oil and oil products and their effects can increase the price of other goods and services and also changes the manufacturing benefits in domestic and international markets. Considering the strategic position of oil in the economy of countries, in addition to the direct effects of price fluctuations, the resulting

uncertainty seems to affect the economic performance of oil-exporting countries. According to Bernanke's theory (1997), uncertainty about oil prices can irreversibly reduce the investment rate in this field and also negatively influence GDP due to the redistribution of income between oil exporting and importing countries and economic growth and other macroeconomic variables by postponing the investment decisions. These will be more pronounced for oil-exporting countries (Bidabad and Peikarjou, 2007: 92).

Natural resources and their resulting revenues can affect the economy of countries in different ways. Depending on how natural resources and their resulting revenues affect the economy of any country, they can either accelerate or impede the development of that country. For example, the abundance of natural resources in countries such as Norway and Indonesia has positively affected the economic growth of these countries through the development of infrastructure and human capital. By contrast, countries such as Nigeria that enjoy abundant underground resources have experienced low growth rates even compared to similar countries without natural resources (Rosi *et al*., 2015: 82). Therefore, the most important role of oil and oil products is to provide the lion's share of a country's foreign exchange earnings. In addition, various economic sectors undeniably rely on oil revenues to meet their import needs. It can be hence stated that the decreased foreign exchange earnings from crude oil exports can deteriorate a country's foreign exchange situation and also reduces the import of intermediate and capital goods, production, and investment rate (Altajani and Arbabafzali, 2012: 93).

Hamilton (1973) studied the effects of sudden increases in oil prices on the US macroeconomic performance and reported that the 1970s economic recession in the US was the result of a sudden increase in the oil price. The findings of this study turned into a source of concern about the oil price fluctuations among many policymakers, because oil price fluctuations were recognized in oil-importing and oil-exporting countries as one of the main factors causing many economic crises (Fatahi *et al*., 2013: 63). The overflow of increased oil revenues into other economic sectors actually increases the overall economic demand, which generally raises the price of goods and services. This leads to the increased profitability of manufacturers in some economic sectors, which can attract capital and labor to non-tradable sectors such as construction. On the other hand, it weakens the tradeable economic sectors such as agriculture, industry, and mining. This phenomenon is referred to as the Dutch disease in the economic literature (Cordon and Neary, 1982; Krugman, 1987; Polterovich *et al*., 2010). Rodriguez and Sachs (1999) argued that countries with abundant natural resources are more likely to have a higher GDP per capita when compared to countries with poor natural resources. Economic experts generally believe that the shocks caused by the oil price increase or decrease are not to the benefit of oil-exporting countries. The shocks caused by the oil price reduction often force

governments to impose more restrictions on the import of goods and services in order to provide the necessary domestic needs and timely repay foreign obligations through foreign exchange savings. Since capital goods and raw materials account for the lion's share of imports to developing countries, such as Iran, restrictions on imports can adversely affect the production sector of these countries. This situation will inevitably lead to inflationary pressures, economic stagnation, and increased unemployment rate (Jahadi and Elmi, 2011: 18).

Effects of inflation rate fluctuations on economic growth:

There is ample theoretical literature emphasizing the importance of fluctuations in the inflation rate and relative price dispersion in economic growth. Most theoretical studies have discussed the effect of these two variables on private investment and their indirect effect on economic growth (Lucas, 1988). On the other hand, a high or highly fluctuating inflation rate increases the cost of transactions and reduces investment in productive activities, which finally lead to a reduction in economic growth. Okun (1971) found that countries with higher inflation rates generally experience greater fluctuations in the inflation rate. Okun also stated that a high inflation rate is associated with fluctuations in the inflation rate. Many studies later reported a one-way or two-way relationship between the inflation rate and inflation uncertainty, which was measured in different ways. For example, Jafee and Kleiman (1977), Logue and Willett (1976), and Taylor (1986) proposed inflation fluctuations as an alternative to inflation uncertainty. Carlson (1977) and Cukierman and Wachtel (1979) also employed inflation expectation dispersion as a substitute for inflation uncertainty, as proposed in Michigan and Livingston's studies. In addition, more recent studies have measured inflation fluctuations with the conditional variance of inflation (Engle, 1982-3; Holland, 1988; and Cosimano and Jansen, 1988). As a result, there are different views of the effects of the inflation rate on economic growth in the theoretical literature on economic growth models. Some economic theories posit that there is no relationship between the inflation rate and economic growth (Gokal and Hanif, 2004: 37), whereas others have considered a negative relationship (Smyth, D. J., 1994: 675) or a positive relationship (Mallik and Chowdhury, 2001: 125) between these variables.

Effects of institutional quality index (IQI) on economic growth:

Following the failure of economic growth theories in explaining the low and unstable economic growth of poor countries and the spread of inequality at the global level, the fourth generation of economic growth theories was proposed as the institutional and political models of economic growth (Snowden and Vane, 2005: 245). Institutional economists (North, 1990: 117) argue that the difference between countries in human capital, physical capital, and technology (which were emphasized in the precious three generations of economic growth theories) is the direct and proximate determinants of economic growth and development

and institutions are the fundamental or deep determinants of economic growth. Accordingly, the identification of these fundamental factors is the prerequisite for designing a framework of policy recommendations. Since such frameworks are something beyond recommendations and instructions, e.g. technological development, they can be used to mitigate the risk of potentially unwanted negative results of these policies (Valeriani and Peluso, 2011). As defined by North (1990), institutions set the rule of the game in a society. He argues that instructions are actually man-made restrictions that form human interactions. Technically speaking, institutions determine a limited set of choices for members of society. According to institutional economists, institutions are of special importance because they structure the motivations hidden in human exchanges. The main function of institutions is to reduce the uncertainty and cost of exchanges in economic, social, and political activities (Momeni, 2006: 143). Institutions support property rights, guarantee the implementation of contracts, motivate entrepreneurs, maintain macroeconomic stability, manage risk-taking and risk-seeking of financial intermediaries, reduce uncertainty and cost of transactions, provide networks of social security, and make the sovereignty accountable in order to provide a set of political, cultural, and economic conditions and platforms through which people can acquire and accumulate skills and economic enterprises can accumulate capital and manufacture products. Based on the new approach of institutionalism, the type of governance and regulations of institutions are among the primary and main factors that motivate people to engage in physical investment and the development of skills and technologies, all of them lead to long-term economic success, higher production and income level, and higher economic wellbeing (Jafari and Azarmand, 2005: 15). Although the history of debates about the effects of institutions on the economic performance of societies dates back to several decades ago, these effects have been empirically examined by researchers since the mid-1990s. Therefore, this can be an intriguing area of research for Iranian researchers and students.

