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How Fluctuations in Macroeconomic Indicators Affect Inflation in Iran

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Given the effects of inflation on the decline of household welfare and its impact on production and investment, identifying the factors affecting it in order to adjust inflation and achieve price stability is necessary. Therefore, using the TVP-FAVAR model, which differentiates the fluctuations in factors affecting inflation, we try to identify the effects of different shocks such as liquidity, oil revenues, spot market exchange rates, economic growth, interest rates on bank facilities, budget deficits, inflation uncertainty and unemployment on inflation in Iran. In this study, seasonal data from 1370 to 1394 are used. The results, based on the TVP-FAVAR model, reflect the fact that all variables affecting inflation have a positive effect on this variable. Due to the negative effect of changes in economic growth on inflation rate, especially from 1388 to 1394, the existence of stagflation is confirmed. The shock caused by changes in oil revenues is also an important factor in creating inflation in the economy.

Keywords: Inflation, Economic Growth, Stagflation, TVP-FAVAR.
JEL Classification: E31, E37

1 Introduction

High inflation has always been one of the characteristics of Iran's economy in recent decades, which has become a chronic phenomenon. This economic phenomenon is considered as one of the most important macroeconomic variables that, in addition to positive or negative economic effects, has also social consequences and even effects the success or failure of states in democratic systems, as far as people judge the politicians in power by the performance of governments in controlling inflation.

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Inflation is a complex phenomenon with a variety of dimensions. In a simple, commonly accepted by most economists, inflation is a situation where the general level of prices is constantly increasing over time; therefore, the element of time and the continuous increase in the general level of prices is very important in defining inflation. (Taghizade & Ahmand, 2017)

A noteworthy point about inflation is, despite a definite meaning, there is no single view of the causes of inflation. Some economists point out that the excessive growth of money is the main source of inflation. Some others think that excess demand in the commodity market, cost push and rising prices of production inputs, other structural factors in various sectors, and the weakness of agricultural and foreign trade sectors are the main sources of inflation. At the same time, the role and contribution of each factor may vary.

According to Stock and Watson (2008), one of the most important problems that former models (traditional models consistent with classical boundary assumptions) had was that they could not have accurate predict over time. It was sometimes observed that some models could well estimate the forecast only during the recession, while some others estimated the forecast only during the boom period and this led to a situation that no model could solve the problem and provide more reliable forecasts at all times (stagnation and boom). To solve this problem, the Time Varying Parameters Factor Augmented Vector Auto Regression, TVP-FAVAR, method is used. Several studies have been carried out in the form of structural models and using TVP methods. At the same time as extending the TVP models, the FAVAR models were introduced that moderated vector autoregressive models by adding the missing factor. This missing factor can be the probability of occurrence of fluctuations in a variable. The two above-mentioned methods increased the ability to analyze vector-based studies, so that the combination of TVP and FAVAR models could provide powerful analysis with economic tools (Korobilis, 2013).

Although TVP-FAVAR have a high ability in determining factors affecting inflation druing time, however, taking into account a massive number of variables, regardless of the source of shocks, the mechanisms of influence and causal relationships are the shortcomings of this method. It should be noted that TVP-FAVAR, like the VAR models, presupposes the absence of structural relationships and is only based on causal relationships which determines interaction between variables (Rasouli, 2013).

Because of the importance of this subject in Iran's economy and the inefficiency of traditional methods, the shock caused by each of the factors influencing inflation forecasting over time has been investigated. The article

is organized as follows: In the second part, empirical studies are examined. In the third and fourth sections, the template structure and the model's econometric estimation and analysis of the data will be presented. Finally, in the final section, summaries and policy suggestions will be made.

Table 1
Examining the Dimensions of Inflation

Row	Dimensions of inflation	Description	The reasons for the rise in prices
1	Inflation due to demand	Occurs when for whatever reason, demand growth is more than supply growth. Its other name is [demand-induced inflation] and in that, the purchasing power of people is high and the demanded goods are low. The ever-increasing demand for buying leads to disrupting prices and possibly creating a black market, and the aggression and influx of people to buy more and more.	The budget deficit and the growth of government expenditures, the growth of liquidity, the growth of exchange rates, the growth of oil revenues
2	Cost inflation	This kind of inflation is due to an increase in the cost of producing goods.	Reduced productivity, increased prices of raw materials, and wage increases can cause this type of inflation.
3	Import inflation	Because of the correlation of domestic prices with global prices, the rise in global prices has two direct effects (through the rise in prices for imported goods and services), and indirectly (through the effect of inducing prices on similar goods inside).	Due to recent sanctions opening of credits has been too difficult. In the wake of the sanctions, intermediate cash purchases and insurance, risk and shipping costs have also increased.
4	Structural inflation	This inflation is due to a series of structural disturbances and barriers that prevent a rapid increase in production in response to demand, even when the factors of production are idle.	Limitation in production capacity and low elasticity of supply, lack of internalization of production technology, financial constraints in enterprises and low human capital and monopoly in the markets.
5	Expected inflation	When inflationary expectations are formed in the society, it will simultaneously increase demand and reduce supply, thus cause a sharp rise in prices.	With regard to inflation expectations and uncertainty about inflation, the inflation will increase.

Source: Current research and study Giorgio (2006).

2 Theoretical Foundations and Research Background

In modeling inflation in the economy of Iran, there is no single view on the determinants of inflation. Some economists assume that extraordinary growth of money is the main source of inflation while other groups think that excess demand in the commodity market (Jafari Samimi and Gholizadeh Kenari, 2007), or the cost push (Naeini and Mirhoseini, 1999) or the rise in the prices of production inputs are the main sources of inflation. And others, believe that inefficiency in various sectors and the weakness in agriculture sector and the single-product trade are the main sources of inflation.

