Artículo de investigación

The Impact of Monetary Disorders on Inflation and Business Cycles in Iran's Economy

El impacto de los trastornos monetarios en la inflación y los ciclos económicos en la economía de Irán

O impacto dos distúrbios monetários na inflação e nos ciclos de negócios na economia iraniana

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Written by:
M. Nazari Samani*[4]
E. Asadi[5]

Abstract

In this paper, we have investigated the effect of monetary disorders on inflation and business cycles in Iran's economy during the period 1973 to 2012. Monetary disorders are defined by two indexes of monetary policy uncertainty and shock to liquidity growth. In the first step, the causal relationship of monetary policy uncertainty on real GDP fluctuations, employment fluctuations and inflation are estimated using Granger causality test. To this purpose, to follow Haghighat and Mohammad Gholipour Tapeh (2014), the conditional variance of liquidity growth extracted from models of GARCH family was applied as a substitute for monetary policy uncertainty. In the second stage, the reaction of economic growth, employment growth and inflation to the shock to liquidity growth are estimated using impulse response function technique derived from VAR model. The results indicate the existence of one-way Granger causality relation of monetary policy uncertainty in all three variables of real GDP fluctuations, employment fluctuations and inflation. Also, based on the results, impulse response function reduces the shock to liquidity growth as much as a standard deviation, real GDP growth and employment after a period and increases inflation. Accordingly, the hypothesis of the effect of monetary disorders on business cycles in Iran's economy in the period of this research cannot be rejected.

JEL classification: E23, E31, E32, E52

Resumen

En este documento, hemos investigado el efecto de los trastornos monetarios en la inflación y los ciclos económicos en la economía de Irán durante el período de 1973 a 2012. Los trastornos monetarios se definen por dos índices de incertidumbre de la política monetaria y el impacto del crecimiento de la liquidez. En el primer paso, la relación causal de la incertidumbre de la política monetaria sobre las fluctuaciones del PIB real, las fluctuaciones del empleo y la inflación se estiman mediante la prueba de causalidad de Granger. Para este propósito, siguiendo a Haghighat y Mohammad Gholipour Tapeh (2014), se aplicó la varianza condicional del crecimiento de la liquidez extraída de los modelos de la familia GARCH como sustituto de la incertidumbre de la política monetaria. En la segunda etapa, la reacción del crecimiento económico, el crecimiento del empleo y la inflación al impacto del crecimiento de la liquidez se estiman utilizando la técnica de función de respuesta al impulso derivada del modelo VAR. Los resultados indican la existencia de una relación de causalidad de Granger unidireccional de la incertidumbre de la política monetaria en las tres variables de fluctuaciones del PIB real, fluctuaciones del empleo e inflación. Además, en función de los resultados, la función de respuesta al impulso reduce el impacto del crecimiento de la liquidez tanto como una desviación estándar, el crecimiento del PIB real y el empleo después de un período y aumenta la inflación. En consecuencia, la hipótesis del efecto

[4] Department of Economics, Khomeini Shahr Branch, Islamic Azad University, Isfahan, Iran
*Corresponding Author: Email: samani.mn@gmail.com
[5] Department of Economics, Shiraz Branch, Islamic Azad University, Shiraz, Iran Email: easadi_63@yahoo.com

Keywords: Monetary policy uncertainty, liquidity growth, business cycles, GARCH models, impulse response function.

de los trastornos monetarios en los ciclos económicos de la economía de Irán en el período de esta investigación no puede ser rechazada.
Clasificación JEL: E23, E31, E32, E52

Palabras claves: Incertidumbre de la política monetaria, crecimiento de la liquidez, ciclos económicos, modelos GARCH, función de respuesta al impulso.