3- Empirical studies:

Here we review the most relevant foreign and domestic studies on the research subject.

Foreign studies:

Apollos *et al*. (2015) investigated the relationship between GDP, exchange rate, imports, exports, and inflation rate in Nigeria in the period 1986-2013. The results of the econometric model estimation showed a significant and positive relationship between GDP, exchange rate, and exports. The results also indicated that exchange rate fluctuations affected the economic growth of Nigeria.

In a study titled “Efficiency of Macroeconomic Variables under Nominal and Real Uncertainty”, Zamin Shah *et al*. (2017) investigated the dynamic

relationship between inflation uncertainty and economic growth in four South Asian countries, namely Pakistan, India, Bangladesh, and Sri Lanka. The results of model estimation showed that Devereux's theory (1989) was not true in all the studied countries because the nominal and real inflation uncertainty did not affect economic growth similarly in all countries.

Presley and Boqiang (2018) studied the relationship between exchange rate fluctuations, oil price shocks, and economic growth in a small imports-based economy. The results of the VAR model estimation demonstrated that increases in the oil price increase the GDP of Liberia. In addition, the real GDP of this country significantly decreases with the increase in the exchange rate, increasing consumer prices. Their findings generally suggest that the rising oil prices are sometimes to the benefit of crude oil importers.

Zalle (2018) investigated the effects of natural resources on the economic growth of 29 African countries with an emphasis on the role of the quality of institutions and human capital. Considering the two-way relationship between human capital and the quality of institutions in any society, the results of estimating the Lag Lagrange model indicated that the abundance of natural resources caused rent and corruption in African countries from 2000 to 2015. Accordingly, they recommended that these countries should invest in human capital development to have high-quality institutions and reduce corruption in order to achieve sustainable growth and optimally take advantage of natural resources.

In a study titled "Relationship between governance and economic growth", Fraj *et al*. (2018) investigated the role of currency regimes in the economic growth of 50 countries in the period 1996-2012. Their findings demonstrated that governance does not significantly affect economic growth. Nevertheless, a flexible currency regime can encourage economic activities and greatly affect the economic growth of countries. On the other hand, a flexible currency regime improves the governance quality of courtiers by increasing their economic growth.

Thanh (2009), in a study about the effects of macroeconomic uncertainty on the formation of economic cycles, examined the model proposed by Jurado, Ludwigson, and Ng (2015) for measuring the effects of uncertainty on the US macroeconomics. The results demonstrated that uncertainty negatively affects the US economic growth and increases the depth and multiplicity of economic cycles in this country.

Eydena *et al*. (2019) investigated the effect of oil price fluctuations on economic growth in members of the Organization for Economic Co-operation and Development (OECD) using GMM. They concluded that oil price fluctuations had negative but heterogeneous effects on the economic growth of countries, as the smallest effects of crude oil price fluctuations were observed on the economic growth of Norway and Canada.

Jin and Kun Guo (2021) examine the dynamic relationship between the capital market and macroeconomic variables between China and America. In this study, which was carried out with description of the -ermal optimal path (TOP) for monthly data of the period of 2005-2019, they came to the conclusion that the stock market is not the leader in the capital market, and the three indicators of consumption and industry and the real estate market are the influencing variables of transition to economic growth in these two countries.

Ameziane and Benyacoab (2022) examine the impact of exchange rate fluctuations on economic growth under different exchange rate regimes in emerging economic countries using the panel method (ARDL-CS) for the period 1990-2020. The results imply that in these countries, exchange rate fluctuations directly and indirectly affect economic growth, and in countries that choose a medium exchange rate regime, this effect is weaker.

Domestic studies:

Dehghan Menshadi and Rahimpour (2013) studied the relationship between macroeconomic instability and economic growth in Iran in the period 1967-2008 by using a vector autoregression (VAR) model. Their results showed a long-term relationship between macroeconomic instability (a combination of the inflation rate, budget deficit, and exchange rate) and economic growth in Iran, as macroeconomic instability in Iran acts as a serious obstacle to real economic growth and its continuation. Therefore, macroeconomic stabilization can be an effective step towards a high and continuous economic growth rate in Iran's economy.

Mobini Dehkordi and Mohammadi (2014) employed seasonal data to investigate the effect of exchange rate uncertainty on economic growth with and without oil in the period 1990-2011. The results of estimating the economic model using GMM indicated that the real exchange rate uncertainty negatively affects economic growth (with and without oil) to the extent calculated in this study and then positively affects this variable. In addition, human capital, active population growth rate, and investment rate, with positive coefficients, significantly affected economic growth with and without oil.

Shakeri *et al*. (2014) investigated the relationship between institutional variables and economic growth in the Middle East. Proposing a new index for institutional quality based on variables such as bureaucratic quality, the rule of law, the right to comment, and accountability, they concluded that this coefficient had a positive and significant effect greater than one on economic growth.

Mohammadzadeh *et al*. (2017) employed a dynamic panel data model to study the effect of government size on good governance and economic performance in 50 selected countries during the period 1996-2013. Their results indicated the positive effect of employment and the negative effect of the inflation rate on governance. In addition, the economic growth model estimation showed the significant and negative effect of government size and the significant and positive

effect of good governance, human development index, FDI, exports, and ICT share of imported goods on economic growth.