In general, studies on the causes of inflation in Iran are related to the structural constraints of the Iran's economy, such as the continuing budget deficit, inelastic supply, structural dependence of production on imports, incorrect allocation of currency (Shahab, 2007), the steady increase in liquidity and reduced production.

In empirical studies due to the limitations of the research methodology in expressing the variables influencing inflation in Iran, the inflation determinants assumed to have permanent effects. In sum, a glance at the Phillips curve in the last half century suggests that relationships between variables change over time. Table one shows how affecting variables influence inflation on the basis of theoretical foundations.

In the following, the results of internal and external research carried out on the subject of the research will be discussed:

Primiceri (2005) first uses the method of variable parameters over time with the TVP-SVAR Structural Autoregressive Approach and seeks to forecast inflation for the United States. In this comprehensive study, the researcher examines the forecasted methods used in previous studies and makes a comparison. He shows that at any given time, what variables have been able to forecast inflation, and in addition, he has determined what the sustainability of inflation has been. The main advantage of this method is to analyze the sensitivity of inflation changes in each period. It determines how changes in variables affect inflation and its sustainability. The main influential variables are the volume of liquidity, unemployment and interest rates, which have the most impact in terms of liquidity, interest rates and unemployment, respectively. The only weak point of this method is that all macroeconomic variables that could be potential inflation predictors can not be scrutinized.

Sargent and others (2005) forecast inflation for England using Bayesian methods. In this study, due to the excessive number of variables and the limitations of Bayesian methods in time varying variable models, forecast is made on the basis of factorialization and placement of homogeneous variables

in a block. In this study, the model used is BMA-TVP and forecasts GDP in addition to inflation. This model, like other TVP models, includes algorithms of space-mode models, which is more powerful than previous ones, but the main limitation is that it could not use the variables individually. By blocking variables, the power of the model is reduced, and also possibilities are also limited. However, the results indicate that the main determinant and influential factor in GDP is industrial outputs and private investment, while government spending is the main determinant of inflation.

Moser et al. (2006), based on the generalized Phillips curve provided by Stack and Watson (1999), forecast inflation for Australia. In this study, the variables being forecasted are liquidity, unemployment, industrial production, and industrial goods exports. In this study, the main goal is to identify the best inflationary forecaster in Australia. The results show that changes in liquidity are better than other variables to forecast inflation for Australia.

Mumtaz (2010) discusses whether stability and sustainability can be fully attributed to inflation targeting policy in the UK over the past two decades. He uses the TVP-FAVAR model to answer this question. The results of this study confirm the results of previous studies on the decline in fluctuation and sustainability of production and inflation in the UK. He concludes that the absence of non-political shocks is an important factor in the sustainability of the UK economy. Exclusivity based on instantaneous response functions does not reveal evidence of a price riddle.

Groen et al. (2010) forecast inflation in the US economy. This study, with the aid of the Bayesian model, performs a structural failure to forecast the inflation rate. This study is based on real data from the United States in the years 1960-2008. The variables on which inflation is forecasted are real GDP, liquidity, inflation uncertainty, and inflation. The researchers used the MCMC algorithm to forecast, and in addition to the Monte Carlo model, the TVP-AR, SB-AR and UC-SV models are also estimated. In this study, the relationships between each of the macroeconomic variables such as oil prices, real GDP, and inflation with inflation are investigated, and the probability of persistence of inflation in each period of time is also calculated.

Garratt et al. (2011); according to the US, Australian, Norwegian, British and New Zealand statistics, estimate the correlation between inflation and the GDP gap. In this study, Garat and others examine the relationship between inflation and GDP gap using TVP-EWSC and TVP-RWSC. The main purpose is to present these two methods and compare their forecast power of inflation. The results show that the second method has been able to forecast inflation in these countries better.

Nakajima et al. (2011) examine the relationship between a number of economic variables and inflation in Japan. This study, first introduces the generalizations of TVP models and then uses three approaches from TVP models, TVP-AR, TVP-VAR and TVP-SVAR, and compares their forecast power. Another result of this study is the sensitivity analysis of inflation reaction to changes in macroeconomic variables.

Onch et al. (2013) forecat Turkish inflation using a large number of econometric models, including single equation models, frequency and time domain-based analysis methods, time-varying parameter Phillips curve model, a set of BVAR, VAR models and dynamic factor models during the global crisis (2008). Their empirical results show that models that combine more economic information have better performance in forecast, and the combination of forecasts lead to a lower forecast error compared to many other models.

Ux et al. (2015) examine the relationship between production gap and inflation using a nonlinear method. They show that the shape of the Phillips curve in the United States is nonlinear and asymmetric, and that monetary policy in the United States is dependent on economic cycles and inflation uncertainty.

Lee et al. (2016) study the hybrid new Keynesian Phillips curve in the United States using quantile regression. They achieve two important features that are ignored in models with a conditional average structure. First, there is more sensitivity to expectations in the higher quantiles. An important application of this is that monetary policy is more efficient in economic stability. Second, the role of the backward looking component is heavily dependent on the various levels of the quantile, so that the coefficients of lagged inflation to the right of distribution are small and not significant.

Komijani and Tavakolian (2011), also introduce a nonlinear reaction function for monetary policymaking in Iran according to which, the growth rate of monetary base is determined based on the output gap and the deviation of inflation from the inflation target. It is also assumed that coefficients of output gap and inflation gap are different during the recessionary and expansionary phases. They include the average inflation and the lagged as the targeted inflation rate. Finally, they conclude that during the recession, the Central Bank's sensitivity is more focused on the output gap, while during the boom it is more focused on inflation.

Tavakolian (2012) introduces a rule in a DSGE model which is very similar to the Taylor rule. This rule, like the Taylor rule, takes into account the deviation of inflation from inflation target and output gap as the goals of the

Central Bank. But, unlike the Taylor rule, which considers interest rate as instrument, this rule outlines the growth rate of the amount of money (money supply) as a tool for monetary policy making in the economy of Iran. Therefore, in this rule, unlike the Taylor rule, in which the coefficients of the two targets are positive, both coefficients are negative that indicates the growth rate of money as a tool.