Resumo

Neste artigo, investigamos o efeito dos distúrbios monetários sobre a inflação e os ciclos econômicos na economia do Irã durante o período de 1973 a 2012. Os distúrbios monetários são definidos por dois índices de incerteza da política monetária e por choque no crescimento da liquidez. No primeiro passo, a relação causal entre a incerteza da política monetária sobre as flutuações do PIB real, as flutuações do emprego e a inflação é estimada usando o teste de causalidade de Granger. Para este propósito, para seguir Haghighat e Mohammad Gholipour Tapeh (2014), a variância condicional do crescimento de liquidez extraída de modelos da família GARCH foi aplicada como um substituto para a incerteza da política monetária. No segundo estágio, a reação do crescimento econômico, crescimento do emprego e inflação ao choque para o crescimento da liquidez são estimados usando a técnica de função de resposta impulsiva derivada do modelo VAR. Os resultados indicam a existência de uma relação de causalidade de Granger unidirecional da incerteza da política monetária em todas as três variáveis de flutuações reais do PIB, flutuações do emprego e inflação. Além disso, com base nos resultados, a função de resposta ao impulso reduz o choque para o crescimento da liquidez, tanto quanto um desvio padrão, crescimento do PIB real e emprego após um período e aumenta a inflação. Consequentemente, a hipótese do efeito dos distúrbios monetários nos ciclos de negócios na economia do Irã no período desta pesquisa não pode ser rejeitada.

Classificação JEL: E23, E31, E32, E52

Palavras-chave: Incerteza da política monetária, crescimento da liquidez, ciclos de negócios, modelos GARCH, função de resposta ao impulso.

1) Introduction

Sharp fluctuations in economic variables such as liquidity can be warned ahead of time of occurrence, consequently, we can help to reduce their adverse effects. Analysis of economic variables under the study theories can be a solution for this purpose. Liquidity in Iran is one of variables that is always associated with many fluctuations and determining its' optimal level is discussed every year. Variables such as price and oil revenue and government budget deficit are of those that strongly fluctuate the country's liquidity. Several studies show that still there is no consensus in the world on the effects of monetary policy on the economy's real variables; usually empirical studies determine the role and impact of these policies on the economy's real variables. In Iran, also many studies have been conducted about the effects of monetary and fiscal policies on economy's variables such as economic growth, exchange rate, consumption expenditures and price or stock returns etc.; but very rare researches have been done on the effects of monetary disorders including uncertainty and shocks of money on the economy's real variables. This way, the present study is dedicated to the analysis of time series data based on the analysis of the effect of monetary disorders in form of monetary policy uncertainty and shocks to liquidity growth on real GDP, employment and inflation of the country during the period 1973 to 2012. Continuation of the study is as follows:

In the second part of this article, the literature is presented. The third part of this article is explanation of a number of previous studies inside and outside of the country. The fourth section describes the way of extracting monetary

policy uncertainty from liquidity growth. The fifth section is dedicated to estimation methods of the research patterns. Part six is review of extracted monetary policy uncertainty and time process of the research variables. The seventh, eighth and ninth sections relate to the estimation of desired models. Stationary data used in the models, Granger causality test and impulse response function (IRF) are estimated in these sections. In final section (part tenth) the summary of the results is provided.

2) Literature

Economic growth, full employment and price stability are the three main objectives in the macroeconomic. Thus, most of the discussions and macroeconomic theories have been developed around these three axes and different views have been presented about achieving these goals. A large part of the macroeconomic discussions has been allocated to the business cycles and fluctuations in real economic variables from their long-term trend in last three decades. A critical attitude related to the business cycle is the attitude of the real business cycles (RBC). Advocates of this approach, including Baxter and King (1993), unlike new classics that knew monetary as the nature of cycles, believe that business cycles have a real nature and the origin of cycles are government expenditure shocks and technology shock and changes in workers' inter-temporal decisions is looking to change inter-temporal elasticity of substitution of work and the rest is looking to change in interest rate. They believe that cycles are a reflection of voluntary decisions in different technological and economic conditions. But the New Keynesians while acknowledging a part of beliefs of the fans of real business cycles, also confirm criticizes on their assumptions which mostly are experimental in their opinion. Blanchard and Perotti (2002) believe that consumers do not follow the rule Ricardian and it will increase the shocks to government expenditure, private consumption and consequently gross domestic product. On the other hand Mankiw (1985) also believes that what Keynes presents in general theory of business cycles is due to the market failure. In Mankiw's opinion, the new Keynesian accept the framework provided by neoclassical synthesis meaning that the economy can be deviated from its equilibrium level in short term and therefore, monetary and fiscal policy can have an impact on economic activities.