In a study titled "Analysis of inflation rate, production growth, and economic stability in Iran", Mousavi and Soltani (2017) concluded that the effect of expansionary financial policies is much greater on the inflation rate than on the production rate. The results of calculating the core inflation also showed that the inflation rate in Iran is mainly rooted in the overall economic demand. They recommended that the economic demand policies should be managed through monetary and financial contractionary policies in a way to ensure production growth and inflation rate reduction.

Samadi *et al*. (2018) employed a non-linear VAR model to investigate the asymmetric effects of oil price shocks on the interest rate and economic growth in Iran. The results showed that oil price shocks, under two regimes of high and low fluctuations, affect interest rates and economic growth differently and asymmetrically. Oil price shocks initially cause a sharper decrease in economic growth but an increase in economic growth under the high fluctuations and low fluctuations regimes, respectively.

Mirjalili *et al*. (2018) used an unbalanced panel data model to study the factors affecting the inclusive growth of some members of the Organization of Islamic Cooperation in the period 1995-2015. Their results indicated that GDP per capita growth was the most important factor in the inclusive growth of Islamic countries in the studied period. Other factors were inflation rate control, human capital growth, investment attraction, government expenditure control, and commercial openness. However, the increased ratio of bank credits to GDP, which measures financial deepening and foreign direct investment, showed no positive effect on the inclusive growth of Islamic countries.

Jahormi *et al*. (2018) employed a VAR model to investigate macroeconomic instability and growth in the period 1981-2013. The results showed that the importance of the workforce was more than other variables only in the agriculture sector, whereas physical capital was the most important determinant of economic growth in other sectors. In addition, economic instability negatively affected the economic growth of all macroeconomic sectors.

Hassanvand *et al*. (2019) studied the simultaneous effects of good governance and government spending on economic growth in MENA countries. They used GMM to estimate the model in the period 2002-2016. The results showed the significant and positive effects of good governance (the weighted mean of six indicators) and government spending on economic growth. In addition, the GDP of the past period, commercial openness, and private sector investment showed a significant and positive effect on economic growth, whereas the inflation rate had a significant and negative effect on economic growth.

Hassanvand et al. (2019) investigated the simultaneous effect of good governance and government expenditures on economic growth in MENA countries. To estimate the model, the generalized method of moments (GMM) was used in the period of 2002-2016. The results show that good governance (weighted average of six indicators) and government expenditures have a positive and significant effect on economic growth. The effect of variables of GDP of the past period and trade openness on economic growth is positive and significant. The effect of inflation variable on economic growth is negative and significant, as well as the effect of private sector investment variable on economic growth is positive and significant.

Pourali et al. (2021) have investigated the effects of macroeconomic and institutional variables on the economic growth of developing countries using the ordinary least squares method in the period of 2006-2019. The results of the estimation indicate that, among macroeconomic variables, inflation and foreign debts have a negative effect on economic growth, and international trade, human capital and physical capital have a positive effect on economic growth.

As it can be seen, a few studies have dealt with the relationship between economic instability and economic growth with an emphasis on the concept of instability. It is hence impossible to find extensive and comprehensive tools to explain the relationship between these two variables. However, the components of economic instability such as inflation rate (price index changes), exchange rate fluctuations, and macroeconomic external shocks (e.g. oil price fluctuations) have been addressed in many studies (Dehghan Menshadi and Rahimpour, 2013: 4). To achieve a better understanding of the effects of uncertainty of macroeconomic variables on economic performance, a model beyond the Neoclassical Growth Model of Mankiw (Romer and Weil, 1992) was employed in this study. In addition, the findings of Zamin Shah *et al*. (2017), who added fluctuations in macroeconomic variables to the economic growth model, were used for this purpose. No similar domestic study has yet used the same econometric method.

4- Modeling:

The Neoclassical Growth Model of Mankiw (Romer and Weil, 1992) is one of the strongest models analyzing the difference between countries in economic performance. This model measures the difference between the economic performance of countries based on the accumulation of physical and human capital. However, they have not explained the sources of differences in the accumulation of physical and human capital, except savings. In other words, they only suggested that, if labor force growth remains constant, countries with a higher savings rate experience higher levels of physical and human capital stock and higher production per capita of the labor force (Adeli, Shahraki, and Kalai, 2010: 7). On the other hand, fluctuations in macroeconomic variables seem vital

for the accumulation of human and physical capital, as stated earlier. Therefore, this model seems to be incomplete without considering the fluctuations.

Here we briefly introduce the economic growth model employed in this study and then compare it to the research literature in order to find the best model for investigating the effects of macroeconomic variables uncertainty on the economic growth of Iran.

The intended economic growth model consists of two main axes: production and growth. The production function indicates how the primary factors are combined to produce goods in an economy and how much goods are produced by combining these factors. These factors are divided into two main groups: capital (k) and labor (L). as a result, the production function will be as follows:

$$Y = F(L, K) \quad (1)$$

GDP per capita usually outweighs total GDP when discussing economic growth, because GDP per capita can be considered an important indicator of wellbeing. Accordingly, the GDP produced by each worker is equal to the total capital allocated to each worker in an economy. Considering the features of this production function, GDP per capita increases with the increase in capital per capita.