Sahabi et al. (2013) study the role of monetary policies in increasing liquidity growth and its effect on the formation of moderate and high inflationary regimes in Iran using Markov switching model. According to their results, in the medium-term inflation regime, one percent increase in liquidity growth, with a lag, leads to 57.5% inflation increase, but in the high inflation rate regime, the significant effect of liquidity growth on inflation is not detected. The results of the estimation of Markov switching model with time-varying transmission probabilities illustrate the positive effects of liquidity growth on the persistence of medium and high inflationary periods in Iran.

Khezri et al. (2015) suggest that GDP growth, monetary base growth, inflation, exchange rate and bank interest rate are main variables in estimating the latent variables of 11 speculation sectors. Their results indicate changing status of the relationships between the above variables over time and also the effect of the contribution of general economic status on relationship between variables. The liquidity growth rate and the structural and institutional weaknesses in absorbing the resources of higher liquidity by the manufacturing sector, in addition to the movement of liquidity to the country's non-productive sector and speculation, have caused severe inflation in the economy.

Mohammadi et al. (2015) take into account the common factors affecting wage inflation and unemployment in the form of a system of simultaneous equations, to analyze the causal relationship between these two variables based on the Phillips curve. Two models are estimated: in the first model, wage inflation is assumed as a function of the current unemployment rate and the lagged inflation rate while in the second model, the inflation rate of each period is assumed as a function of the output and wages of the current period and the lagged inflation. The results of the study indicate that the Phillips curve exists during the years 1977 to 2006 in Iran.

Yazdani and Zare Ghashlaghi (2016) evaluate the effect of exchange rate changes on inflation as well as structural vector autoregressive (SVAR) model. The results indicate that one of the important and fundamental factors influencing inflation is exchange rate changes or in other words, general foreign exchange policies, that causes a structural inflation. Therefore,

adopted foreign exchange policies including the stabilization of exchange rates have been inflationary.

Akbarifard et al. (2017) Using Firewall and Cuckoo algorithms include liquidity, exchange rate, real interest rate, expected inflation and industrial output into linear and nonlinear models of inflation. They show that the nonlinear model is more suitable for modeling inflation, and the Firewall algorithm gives better results than the Cuckoo algorithm. According to the accuracy of the nonlinear model of Firewall algorithm, it is used to predict inflation in the future.

3 Methodology of Research

3.1 Introducing the Model

The TVP-FAVAR model is used in this study. The data consist of seasonal time series of Iran during the period of 1370 to 1394. The data source is the Central Bank of the Islamic Republic of Iran. Further, the basics of the TVP-FAVAR approach will be introduced in brief.

According to Stock and Watson (2008), a major problem with previous time series models is that they could not forecast correctly over time, and some of the models are well-suited during the boom and some during the recession. This led to the emergence of time-varying parameter models and the Monte Carlo Markov Chain (MCMC) models that forecast massive models (with a large number of variables) over time. In these models, the estimation coefficients change over time. Due to structural failures and observed cyclical changes, the previous models did not have the ability to calculate parameters in these conditions.

Instability of each of the estimated parameters leads to structural failure in the model (Marzban and Nejati, 2009). In the early studies, the structural failure test was used for linear regression models at a predetermined point in time and was performed externally (Chavo, 1975). In the following years, the structural failure test methods are performed internally at uncertain points (Bai and Peron, 2003). In recent years, for the sake of better explanation of the structural failure patterns, modifications have been made to the regime (Alavi And Jamazi, 2010), but due to the limited number of regimes in the models, the time parameters are generalized (Coop et al., 2012). Accordingly, any changes in the behavior of a times series involving a change in the width of the source and the sequence of the series is defined in the new econometric theory of structural failure (Akbari et al., 1395). Accordingly, in the present

study, in each period, when the behavior of the time series has changed, slope and width for that period has been calculated from a separate point.

Also, the number of variables and estimates can be high. Increasing the number of variables creates large and bulky models. In this category of models, whenever there are m variables at t intervals in the model, $2m^t$ models must be estimated (Coop and Carobellis, 2011). Several studies have been carried out in the form of structural models and using TVP methods. In the following, FAVAR models are developed to determine the factors affecting the dependent variable at different time periods so that the combination of TVP and FAVAR models provide a powerful tool for economic and political analysts. In Figure 1, the conceptual diagram of the present research is presented:

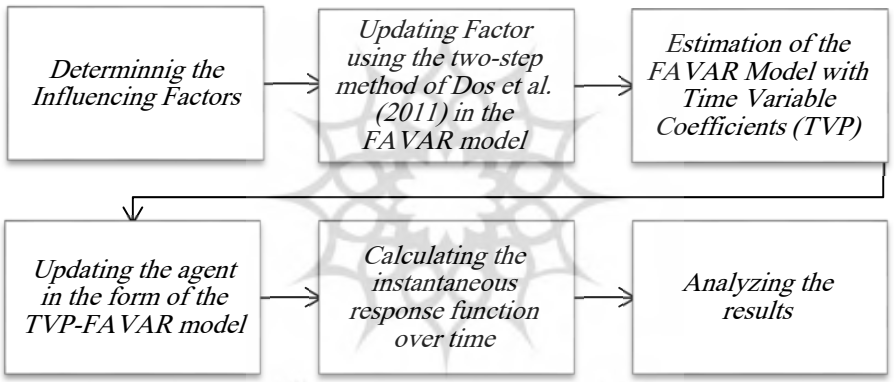

Figure 1. Basics of the Method and Conceptual Diagram of the Research. Source: Research Findings