According to the classical school, due to the assumption of full employment, an increase in the money supply only raise the price level and have no effect on the real economy. In other words, Classics believe that money is neutral. But in neo-classical approach, since the assumption of full employment is excluded, it is believed that increasing the money supply in short term through increasing the demand for goods and services can both increase the production and prices and consequently, according to neoclassical model of inflation, money is not neutral and in short term, money leaves some real effects from itself. This theory is stated in other way by the proponents of rational expectations such as Lucas (1972). According to the school of rational expectations, economic units of expectations form themselves according to the information related to the past and present and not just based on the past information. Based on this approach, the predicted monetary policy will have no effect on real economy in short term. Hence, the central bank can effect on the real production and employment just in case to take completely unpredictable and undeclared monetary policies; the policies that have already been announced will actually fail, because it already is predicted by economic units and economic units carry out necessary and appropriate adjustment with that policies. Accordingly, Sargent and Wallace (1975) also believe that the nature of the business cycles will be credited from unpredicted money.

However, evidences and numerous studies show that many economists believe that monetary disorders can affect fluctuations of real variables of economy and their deviation from long term path. Uncertainties are considered as a batch of monetary disorders. According to some economists and even specialists in other sciences, uncertainty is a situation in which the possibility of obtaining some results is not exactly clear. Uncertainty can effect on different markets such as money market, goods and economic variables. There has been less attention to the way of effecting the uncertainties on each other in different markets.

Initial theories about the effects of monetary disorders from the type of uncertainty of monetary policies on interest rate channel have emphasized that in this way, instability in money and liquidity growth will affect the level of economic activities. According to Evans (1984), increasing instability in liquidity growth will lead to increase fluctuations of interest rate. That's why the risk of bonds will also be increased. The

other hand, increase in the risk of holding bonds will increase the demand for money and follow it the interest rates and it will lead to a reduction in consumption expenditures by households, reduction of investment by firms and consequently it will reduce the production. Well as some economic theories suggest, the mechanism of monetary uncertainty impact on economic growth is that the increase in monetary fluctuations leads to increase uncertainty about the future economic conditions and this in turns leads to increase the money demand due to raise in precautionary money demand. Increase in money demand lowers the velocity of money and this will reduce the level of national production and employment (Belongio, 1996). In other words, more fluctuation in money growth will induce the increase of maintaining the real money and will leave negative effects on the real economy (Cronin, Kelly and Kennedy, 2011).

To see if the increase of uncertainty about future monetary growth has a significant impact on economic activities or not is an empirical question. In addition, if increased uncertainty has some impacts on real economic variables, naturally, the type of its impact on economic variables can arise from different directions which is usually specified by empirical tests. Although many studies have been carried out in Iran on the effects of fiscal and monetary policies on the real variables, but few studies have focused on the role of money disorders in forming business cycles in Iran. Thus, in this study, we have tried to find how money disorders in form of uncertainties and shocks of monetary policies effect on the real variables of economy including real GDP and employment. Also, we have reviewed the effect of uncertainties and shocks of money on inflation.

3) Research background

Heidari (2008) in a study reviewed the growth of money supply and its' effects on production and employment in Iran's economy and rational expectations hypothesis based on neutrality of monetary policy or lack of the impact of this policy on mentioned real variables during the years 1996 to 2003. The results of the estimation of production equation reject the influence of unpredicted component of money on the production variable, hence, the obtained results show this point that predicted and regular monetary policy during the study in Iran's data framework has effected on economic growth. In addition to the results of estimating the unemployment rate equation, the impact hypothesis of unpredicted component of money on real variable of employment is rejected and the impact of predicted growth of money with a time lag on employment is rejected. Generally, the results of this study don't confirm the followers' approach of rational expectations based on the lack of effectiveness of regular monetary policies on real variables of production and employment.

Komeijani, Tavakkolian and Tavakkolian (2013) evaluated the Granger causality relationship between the six variables of inflation, rising oil prices, inflation uncertainty (nominal uncertainty), national production uncertainty (real uncertainty) and oil price uncertainty in Iran's economy during the period 1988 to 2007 using a tri-variable Generalized Autoregressive Conditional Heteroskedasticity (GARCH). The results show that by increasing uncertainty of production growth, both inflation and growth will be increased. But they don't agree the Friedman's hypothesis (1977) about increase of inflation uncertainty leading to reduction of production growth.

Haghighat and Mohammad Gholipour Tapeh (2014) in a study evaluated the effect of money growth uncertainty on Iran's economic growth in the period 1990 to 2010. They applied GARCH model to calculate uncertainty of liquidity growth and used a model of Auto-Regressive Distributed Lags (ARDL) and Pesaran's boundaries test to evaluate its' impact on economic growth. Their results show that by increasing uncertainty of liquidity growth, the country's economic growth will be reduced both in short-term and long-term.