The second axis is growth, which shows the temporal changes in capital stock. To determine the investment rate in this model, it is assumed that part of the total GDP in an economy is consumed and another part is saved and finally invested. Therefore, saving or investment can be assumed as a coefficient of total GDP:

$$S = sY \quad (2)$$

It is also assumed that the capital stock decreases with a depreciation rate of *d*. As a result, changes in the capital stock (*K*) will be as follows:

$$K = sY - dK \quad (3)$$

Growth theories mainly aim to explain why the per capita income continuously increases in different countries. A growth model, as introduced in the previous section, shows the constant per capita income under a long-term equilibrium state. This is consistent with the revealed reality of growth, i.e. continuous increase in per capita income. Accordingly, technological developments are included in the model as a labor productivity factor:

$$Y = F(AL, K) \quad (4)$$

In this equation, *A* denotes the technology level that is assumed to constantly grow at a rate of 8%. Under the long-term equilibrium state, the effective capital per capita will be constant:

$$sf(k^*) = (n + d + \delta)k^* \quad (5)$$

When the effective capital per capita is constant, the effective GDP per capita will be also constant. Therefore:

$$Y^* = f(k^*) \quad (6)$$

The constant value of effective GDP per capita means that the GDP per capita of each worker grows uniformly with the technology growth rate (labor productivity) (Koochzadeh and Jalai, 2012). Based on the above-mentioned points about the intended economic growth model and the research literature, other variables were added to the model, in addition to the labor force and capital stock. Accordingly, the effect of uncertainty of macroeconomic variables on Iran's economic growth was investigated based on conventional explanatory variables, such as labor force growth and fixed physical capital growth (the Solow-Swan growth model, 1956) and human capital (the Lucas growth model, 1988). In addition, the uncertainty of macroeconomic variables was considered based on the findings of Tang (2015) and Zamin Shah *et al*. (2017).

$$EG_t = \alpha_0(S_t) + \alpha_1(S)POIL_t + \alpha_2(S)REX_t + \alpha_3(S)INF_t + \alpha_4 Q_t + \alpha_6\alpha_5 L_t + \alpha_6 K_t + \varepsilon_t \quad (7)$$

In this equation, EG_t, $POIL_t$, REX_t, INF_t, Q_t, L_t, and K_t represent Iran's economic growth rate, OPEC oil price fluctuations, real exchange rate fluctuations, inflation rate fluctuations (annual changes), institutional quality index (IQI), labor force growth, and fixed physical capital growth, respectively. In Equation 7, S_t indicates the state variable that ranges between 0 and 1. In addition, α1, α2, and α3 are coefficients of fluctuations in oil price, real exchange rate, and inflation rate, which are calculated in each regime. However, the IQI coefficient is calculated without a rotation because economic theories assume that IQI always affects economic growth positively.

It is noteworthy that the data related to the World Development Indicators (WDI), International Country Risk Guide (ICRG), Political Risk Services, and the Organization of the Petroleum Exporting Countries (OPEC) were extracted for model estimation.

First, the EGARCH method was employed to estimate fluctuations in oil price, exchange rate, and inflation rate in the period 1985-2017. Then the MRS-GARCH was used to analyze how these fluctuations affect economic growth.

5- Model estimation results:

Since many economic time series, such as exchange rate, oil price, and the stock market, have undergone great or small fluctuations in some periods due to economic shocks, it does not seem much unreasonable to assume the homogeneity of variance in this series of variables (Heydari, Rafah Kehriz, and Berenjabadi, 2018: 234). Considering the status quo of Iran's economy, the instability of the real exchange rate, oil price, and inflation rate were used in this study. There are different methods to calculate the instability of variables, including the Hodrick-Prescott (HP) filter or GARCH models. Most previous studies have employed GARCH models for this purpose. Therefore, a GARCH model was used in this study to calculate the instability of variables. The common form of the GARCH (p, q) model is as follows:

$$Y_t = \alpha + \beta' X_t + u_t \qquad U_t \mid \Omega_t \sim iid(0, \varepsilon_t^2)$$
$$\varepsilon_t^2 = \alpha + \sum_{i=1}^{p} a_i u_{t-i}^2 + \sum_{j=1}^{q} B_g \varepsilon_{t-j}^2 \qquad (8)$$

In this equation, ε_t^2 and U_t denote conditional variance and disturbance., respectively. A major limitation of such models is that they consider the same effects for positive and negative shocks. Since negative and positive shocks generally have different effects on economic variables (the effect of a negative shock is greater than that of a positive one), asymmetric methods, including EGARCH, are employed to estimate the variables expressing instability (Brooks, 2014: 9). First proposed by Nelson, EGARCH usually looks as follows:

$$Y_t = \alpha + \beta' X_t + U_t$$
$$\log(\varepsilon_t^2) = \omega + \beta \log(\varepsilon_t^2) + \alpha\left(\left|\frac{u_{t-1}}{\varepsilon_{t-1}}\right| - \sqrt{\frac{2}{\pi}}\right) + \gamma \frac{u_{t-1}}{\varepsilon_{t-1}} \qquad (9)$$

Therefore, EGARCH models were used in this study to calculate the instability of the research variables[1]. It is now necessary to use a suitable model to specify the time series of macroeconomic variables. Considering the nonstationary nature of OPEC oil price, real exchange rate, and inflation rate, it was necessary to first make these variables stationary with first-order differencing and then start modeling with ARIMA.

Based on the correlogram of OPEC oil price, real exchange rate, and inflation rate series, Akaike Information Criterion (AIC), and Schwarz Bayesian Criterion (SBC), the following models were selected as appropriate:

$$POIL_t = \alpha_0 + \alpha_1 POIL_{t-1} + \alpha_2 POIL_{t-2} + \varepsilon_t$$
$$REX_t = \alpha_0 + \alpha_1 REX_{t-1} + \alpha_2 REX_{t-2} + +\alpha_3 REX_{t-3} + \varepsilon_t \qquad (10)$$
$$INF_t = \alpha_0 + \alpha_1 INF_{t-1} + \alpha_2 INF_{t-2} + \alpha_3 INF_{t-3} + \varepsilon_t$$

Based on these equations, the model estimation results are as shown in (Table 1)

Table 1: Results of ARCH effects

Variable	Kurtosis	skewness[2]	Statistic	Sig.
$POIL_t$	*-0/105*	*16/53*	*F-statistic=3/37*	0/032
			*Obs*R-squared=7/04*	0/027
REX_t	*-0/92*	*15/68*	*F-statistic=4/02*	0/048
			*Obs*R-squared=8/21*	0/036
INF_t	*-0/117*	*16/07*	*F-statistic=3/78*	0/052
			*Obs*R-squared=8/51*	0/046

the results rejected the null hypothesis (the absence of ARCH effects). the Results of estimating EGARCH (as in table 2), presents the positive values of θ and indicate that the effects of the positive shocks of the variables are greater, whereas the effects of negative shocks on the reduction of fluctuations are smaller.