Given that in VAR models all variables are considered as endogenous, as a result, y_{it} (where in this study includes variables such as liquidity, inflation, unofficial market exchange rate, economic growth, annual bank deposit, budget deficit and unemployment rate) represents the variables that are considered as endogenous. But given the fact that there are variables that affect the relationship between these variables, the factors that influence this relationship are introduced into the model. In this case, the VAR model becomes the FAVAR model. Accordingly, the factors f is introduced into the model (oil revenues in this research are included as the role of a factor that can affect the relations between the main variables. Since the source of foreign

exchange earnings in Iran's economy is oil revenue, and this variable is generally affected by sanctions, it is considered as a moderator factor). Finally, due to the introduction of structural failures in the model, various coefficients are used in different periods ($\widetilde{\Phi}_{1t},..,\widetilde{\Phi}_{pt}$). In this case, we modify the FAVAR models to the TVP-FAVAR model. A detailed description of the TVP-FAVAR approach is presented in the following.

The total structure of the TVP-FAVAR model in the Corbellis (2009) is shown using the relations 1 and 2:

$$y_{it} = \lambda_{0it} + \lambda_{it} f_t + \gamma_{it} r_t + \varepsilon_{it} \quad (1)$$

$$\begin{pmatrix} f_t \\ r_t \end{pmatrix} = \widetilde{\Phi}_{1t} \begin{pmatrix} f_{t-1} \\ r_{t-1} \end{pmatrix} + \cdots + \widetilde{\Phi}_{pt} \begin{pmatrix} f_{t-p} \\ r_{t-p} \end{pmatrix} + \tilde{\varepsilon}_t^f \quad (2)$$

In this equation it is assumed that each ε_{it} follows a univariate stochastic process. The variance of the expression for each ε_{it} is represented by $var(\tilde{\varepsilon}_t^f) = \tilde{\Sigma}_t^f$. The coefficients $\lambda_{0it}, \lambda_{it}, \gamma_{it}, \widetilde{\Phi}_{1t}, \widetilde{\Phi}_{pt}$ for $i = 1, \ldots, M$ are allowed to be modified based on a random pattern.

The Markov chain Monte Carlo algorithm is not described for this model. The only point addressed is that it merely adds more blocks to the FAVAR to the MCMC algorithm. In short, like many practical macroeconomic models, Bayesian inference on TVP-FAVAR progresses together with a MCMC algorithm that include multiple instances of the same blocks and algorithms.

Suppose for a time period t=1, T a vector of n × 1 variables is used for estimating the non-observable variables in the model. In addition, y_t is a vector of the main macroeconomic variables in the model, which includes the variables of liquidity, inflation rate, unofficial market exchange rate, economic growth, annual bank deposit rate, budget deficit and unemployment. The TVP-FAVAR model is as follows:

$$\begin{aligned} x_t &= \lambda_t^y y_t + \lambda_t^f f_t + u_t \\ \begin{bmatrix} y_t \\ f_t \end{bmatrix} &= c_t + B_{t,1} \begin{bmatrix} y_{t-1} \\ f_{t-1} \end{bmatrix} + \cdots + B_{t,p} \begin{bmatrix} y_{t-p} \\ f_{t-p} \end{bmatrix} + \varepsilon_t \end{aligned} \quad (3)$$

In the above equation, λ_t^y are the regression coefficients, λ_t^f is the loading factor and f_t is the factor. $(B_{t,1}, \ldots, B_{t,P})$ are the VAR coefficients. u_t is the error component with normal distribution and mean zero and covariance Q_t. Given the hypothesis of factor models, it is assumed that the matrix V_t is a diagonal matrix.

The loading coefficients $\lambda_t = \left(\left(\lambda_t^f\right)', \left(\lambda_t^y\right)'\right)'$ and the coefficients of the model VAR $\beta_t = \left(c_t', vec\left(B_{t,1}\right)', \ldots, vec\left(B_{t,P}\right)'\right)$ are extracted in accordance with a random step process over time:

$$\begin{aligned} \lambda_t &= \lambda_{t-1} + v_t \\ \beta_t &= \beta_{t-1} + \eta_t \end{aligned} \tag{4}$$

Where $\eta_t \sim N(0, R_t)$ and $v_t \sim N(0, W_t)$. All errors in the above function are uncorrelated with each other and on time, so the structure is as follows:

$$\begin{pmatrix} u_t \\ \varepsilon_t \\ v_t \\ \eta_t \end{pmatrix} = N\left(0, \begin{bmatrix} V_t & 0 & 0 & 0 \\ 0 & Q_t & 0 & 0 \\ 0 & 0 & W_t & 0 \\ 0 & 0 & 0 & R_t \end{bmatrix}\right) \tag{5}$$

Relationship 5 is called the TVP-FAVAR model. By applying several limitations, other models are extracted from the above model as follows:

- VAR Model Variable Time Added Factor (FA-TVP-VAR)[1]: This model is obtained when the loading coefficients of the first equation are constant in the relation (λ_t) (for all time periods t, $W_t = 0$ in which case $\lambda_t = \lambda_0$).
- Added VAR model factor (FAVAR): This is achieved when λ_t and β_t are constant over time ($W_t = R_t = 0$).
- VAR Model Variable Time Parameters (TVP-VAR): This model is obtained when the number of factors is zero (i.e., $f_t = 0$)
- Model VAR: This model is obtained when the number of factors is zero and λ_t and β_t are constant over time.

Note that in all of the above models, covariance and variance Q_t are constant.