Hallett, Peersman and Piscitelli (2004) evaluated the effect of monetary uncertainty in industry production of 9 OECD member countries. They used uncertainty of price index and uncertainty of exchange rate as a substitute variable for uncertainty of monetary policy. Their results show that uncertainty of price index has had a negative impact on industry production of these countries. They also took different results about effectiveness of exchange rate uncertainty for different countries; however, this effect was negative in most cases. In general, they found that the effect of monetary uncertainty depends on the countries industry.

Serletis and Rahman (2009) in a study in form of the model GARCH-in Mean VAR using season data for America' economy during the period 1959 to 2005 concluded that uncertainty of monetary growth has had negative and significant effect on economic growth of this country.

Stockhammer and Sturn (2012) in a study following Ball (1999) evaluated the effect of monetary policy on unemployment of OECD member countries in the period 1980 to 2007. In this study, they examined the hypothesis in which the risk of residual unemployment remained from economic crisis has been depended monetary policy response in these conditions. The results of econometric operations show that a degree of residual unemployment caused in the sample countries has been due to monetary policies adopted in times of economic crisis.

Cloyne and Hurtgen (2014) in a study evaluated the effect of monetary policy on macroeconomic variables for the UK's economy. They found that an increase in monetary policy index will increase the product. Also, the results suggest that seeking to implement expansive monetary policy in this country, inflation will be raised after two to three periods.

4) Measurement method of variables

In this article, time series data related to Iran's macroeconomic variables including "GDP", "employment, L", "inflation, P" and "liquidity, M2" are loaded from the website of the Central Bank of the Islamic Republic of Iran6 in the period 1973 to 2012. Then, these variables for the research purposes will face some changes using mathematical and econometric methods. Thus, following Haghighat and Mohammad Ghloipour Tapeh (2014), the way of extracting uncertainty of monetary policy from liquidity growth is also explained using models of GARCH family. Also, Hodrick and Prescott Filter was used to extract GDP fluctuations and employment fluctuations from the long-term trend.

4.1. Estimation of monetary policy uncertainty

In 1982, Engle introduced an appropriate substitute for uncertainty variables by providing Autoregressive Conditional Heteroskedasticity (ARCH). In this model, conditional variance of mean equation residuals is used as the substitute variable for uncertainty. In continue, Bollerslev (1986) proposed a similar model as Generalized Autoregressive Conditional Heteroskedasticity (GARCH) to measure uncertainty by extending the model proposed by Engle. In this study, one of the GARCH family models is used to estimate the uncertainty of monetary policy. The way of estimating these models are described below.

4.1.1. Stating the average equation of liquidity growth

To measure the uncertainty of monetary policy, in the first step, time series models of Autoregressive Moving Average (ARMA) from the order (p, q) are used to stipulate an average equation as below:

$$Y_t = \beta_0 + \sum_{i=0}^{p} \beta_i Y_{t-1} + \sum_{j=0}^{q} \gamma_j \varepsilon_{t-j} \quad , \quad \gamma_0 = 1 \qquad (1)$$

So that, Y_t is dependent variable that here is "liquidity growth" and ε_t is residuals related to the regression. Pattern (1) is created of three components including a fixed sentence of β_0, auto-regressive process (AR) with p order and moving average (MA) process with q order. The lag order (p, q) in pattern (1) is determined by Schwarz Criterion. If the time series becomes static after d order differentiation, then estimated by ARMA process, in this case, the process will be in form of a ARIMA model from (p, d, q) order. The use of time series models are very common due to the need to less variables compared with econometric models. Such models are simply made and there is no need to previous theoretical information about the relation between variables for using them (Gujurati, 2004).

4.1.2. Estimate the conditional variance of liquidity growth

After estimating the mean equation, the conditional variance of residuals of this equation

[6] www.cbi.ir

is estimated as a substitute variable for uncertainties using GARCH family models. GARCH model was defined for the first time by Bollerslev (1986) in form of the equation (2):

$$VAR(\varepsilon_t) = h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i {\varepsilon^2}_{t-i} + \sum_{j=1}^{q} \beta_j h_{t-j} \quad (2)$$

$$\alpha_0 > 0 \ , \ \alpha_i \geq 0 \ , \ \beta_j \geq 0$$

In equation (2), α_i to be positive and significant means that conditional variance is sensitive towards fluctuations of previous periods and response quickly to the market movements. Also, β_j to be positive and significant means that uncertainty is non-damping. This means that uncertainty is continuing over time and is transferred from one period to the next. In other words, it takes a relatively long time to change.