[1] To avoid wordiness, the calculations of EGARCH models were not included in this study. You can refer to Brooks (2014) to get familiar with how to calculate the instability of variables.

[2] A kurtosis value greater than 3 can indicate the autocorrelation in the residual sum of squares (RSS) (ARCH effects).

Table 2-a: Estimation of EGARCH model for oil price

Variable	Conditional mean equation				
$POIL_t$	Parameter	α_0	α_1	α_2	
	Coefficient	2/12	-0/5	0/12	
	Sig.	0/02	0/03	0/05	
	Conditional variance equation				
	Parameter	β_0	β_1	θ	$\emptyset$
	Coefficient	0/08	0/21	0/18	0/81
	Sig.	0/37	0/02	0/003	0

Table 2-b: Estimation of EGARCH model for real exchange rate

Variable	Conditional mean equation				
REX_t	Parameter	α_0	α_1	α_2	
	Coefficient	3/07	-0/07	1/17	
	Sig.	0/12	0/13	0/15	
	Conditional variance equation				
	Parameter	β_0	β_1	θ	$\emptyset$
	Coefficient	1/05	0/65	0/37	0/93
	Sig.	0/07	0/12	0/01	0/01

Table 2-c: Estimation of EGARCH model for the inflation rate

Variable	Conditional mean equation				
INF_t	Parameter	α_0	α_1	α_2	
	Coefficient	0/02	-1/06	1/62	
	Sig.	0	0/14	0/15	
	Conditional variance equation				
	Parameter	β_0	β_1	θ	$\emptyset$
	Coefficient	1/12	3/15	0/03	1/62
	Sig.	0	0/42	0/14	0/64

Reference: research findings

Positive and negative shocks had different effects on fluctuations in the research variables (as in Table 2), It can be hence stated that the shocks of OPEC oil price, real exchange rate, and inflation rate asymmetrically affect the fluctuations. In other words, positive shocks have greater effects on fluctuations in the research variables than negative shocks do. Finally, ARCH effects were tested again after estimating the EGARCH model, and the results indicated the absence of ARCH effects in the model residuals[1].

After calculating the uncertainty of the model variables, the optimal number of lags was calculated based on AIC and SBC in order to estimate MRS-GARCH. The values obtained from AIC and SBC for one to four lags, (as in Table 3) presents.

[1] To avoid wordiness, the results of this test (correlogram, AIC, and SBC) were not presented here.

Table 3: Results of AIC and SBC for determining the optimal number of lags in the MRS- GARCH

Lag	SBC	AIC
1	5.1253	4.9969
2*	5.1147*	4.9787*
3	5.0867	4.9421
4	5.2691	5.0378

*Optimal number of lags

According to Table 3, both AIC and SBC indicated that the optimal number of lags for the model estimation was 2. After selecting the optimal number of lags, the number of regimes was determined using AIC., which is more suitable than the likelihood function for determining the number of regimes. The table below shows the values obtained from AIC and the likelihood function for 1 to 3 regimes.

Table 4: Calculation of the number of regimes by using AIC

Number of regimes	AIC	ML
1	244.0763	-112.0381
2*	232.3807*	-115.1903*
3	252.9288	

*Optimal number of lags

The optimal number of regimes for the model estimation was 2. The values obtained from AIC and the likelihood function under the two regimes were the lowest and the highest, respectively (As in Table 4). As mentioned earlier, there are different modes of MRS-GARCH, in each of which a certain part of the equation is dependent on the regimes. As a result, the maximum value of the likelihood function was used to select the best mode. Accordingly, the model with the maximum likelihood value was selected as the optimal model. (as in table 5), the maximum likelihood for the two intended modes.

Table 5: Optimal estimation of MRS-GARCH

MRS-GARCH	ML
MRS(2)-AR(2)- EGARCH*	-101/0288*
MRSX(2)-ARX(2)- EGARCH	-100/1903

*Optimal number of lags

Based on Table 5, it can be concluded that the highest likelihood value is related to the model in which the intercept and coefficients of fluctuation lags are dependent on the regimes.

Before the model estimation, the reliability of the research variables was tested using the augmented Dickey–Fuller test (ADF), the Phillips–Perron test, and KPSS based on the first-order differencing in Eviews-9.

Table 6: Results of augmented Dickey-Fuller test (ADF)

ADF value						
Variables	Surface			First-order differencing		
	With intercept	With intercept and time series	Total result	With intercept	With intercept and time series	Total result
EG_t	0/071	1/83	Unsteady	4/74	4/72	Steady
$POIL_t$	2/74	3/76	Steady	-------	---------	-----
REX_t	3/162	2/04	Unsteady	6/87	4/97	Steady
INF_t	2/83	2/55	Unsteady	2/86	9/03	Steady
Q_t	1/701	1/68	Unsteady	5/32	6/56	Steady
L_t	4/32	5/08	Steady	-------	---------	-----
K_t	0/82	4/45	Steady	------	--------	-----
The critical McKinnon's value at a significance level of 5%	2/9	3/47		2/9	3/47	

Table 7: Results of Phillips–Perron (PP) test

PP statistic						
Variables	Surface			First-order differencing		
	With intercept	With intercept and time series	Total result	With intercept	With intercept and time series	Total result
EG_t	3/57	7/87	Steady	--------	----------	----
$POIL_t$	2/55	3/22	Unsteady	5/77	6/00	Steady
REX_t	0/62	2/72	Unsteady	2/24	4/68	Steady
INF_t	1/78	1/89	Unsteady	4/73	3/89	Steady
Q_t	1/03	6/59	Steady	--------	----------	----
L_t	0/89	2/85	Unsteady	13/73	13/65	Steady
K_t	2/82	2/44	Unsteady	8/74	9/10	Steady
The critical McKinnon's value at a significance level of 5%	2/9	3/47		2/9	3/47	