2.3 Introduction of Research Data

The data used in this study are as follows:

- The liquidity stock
- Inflation rate based on consumer price index (CPI)
- Unofficial market exchange rate
- Economic Growth based on Gross Domestic Product (GDP)
- The one-year deposit stock
- Budget deficit based on government fiscal stance

[1] Factor-Augmented Time-Varying Parameter VAR

– Unemployment rate

4 The Results

In this study, seasonal data of 1370 to 1394 of the variables mentioned in the previous section are used; the source of all variables is Time Series Database (tsd) of the Central Bank of IR Iran. After estimating the TVP-FAVAR model with four lags, the results of the impulse response functions (IRFs) of the variables on inflation are presented for up to 10 periods. Since the impulse response functions are time-varying, in the graphs bellow x axis is year, y axis is IRF time length and z axis represents IRF.

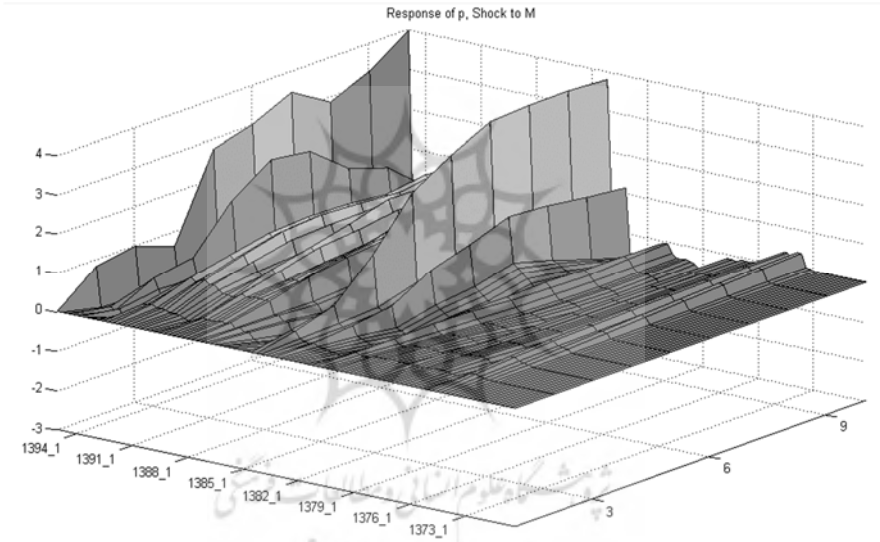

Figure 2. The Effect of Liquidity Growth Shock on Inflation (Source: Research calculations)

According to Figure 2, liquidity growth in all periods has a positive impact on inflation, but this positive effect varies over the years. The highest reaction of inflation rate to liquidity shock is seen over the period of 85-89, and also, the period after 92. In fact, during the first period, due to rising oil revenues, liquidity has increased sharply, and led to a dramatic impact on inflation. A similar effect can be seen in the period after 92, but this effect is slightly different from the previous one.

In other words, liquidity is affected during this period due to the prospect of lifting sanctions and increasing oil revenues. While in the period of 89-91, because of the drop-in oil revenues the effect of liquidity on inflation was reduced. In 1394 and after implementing JCPOA (Joint Comprehensive Plan of Action), the role of liquidity on inflation has sharply increased. It should be noted that during this period, liquidity increase has a positive impact on inflation, but as will be discussed later, during same period, the exchange rate also has a significant impact on inflation, which is the function of the instantaneous reaction of inflation to currency shock. But since 1392 and the realization that the exchange rate declined dramatically, the positive effects of liquidity overlap with the negative effects of the exchange rate depreciation and the inflation rate is reduced.

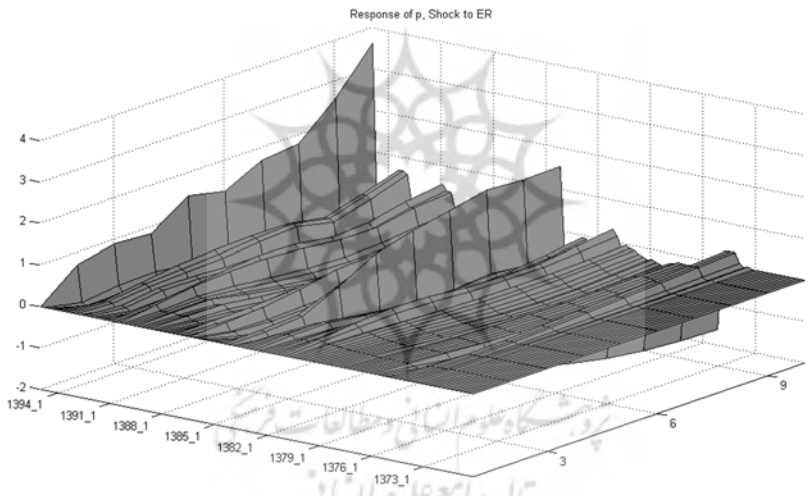

Figure. 3. The Effect of Currency Shock on Inflation (Source: Research calculations)

According to Figure 3, the exchange rate in all periods has a positive impact on inflation rate, but the severity of the effect of this variable varies over time. The most frequent reaction to the exchange rate shock is seen in the 1385-86 period, as well as in the period after 1392. The increase in oil revenues in 1385 and 1386, due to rising Rial revenues of oil and injecting these revenues into the economy without planning, caused a rise in inflation during this period. Also, with the sharp increase in the exchange rate in 1391 and 1392, and the expansion of sanctions, the formation of inflation expectations increased which all resulted in high inflation.

In general, the shock effect of the exchange rate on inflation in 1391 and 1392 can be analyzed in some ways: The dependence of output on imported raw materials and intermediate goods caused the producer price inflation to be affected by exchange rate impulses, and an increase in the exchange rate led to producer price inflation. Also, given that the consumer price index is both a combination of the value added of domestic goods and the value added of imported final goods, consumer price inflation also ensued the exchange rate fluctuations. Therefore, imported inflation caused by exchange rate shock is an important factor in explaining the fluctuations of domestic inflation.