One of the serious shortcomings on the GARCH model is that positive and negative fluctuations with equal size of (ε_t) have similar effects on h_t. But in fact, economic agents show different reactions to good and bad news. So, two asymmetric models are used in order to segregate the effect of negative and positive fluctuations. One of the models as TGARCH by Glosten et al, (1993) is introduced as below:

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i {\varepsilon^2}_{t-i} + \sum_{j=1}^{q} \beta_j h_{t-j} + \sum_{k=1}^{r} \gamma_k {\varepsilon^2}_{t-k}\, d_{t-k} \quad (3)$$

$$\alpha_0 > 0 \ , \ \alpha_i \geq 0 \ , \ \beta_j \geq 0$$

In equation (3), if the coefficient γ is negative, it indicates that negative and positive fluctuations of liquidity growth with same largeness will have different effects on liquidity growth. It means that in short term, positive fluctuations effect on liquidity growth uncertainty more than negative fluctuations. It is clear that the effect of negative fluctuations on uncertainty will be equal to $\sum_{i=1}^{p} \alpha_i - \gamma$ and the effect of positive fluctuations will be equal to $\sum_{i=1}^{p} \alpha_i + \gamma$ (Engle, 2001).

Another model proposed by Nelson (1991) is Exponential Generalized Auto-Regressive Conditional Heteroskedasticity (EGARCH). This model like TGARCH, provides the possibility of reviewing asymmetric effects of positive and negative fluctuations of liquidity growth separately and is presented as below:

$$log(h_t) = \alpha_0 + \sum_{i=1}^{p} \alpha_i log\left(\frac{|\varepsilon_{t-i}|}{\sqrt{h_{t-j}}}\right) + \sum_{j=1}^{q} \beta_j \log(h_{t-j}) + \sum_{k=1}^{r} \gamma_k\, log\left(\frac{|\varepsilon_{t-k}|}{\sqrt{h_{t-k}}}\right) \quad (4)$$

Since in this model, the variance equation is expressed in logarithmic form, limitations of GARCH model of all coefficients being positive is resolved and there is no need to specify being non-negative of coefficients. In equation (4), if the coefficient is $log(\frac{|\varepsilon_{t-k}|}{\sqrt{h_{t-k}}}) > 0$, the effect of positive fluctuations on conditional variance logarithm is equal to $\alpha + \gamma$ and if it is $log(\frac{|\varepsilon_{t-k}|}{\sqrt{h_{t-k}}}) < 0$, the effect of negative fluctuations on conditional variance logarithm will be equal to $\alpha - \gamma$ (Kalimeris, 2012).

In the present study, one of introduced models according to the results and limitations on GARCH models will be applied to estimate liquidity growth uncertainty.

5) Method of evaluating the effect of shocks and uncertainties of monetary policies on business cycles

In this research, we aim to review the analysis of the effect of monetary disorders in form of liquidity shock and monetary policy uncertainties on target variables in macroeconomic including real GDP, employment and inflation in two steps.

In the first step, the presence or absence of a causal relationship between conditional variance of liquidity growth as constitute variable for monetary policy uncertainties on fluctuations of real GDP and employment and inflation fluctuations is evaluated using Granger causality test. In the second step, the effect of the shock to liquidity growth as the index of monetary policy on three desired variables in form of economic growth, employment and inflation growth is evaluated using impulse response functions (IRF) which is extracted from a vector autoregressive (VAR) model.