Table 8: Results of KPSS

KPSS statistic						
Variables	Surface			First-order differencing		
	With intercept	With intercept and time series	Total result	With intercept	With intercept and time series	Total result
EG_t	1/15	0/35	Unsteady	0/098	0/087	Steady
$POIL_t$	0/17	0/14	Steady	-------	----------	------
REX_t	1/32	0/43	Unsteady	0/15	0/05	Steady
INF_t	1/07	0/1	Steady	-------	----------	------
Q_t	1/17	0/19	Unsteady	0/20	0/141	Steady
L_t	1/18	0/11	Steady	-------	----------	------
K_t	0/20	0/18	Steady	-------	----------	------
The critical KPSS value at a significance level of 5%	0/46	0/146		0/46	0/146	

Note: H0 in the KPSS test indicates that the studied variable is stationary

Based on the results (as in tables 6, 7, and 8), it can be concluded that some variables were steady and some of them were unsteady. According to Perron (1989), the results of these tests may be biased if there is a structural break in the data. Therefore, the unit-root tests of Zivot-Andrews and Lamzin-Pupel were performed to measure the co-integration of variables. Table 9 presents the results of the unit-root Zivot-Andrews test with one structural break in the data.

Table 9: Results of unit-root Zivot-Andrews (ZA) test

Variables	za	Lag	Breakpoint
EG_t	-4/47	4	1988:2
$POIL_t$	-5/7	2	2008:2
REX_t	-3/95	4	2012:3
INF_t	-7/11	1	1996:4
Q_t	-3/69	3	1994:3
L_t	-4/27	4	2004:2
K_t	-6/52	4	2011:1

Note: Zivot and Andrews (1992) calculated the critical ZA values to be -5.75, -5.08, and -4.82 at the 1%, 5%, and 10% levels of significance, respectively

The results of the ZA test (as in table 9) showed that REX_t and Q_t, assuming an endogenous structural break, were a sum of order 0 at the 5% level of significance. By contrast, other variables were not a sum of order 0 while assuming this endogenous structural break.

Table 10: The results of estimating MRS- GARCH for economic growth (dependent variable)

Variables	Coefficient	Standard deviation	T-value
Constant(0)	-13/337	۷۱2/	۹۱-4/
Constant(1)	26/699	۶۷2/	۹۷9/
L_t	5/225	۴۱8/	6/21
K_t	-1/174	۲۶7/	-1/60
Q_t	0/932	۱۷2/	4/42
$POIL_t$ (0)	-14/805	1/01	-13/110
$POIL_t$ (1)	40/701	0/61	0/21
REX_t (0)	-6/182	0/35	-6/71
REX_t (1)	-9/645	0/31	۴۱-4/
INF_t (0)	21/615	0/04	۶۸7/

INF_t (1)	-6/701	0/01	-0/91
EG_t1(0)	1/327	۱۵0/	3/93
EG_t1(1)	0/369	0/97	۱۷3/
EG_t2(0)	0/088	۰۳۵0/	۰
EG_t2(1)	-0/274	0/397	۵۶-4/
σ_0	0/646	۰۲۶1/	–
σ_1	0/604	۱۲۵0/	–
Log likelihood	-809/847	-580/612	-568/743

The majority of the coefficients are significant at the 10% level (as in table 10). The intercept in Regime 0 was 13.337, while it was 26.699 in Regime 1. The regime with a negative intercept, according to Hamilton, represents the stagnation regime, while the regime with a positive intercept represents the prosperity regime (Asadi and Esmaili, 2013: 15). As a result, Regime 0 and Regime 1 represent the periods of economic recession and prosperity, respectively, in this study. Because the variance of the disturbance component in the estimated model was determined by the state variable, the variance of the disturbance components related to the equations of the two regimes differs and was equal to 0.646 in Regime 0 (recession) and 0.604 in Regime 1 (prosperity). Indeed, the data show that Regime 0 fluctuates less than Regime 1.

Labor force growth had a coefficient of 5.522, indicating a positive effect on economic growth during the studied period, as shown in Table 10. This highlights the importance of focusing more attention on employment issues in Iran. It should be noted that, in addition to increasing output directly, labor employment increases output through diffusion effects (Jozarian, 2011: 109). Furthermore, when the labor factor's weight is compared to the weight of other variables, it can be concluded that the majority of the industries affecting Iran's economic growth are users, and thus labor force employment has a very high impact on the country's economic growth.

The growth of fixed physical capital had a coefficient of -1.174 in this model, indicating that capital had a negative (but insignificant) effect on Iranian economic growth. Given the model's insignificance of the physical capital growth factor and the lack of need to analyze why this is the case, the author believes this is not so far off the mark. Due to a lack of conditions such as security, profitability uncertainty, instability, and a low real profitability rate, as well as the conditions for capital outflow from the country and the lack of a clear strategy to attract private and foreign investment, the government in Iran has attempted to compensate for this existing gap by using revenue from oil sales and

because government investments are mostly in the private sector (Pezhuyan, 1990: 112). As a result, these investments not only do not help Iran's economic growth, but in some cases actually slow it down. This emphasizes the importance of properly implementing Article 44 of the Constitution, as well as support for domestic and foreign investors, in order to solve this problem.