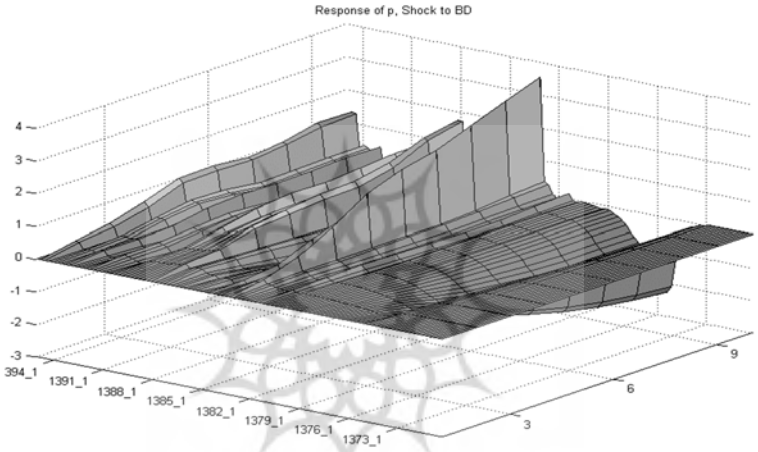

Figure 4. The Effect of Budget Deficit on Inflation (Source: Research calculations)

Based on Figure 4, the budget deficit has a negative effect at the beginning of the period and in the middle and late periods has a positive impact on the inflation rate, with a U reversal behavior. However, the severity of the effect on this variable varies over time. In the early years, due to the implementation of government contractionary policies to reduce the budget deficit and strengthen the Central Bank's independence and for the repayment of part of the government's debt to the Central Bank, the negative impact of the budget deficit on inflation was created.

The largest response of inflation to the budget deficit shock happens in the period 1388- 1384. During this course, which coincides with fourth development foreign reserves withdrawals due to the budget deficit averages about 1,140 trillion, that accompanied by the pressure of international sanctions and the inability in financing deficit, the ownership of capital assets

and allocating it to cost credits reduced, and the exchange rates and borrowing from the Central Bank increased, which in turn provided the framework needed to create inflation at that time. Also, from 1390, with the increase in sanctions and the reduction of government revenues, the policy of monetization of the budget deficit has been placed as the top priority of the government which intensified the impact of the budget deficit on inflation in these years.

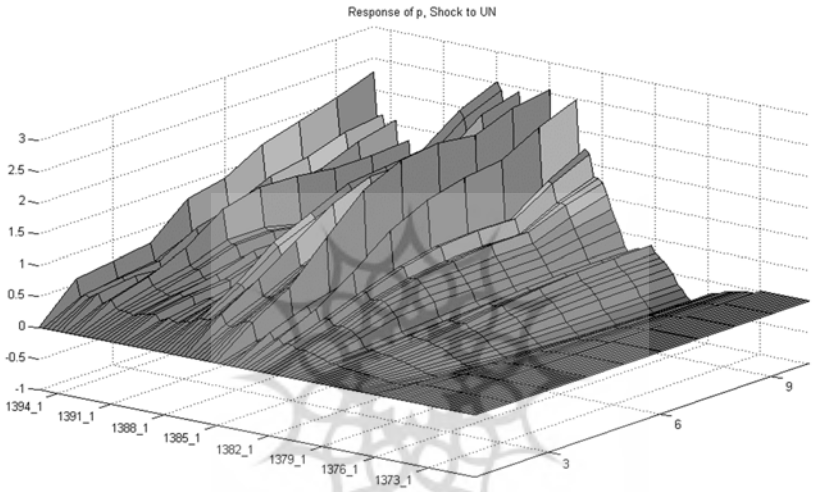

Figure 5. The Effect of Unemployment Shocks on Inflation (Source: Research calculations)

According to Figure 5, unemployment throughout the whole period has a positive impact on inflation, but the severity of the effect of this variable varies over time and has increased over time. The positive correlation between the unemployment rate and inflation based on the short-term Phillips curve is not justifiable. This positive correlation can be justified by rightward shift of the Phillips curve, which is an evidence of the occurrence of a recession in the economy. In the last four decades, the average annual growth has been two percent, which is lagging behind the average population growth rate of more than 3 percent, which is disproportionate to the demand for labor. Meanwhile the lack of jobs that are proportional to the skills of the workforce, the shift of labor into university education, and the lack of investment in early-returns and small projects caused a disruption of the supply of labor in Iran. But, as stated, due to the low level of investment and profitability of the intangible sectors,

rising inflation along with rising unemployment is observed simultaneously. It is worth noting that the improvement of the business environment, the implementation of contractional monetary and fiscal policies with a one-digit inflation target, the implementation of open-ended economic policies and the emergence of a positive outlook on the implementation of the deal from 1392 onwards partly reduced the effect of this variable on inflation.

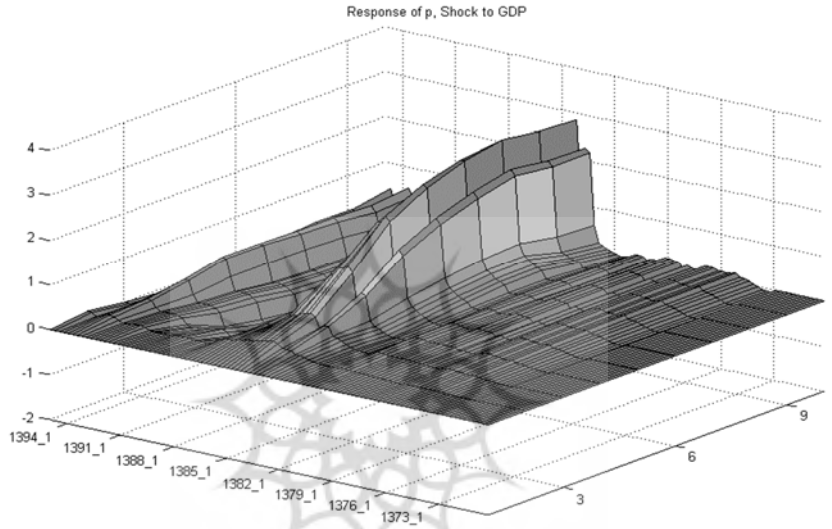

Figure 6. Effect of Economic Growth Shock on Inflation (Source: Research calculations)

Figure 6 shows that economic growth in the beginning and middle of the period has a positive effect and at the end of the period has a negative effect on the inflation rate. It is visible as a U-inverse behavior, but the intensity of the effect of this variable in various time intervals has a high fluctuation. The positive correlation between economic growth and inflation indicates a strengthening of inflation by reducing the supply function and moving it to the left and the top.