5.1. Granger Causality Test

Generally, Granger causality test includes below regression estimations:

$$h_t = \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{j=1}^{q} \beta_j h_{t-j} + u_{1t} \quad (5)$$

$$Y_t = \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{j=1}^{q} \beta_j h_{t-j} + u_{2t} \quad (6)$$

So that h_t is conditional variance of liquidity growth, Y_t is constitute vector for each of desired variables including production fluctuations (CGDP), employment fluctuations (CL) and inflation (P). u_{1t} and u_{2t} are also residuals in two regressions. Null hypothesis in two regressions will be respectively as below:

$$H_0: \alpha_1 = \alpha_2 = \cdots = \alpha_p = 0 \quad (7)$$

$$H_0: \beta_1 = \beta_2 = \cdots = \beta_q = 0 \quad (8)$$

If estimated coefficients related to h_ts with q lags in equation (6) are non-zero in sum statistically, but estimated coefficients related to Y_t variable with P lags in equation (5) are zero in sum statistically, then there is one way causal relation from monetary policy uncertainty (h_t) towards 3 introduced variables (Y_t) (Gujurati, 2004).

Hodrick and Prescott Filter is used to extract fluctuations of macroeconomic variables from its' long term trend. Separation mechanism in Hodrick and Prescott method is done via minimizing the target function according to the condition.

$$min: \sum_{t=1}^{n} (Y_t - T_t)^2 \quad (9)$$

$$st: \sum_{t=1}^{n} [(T_{t+1} - T_t) - (T_t - T_{t-1})]^2 = 0 \quad (10)$$

In above equation, Y_t indicates each of the real GDP and employment variables and T_t is the value of each of mentioned variables in their long-term trend.

5.2. Extraction of functions and impulse response diagram of inflation and real variables based on VAR model

The impulse response function is used to view the dynamics of each of the three variables of economic growth, employment growth and inflation to the shock to liquidity growth. These functions are derived from vector autoregressive models and are highly sensitive to the order of VAR model. VAR model, which was proposed for the first time by Sims (1980), is generally presented as follows:

$$Y_t = C + A_1 Y_{t-1} + \cdots + A_p Y_{t-p} + U_t \quad (11)$$

So that,
Y: matrix (L × 1) from dependent variables
C: matrix (L × 1) from fixed sentences or exogenous component
A: matrix (L × (L × P)) from coefficients of the model variables
U: matrix (L × 1) from residuals
L: number of dependent variables
P: number of lags

Generally, interpretation of coefficients in estimated VAR models is difficult due to the high number of estimated parameters. That is why often estimation of impulse response function (IRF) and variance analysis is done to evaluate the effect of endogenous variables. Impulse response function indicates the response of an endogenous variable towards changes of one of residuals or stimulation over time. This tool is obtained from vector autoregressive models in form of moving average display. These functions are powerful tools for analyzing dynamic behavior of the model variables while occurring unpredictable shocks in other variables of the model. Considering equation (11) for the VAR model with P lags and L variables, the impulse response function is estimated as below:

$$Y_t = C + A_1 Y_{t-1} + \cdots + A_p Y_{t-p} + U_t = \sum_{i=o}^{\infty} \Phi_i \, U_{t-i} \qquad (12)$$

So that Φ_i is the matrix of moving average coefficients which indicates the size of variables response towards stimulants or blows. More precisely, each elements of this matrix like $\Phi_{jk,i}$ indicates the response of j variable towards a unit of stimulant or blows from variable k in i previous period. In impulse response chart, vertical axis is based on standard deviation of related variable from its' stable trend (not nominal value of variables).

6) Data

The data used in this research are from time series data in time intervals of 1973 to 2012. Variables used in this research are defined in table (1).

Table (1): variables used in the research

Row	Variable	Symbol	Scale
1	Economic growth	RGDP	Percent
2	Employment growth	RL	Percent
3	Inflation	RP	Percent
4	Liquidity growth	RM2	Percent
5	Monetary policy uncertainty	H	Without unit
6	GDP fluctuations	CGDP	Billion Rials, (Constant 2004)
7	Employment fluctuations	CL	Thousand people

Source: Central Bank of the Islamic Republic of Iran

As is clear in table (1), base of all variables is received from Central Bank of the Islamic Republic of Iran. In continue, time process of each of variable is reviewed.

6.1. Gross Domestic Production (GDP)

GDP is one of indexes that expresses many information about economy of a country. The scale of this variable in the present study is billion Rials and constant in 2004. Chart (1) indicates the time process of real GDP. The country's real GDP in the time period of research from 1,000,000 billion in 1973 has reached 2,000,000 billion in 2012 which is double of its' value in 1973; it was so that the average annual growth has been 2.5 percent. The imposed war7 is an obvious reason for the decline of this indicator during the years 1977 to 1988. The lowest rate of real GDP in this period relates to 1981 for which the number 680,000 is registered.