With a coefficient of 0.932, the IQI had a positive and significant effect on Iran's economic growth, supporting the economic issues of institutionalism. According to North (2000), Hall and Jones (1999), Roderick et al. (2004), and Snowden and Vane (2005), improving institutional quality provides the necessary platform for physical capital formation, which itself contributes to economic growth. The effect of oil price fluctuations on economic growth during the studied period can be divided into two regimes. The intercept in Regime 0 (recession) was 14.805 and in Regime 1 (prosperity) was 40.701, indicating that oil price fluctuations did not have the same effects in the two regimes (asymmetry); thus, the effect of this type of uncertainty on economic growth was less in Regime 0. In other words, if Iran's economy is in recession, economic growth will slow down as OPEC oil prices become more uncertain, worsening the Iranian economy's recession. On the other hand, if Iran's economy is in a period of prosperity, the increase in uncertainty leads to an increase in economic growth, which is mainly due to the heavy dependence of Iran's budget on oil revenues. According to a theory discussed by Griffin (1999) in his book "*An Overview of Globalization and Economic transition*", during times of economic prosperity, production and trade in developing oil-rich countries will increase, owing primarily to an increase in the global oil price. This not only negatively affects the trade balance but also leads to the implementation of unfavorable commercial policies.

According to Table 10, the effect of real exchange rate fluctuations was -6.182 in Regime 0 (recession) and -9.645 in Regime 1 (prosperity). These figures indicate that exchange rate fluctuations had the same negative effects on economic growth in both regimes. Therefore, decisions and other policies on the exchange rate should be made with great care, because on one side of the field, there are industrialists who need raw materials to manufacture their products. Due to the increase in the finished price of their manufactured goods, they are working hard to keep the exchange rate as low as possible. On the other hand, some exporters' competitiveness in global markets has declined as a result of the lack of an increase in the exchange rate. It is worth noting that, encouraged by the relative stability of the exchange rate, some importers have flooded the Iranian market with low-quality consumer goods. As a result, it is possible to conclude that excessive exchange rate fluctuations cause producers to cease production. Another advantage of exchange rate stabilization is that it simplifies future investment planning and reduces risk, as well as creating relative stability in

investment. As a result, no one can deny the significance of studying the exchange rate, its fluctuations, and its effects on production and economic growth.

Table 10 shows that the intercept in Regime 0 (recession) was 21.615 and in Regime 1 (prosperity) was -701.6, indicating that fluctuations in the inflation rate have the same effects in both regimes. As a result, an increase in inflation fluctuations during the recession worsens the Iranian economy's recession.

In the first and second lags, the lagged GDP growth had a positive and significant coefficient. This implies that any lag in economic growth has a positive effect on economic growth. In other words, the current economic growth follows the economic growth in past periods.

Table 11 shows the business cycles of Iran's economy (periods of economic prosperity or recession).

Table 11: Periods of economic prosperity (Regime 1) or recession (Regime 0) in Iran

Regime 0	1985 (1990 -1989) (1995 -1992) (1999 -1997) (2005 -2001) (2011 -2014) (2016 -2017) (2018 -2019)
Regime 1	(1984 -1980) (1988 -1986) 1991 1996 2000 (2010 -2006) 2015 2021

Table 12 summarizes the characteristics of each existing regime. (as in table 12), Regime 0 is the most stable regime because the economy will stay in this regime for an average of 2.13 periods if it enters it. Furthermore, this regime has the highest probability; if a year is chosen at random from the examined sample, it will be in this regime with a probability of 50.55%. The results of Table 12 contradict economic theories because economic theories indicate that periods of recession are usually shorter than periods of prosperity. However, the results in this table are completely consistent with those in Table 10 in terms of the stability of the Iranian economy's recession.

Table 12: Characteristics of economic regimes

Regime	Frequency of being in each regime	Probability of being in each regime	The mean period of being in each regime
Regime 0	21	55.50	2.13
Regime 1	17	44.50	1.05

Table 13 depicts the options for transitioning from one regime to another. Regime 0 is the most stable regime, as can be seen, because the probability of transition from this regime to the same regime is very high (0.65). For example, if the economy is in Regime 0 in Period t-1 with an approximate probability of 0.65, it will also be in this regime in Period t.

Table 13: Possibilities of transition from one regime to another

	Regime 0	Regime 1
Regime 0	0.656	0.644
Regime 1	0.343	0.355

As mentioned earlier, the MRS-GARCH disturbance statements must be normal and free of autocorrelation and variance heterogeneity. Table 14 presents the results of testing the above-mentioned characteristics.

Table 14: Testing the goodness of fit

Test	Type of statistic	Test statistic	Probability
Ljung-Box Portmanteau Test	X^2 (6)	6.442	0.375
ARCH Test	F (1, 25)	0.84	0.367
Jarque–Bera Test	X^2 (2)	3.264	0.195

The results of the Ljung-Box Portmanteau Test for two lags showed that the existence of autocorrelation cannot be rejected at a 1% margin of error. It can be hence concluded that the disturbance statements are free of autocorrelation. The normality test also indicated that the distribution of the estimated model's disturbance statements was normal. The heterogeneity of variance test results also showed that the variance of the disturbance sentences was the same.

6- Summarization and conclusion:

Considering the importance of economic growth in the development of societies, it is necessary to investigate the factors affecting economic growth. The review of the literature on economic growth indicates that many factors affect economic growth, the most important of which are capital stock, labor force, and technological progress. On the other hand, the exchange rate, oil price, inflation rate, and IQI usually affect economic growth differently in developing countries. Therefore, the effects of macroeconomic variables on economic growth should be investigated to clarify different aspects of the relationship between these two

phenomena in Iran’s economy. This study hence aimed to find an answer to the question whether the uncertainty of macroeconomic variables has the same effect on the growth of Iran's economy at all levels and also to determine how fluctuations in macroeconomic variables affect Iran’s economic growth under different economic regimes.

This study investigated the effects of fluctuations in oil price, real exchange rate, IQI, labor force growth, and fixed physical capital growth on Iran's economic growth. To this end, fluctuations in macroeconomic variables were measured in the period 1985-2018 using the EGARCH, and then the MRS- GARCH was employed to analyze how fluctuations in these variables affect economic growth. In this study, coefficients of fluctuations in oil price, real exchange rate, and inflation rate were calculated in both regimes.