The greatest effect of economic growth on inflation is observed between 1384 and 1388. An increase in political tensions between Iran and the United States and the intensification of sanctions, rising price expectations, more profitability of non-productive markets (foreign exchange, housing and gold), and the recession of the capital market, along with the expansion of the volume

of imports, led to a shift in supply curve to the left and to the top. As a result, during this period, we are witnessing an accelerated rise in inflation caused by the economic downturn in Iran. The improvement of the business environment, and the emergence of a positive outlook on executions over the period of 1392 onwards, somewhat reduced the effect of this variable on inflation.

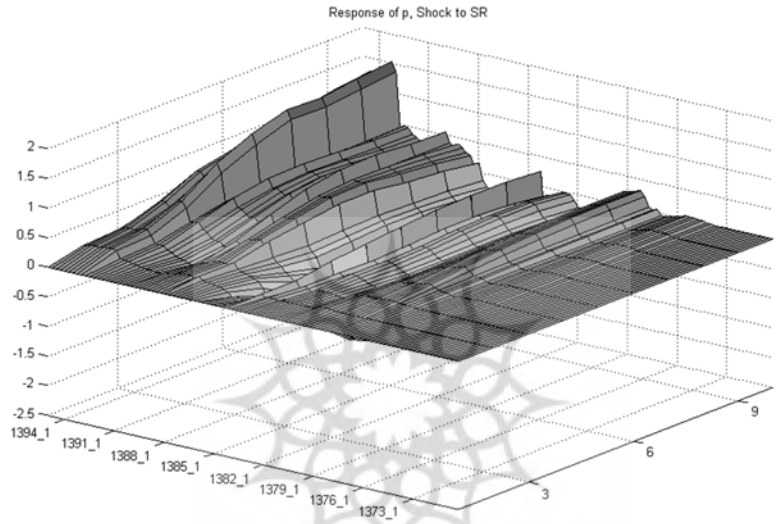

Figure 7. The Effect of Interest Rate on Inflation (Source: Research Calculations)

Figure 7 depicts that the interest rate on the whole period has a positive effect on the inflation rate. According to the chart, the effect is increasing over time. The negative real interest rate and the absence of a nominal interest rate greater than inflation, led to the withdrawal of deposits from banks and the flow of liquidity towards unmarked markets. With the flow of liquidity into parallel markets, along with rising inflationary expectations and rising nominal rates resulted in rising inflation. Also, since 1392, despite a significant reduction in the rate of inflation, the rate of interest on bank facilities did not fall proportionally, which reduced the production and supply. On the other hand, the decline in bank interest rates in recent years has increased liquidity and aggregate demand, which both resulted in higher inflation, as shown in Figure 7.

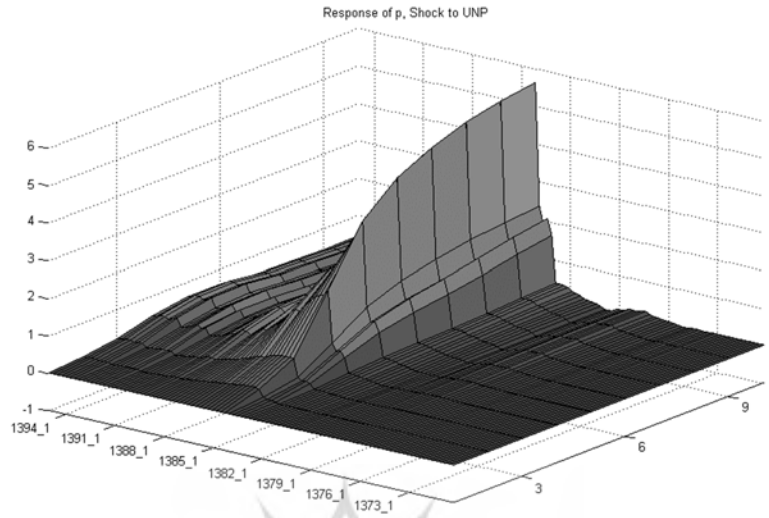

Figure 8. The Effect of Inflation Uncertainty on Inflation (Source: Research calculations)

According to Figure 8, inflation uncertainty over the whole period has a positive impact on inflation. As the graph shows, a reverse U behavior is observed over time. The greatest effect of this variable is observed between 1382 and 1388. The indiscipline financial and monetary policies during this period, the increase of the country's political tensions in foreign relations, the sharp rise in exchange rates and housing prices, and the high level of inflation have created increased uncertainty in inflation during this period. The implementation of contractionary monetary and fiscal policies to control inflation in recent years, the relative improvement of international relations, the housing market downturn and the relative prosperity of capital markets relative to parallel markets in 1392-1394 have been the main causes of reduction in uncertainty over this period.