Hamilton proposed the MRS-GARCH model, also known as the regime change model, in 1989. It is a well-known nonlinear time series model. The term regime change is used because a policy variable may exhibit one behavior during one period of time and another during another. As a result, we may obtain biased results if this issue is not taken into account when investigating the behavior of a variable. However, the main advantage of this model, i.e. flexibility, allows to consider the changes in the variance between processes as well as changes in the mean value (Goldfeld and Quandt, 1998: 541).

Two economic regimes were evaluated in the MRS-GARCH model: Regime 0 and Regime 1 that represented periods of recession and prosperity. Since the intercept of Regime 0 was negative, it was concluded that Regime 0 and Regime 1 represented a period of recession and a period of prosperity, respectively (Hamilton, 1989).

The study findings showed that the oil price fluctuations in the two regimes did not have the same effects, as the effects of the oil price fluctuations under Regime 0 were smaller than their effects under Regime 1. Based on Table 10, the effect of real exchange rate fluctuations was -6.182 in Regime 0 (recession) and -9.645 in Regime 1 (prosperity). These figures indicate that exchange rate fluctuations had the same negative effects on economic growth in both regimes. Therefore, decisions and other policies on the exchange rate should be made with great care.

The results of the model estimation demonstrated that fluctuations in the inflation rate had different effects under the two studied regimes. As a result, an increase in the inflation rate fluctuations during the recession worsens the country's economic status. It is noteworthy that if the inflation rate in a country is higher than the exchange rate growth, imported goods will be less expensive than domestic goods every year. This will reduce exports and increase imports and, finally, lead to the closure of domestic enterprises. If we want the price of imported goods to remain constant in comparison to domestic goods, the exchange rate must rise at the same rate as inflation.

The study results indicated the positive effects of the labor force on Iran's economic growth during the studied period. This highlights the need for further attention to employment and job creation. The coefficient obtained for physical capital was insignificantly negative. The coefficient obtained for IQI indicates that this factor has a positive effect on economic growth in Iran. In other words, increasing IQI creates the necessary foundation for the formation of physical capital, which leads to an increase in economic growth.

The study of the effects of fluctuations in the exchange rate, oil price, inflation rate, and IQI on economic growth has always been a matter of controversy among Iranian policymakers and economic experts. It is hence necessary to understand how fluctuations in macroeconomic variables affect economic growth. The results of this study can provide a suitable perspective and help us to achieve the desired economic goals.

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بررسی پویایی رابطه‌ی بین رشد اقتصادی و نوسانات متغیرهای کلان اقتصادی در ایران (با رویکرد مدل تغییر رژیم مارکف گارچ چند متغیره[1])

چکیده:

ریسک و نااطمینانی امر ذاتی فعالیت‌های اقتصادی است. هدف از این تحقیق، شناسایی نحوه و میزان تاثیرگذاری نوسانات متغیرهای کلان اقتصادی بر رشد اقتصادی در بازه زمانی 1989- 2021 برای اقتصاد می‌باشد. برای دست‌یابی به این مهم، ابتداعاً با استفاده از یک الگوی گارچ نمایی (EGARCH)، نوسانات متغیرهای کلان اندازه‌گیری و سپس، معادله رشد اقتصاد ایران، با لحاظ نوسانات توسط مدل مارکوف سوئیچینگ برآورد شده است. متغیرهای بکار رفته در این مطالعه عبارتند از: نوسان قیمت نفت اوپک، نوسان نرخ ارز حقیقی، نوسانات نرخ تورم، شاخص کیفیت نهادی، رشد نیروی کار، رشد سرمایه فیزیکی و رشد اقتصادی ایران. براساس آماره‌ها، وقفه بهینه برای برآورد مدل دو وقفه و در حالت دو رژیمی، مدل دارای حداکثر مقدار راست‌نمایی بین حالات دیگر است. بنابراین، مدل مارکوف سوئیچینگ MRS(2)-AR(2) مورد برآورد قرار می‌گیرد. نتایج حاصل از برآورد مدل بیانگر وجود دو رژیم رونق و رکود در اقتصاد ایران است، که متاسفانه رژیم رکود ماندگاری بیشتری نسبت به رونق اقتصادی در بازه مورد مطالعه دارد. نتایج برآورد مدل نشان می‌دهد نوسانات قیمت نفت در دو رژیم دارای اثرات یکسانی نبوده که نشان‌دهنده وجود عدم تقارن تاثیر این متغیر در رشد اقتصادی ایران است؛ به‌گونه‌ای که در دوران رکود تاثیر این نوع عدم‌اطمینان بر رشد اقتصادی کمتر از دوران رونق است. بررسی تاثیر نوسانات نرخ ارز حقیقی نشان‌دهنده این واقعیت است که این نوسانات در هر دو رژیم دارای اثرات یکسان و مخربی بر رشد اقتصادی ایران دارد. نوسانات تورم در رکود تاثیر مثبت و در رونق تاثیر منفی بر اقتصاد ایران بجا می‌گذارد. ضریب به‌دست آمده برای کیفیت نهادی بیانگر اثر مثبت این عامل در اقتصاد ایران است؛ زیرا با افزایش کیفیت نهادی بستر لازم جهت شکل‌گیری سرمایه فیزیکی فراهم آمده که این مسئله خود به افزایش رشد اقتصادی منتهی می‌گردد. از این رونمی‌توان نسخه واحدی برای کنترل نوسانات متغیرهای کلان اقتصادی در طی سال‌های مختلف برای کشور صادر نمود و سیاست‌گذار اقتصادی می‌بایست با لحاظ وضعیت قرارگیری اقتصاد در دوران رکود و رونق، با لحاظ اولویت‌های توسعه کشور، سیاست مناسب را عملیاتی نماید.

کلمات کلیدی: اثر نامتقارن؛ ریسک متغیرهای کلان اقتصاد؛ رشد اقتصادی؛ گارچ نمایی؛ ماکوف- سوئیچینگ

طبقه‌بندی: .C32, F31, F41

[1] MRS-GARCH