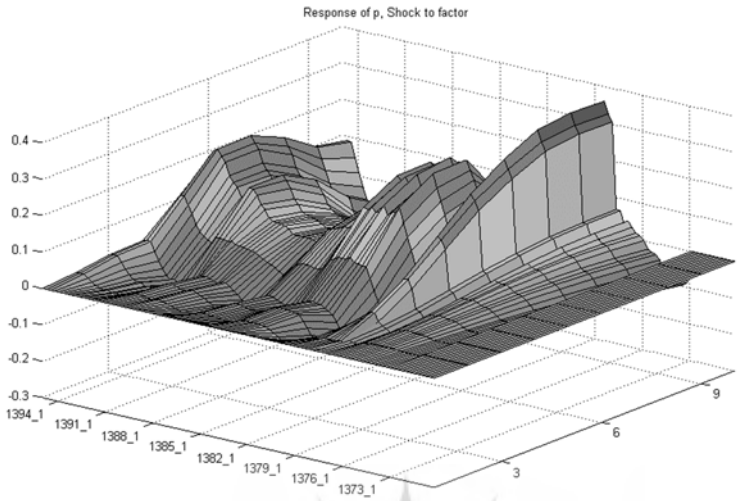

Figure 9. The Effect of Oil Revenues on Inflation (Source: Research Calculations)

Table 2

Results of the effect of different macroeconomic impacts on inflation over time

Variable name	**Severity of correlation at the beginning of the period**	**Severity of correlation in the period**	**Severity of correlation at the end of the period**	**Total period trend**
The volume of liquidity	Neutral	Positive with high gradient	Positive with high gradient	Ascending
Unofficial market exchange rate	Neutral	Positive with an average slope	Positive with high gradient	Ascending
Budget deficit	Negative with gentle slope	Positive with high gradient	Positive with an average slope	Conversely U
Unemployment	Negative with gentle slope	Positive with high gradient	Positive with high gradient	Ascending
Economic Growth	Neutral	Positive with high gradient	Positive with gentle slope	Conversely U
Interest rate	Neutral	Positive with gentle slope	Positive with high gradient	Ascending
Uncertainty about inflation	Neutral	Positive with high gradient	Positive with gentle slope	Conversely U

Source: Research Calculations

Table 3
Results of the Effect of Different Macroeconomic Impacts on Inflation in Different Presidential Periods

Variable	The first two years of the 11th Presidential Administration (from 2014 to 2016)	The Presidential Administration of the 9th and 10th years (2014-2008)	The Presidential Administration of the 7th and 8th years) (007-1997)	The Presidential Administration of the 5th and 6th years (1988-1996)
The volume of liquidity	Positive very steep slope	Positive with high slope	Positive with mild slope	Neutral
Unofficial market exchange rate	Positive with high slope	Positive with average slope	Neutral	Neutral
Deficit of the investment	Positive with average slope	Positive with high slope	Neutral	Negative with mild slope
Unemployment	Positive with high slope	Positive with high slope	Positive with mild slope	Negative with mild slope
Economic Growth	Positive with mild slope	Positive with high slope	Neutral	Neutral
Bank facility profit rate	Positive with high slope	Positive with mild slope	Neutral	Positive with mild slope
Uncertainty of inflation	Positive with mild slope	Positive with high slope	Neutral	Neutral
Oil revenues	Positive with high slope	Positive with average slope	Positive with high slope	Positive with high slope

Source: Research calculations

One can see a positive impact of oil revenues on inflation during the whole period on Figure 9. According to the chart, although the severity of the effect varies over time, this effect has been strengthened over time. The highest rate of influence was observed in the years 1377 to 1379, 1386 to 1388 and 1391 to 1394. Given that oil production capacity in Iran is steady and oil prices are externally determined on global markets, oil revenues in Iran are generally subject to the severity of the country's sanctions and global demand. For example, between 2007 and 2009, global prices boosted oil revenues. Between 1392 and 1394, oil sales increased due to the improvement of international relations and the reduction of sanctions. By turning these oil revenues into Rial and injecting into the economy, they provided favorable conditions for increasing inflation in the economy. In this section, we have tried to summarize the effect of factors influencing inflation in different time periods.

According to Table 2, the indexes affecting inflation generally have a positive impact on inflation and over time, these effects are intensifying. As a result the signaling status of these variables, expecting an uptrend in the near future in the country's inflation rate is expected.

5 Concluding Remarks

The results of the TVPFVAR models reflect the fact that all variables included in the model affect inflation. Also, oil revenues have been an important factor in modulating the impact of variables affecting inflation over time. According to the results of the research, all the variables in the model have a positive effect on inflation. Any standard deviation of the variation in these variables between one and three years has been effective in stabilizing and sustaining inflation in Iran. Based on the results of model estimation, the following policy suggestions are presented:

Given the positive effect of the bank's interest rate on inflation, floating interest rates and its indexation partly contribute to the stability of the savings function and, consequently, reduce fluctuations in the volume of money in circulation and banks hence control inflation.

Imported inflation is an important factor in explaining the fluctuations of domestic inflation and therefore necessary measures should be taken to reduce the import dependency.

Given the positive effect of economic growth on inflation, implementing supply-side policies that move the supply function of the economy to the right and bottom, lead to a reduction in inflation and the country's exit from the recession. Consequently, policies on increasing the level of work culture, increasing human resource productivity and changing the labor market composition can improve economic growth and reduce inflation.

In order to reduce the impact of the budget deficit on inflation, regulating fiscal policies by setting the ceiling for the deficit or public debt-to-GDP ratio, and anchoring the government's annual spending over four-year periods is useful in this regard.

Given that the shock sources in most macroeconomic variables in Iran is due to oil revenue shocks, managing oil revenues ensures the country's economic stability. As a result, it is appropriate that the income from oil sales be considered as a wealth in the perspective document, and this wealth is used over time.

Given that the uncertainty surrounding inflation in recent years has intensified and caused inflation, policies should be taken that reduce inflation uncertainty, like promoting the financial and monetary discipline of the government and the Central Bank, and reducing inflation expectations by stabilizing the money and currency market.

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