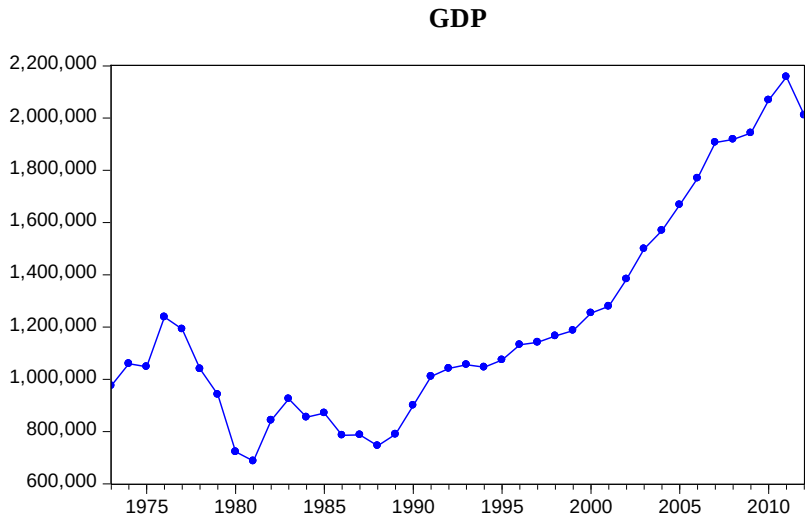

Diagram (1): Process of real GDP with fixed price in 2004 in time period (billion Rials)

The highest annual growth rate of GDP relates to 1982 in which this index has faced a growth of about 22 percent, while, the highest negative growth occurred in 1980 and negative growth of 23 percent returned. After the war, except for 2012 in which GDP had a negative growth of about 6 percent, the average rate of economic growth of the country has been about 4.3 percent from 1989 to 2012. According to the objectives of this study, in reviewing the effect of monetary policy uncertainty on fluctuations of variables, GDP fluctuations are calculated from their long term trend. As mentioned in previous sections, these operations have been implemented via Hodrick and Prescott Filter. Diagram (2) indicates GDP fluctuations along with real values and the value of long term trend. As can be seen in this diagram, during the years 1974 to 1977, the real GDP was higher than its' long term trend and then until 1982, it was lower than its' long term trend. Also in this diagram, the positive fluctuations are evident immediately after the war and negative fluctuations are clear during the years 1988 to 2002. However, the distance from long term trend is much less than the period before finishing the war.

[7] In 1979, after a great revolution, the government of Iran was changed from monarchy to the Islamic Republic. A year later in 1980, Iraq attacked to Iran and this war lasted for eight years.

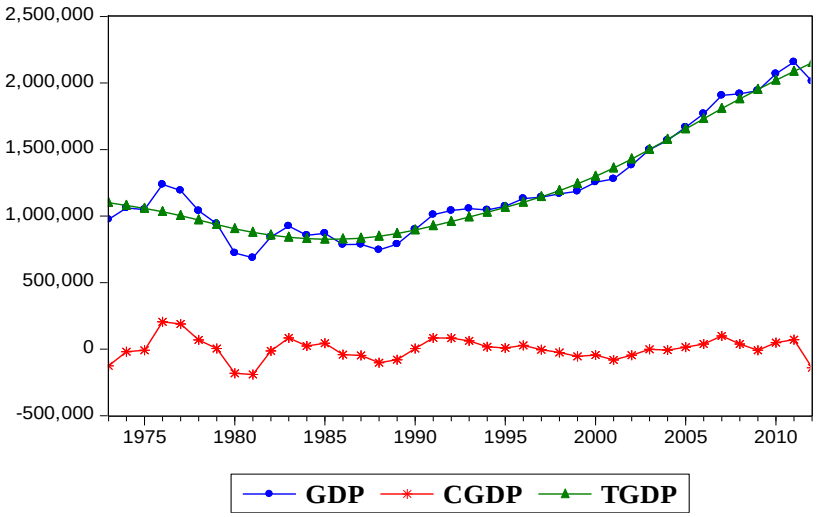

Diagram (2): Time process of the real GDP fluctuations from long term trend (billion Rials)

6.2. Employment

Due to the lack of direct access to data related to employment, in this study, total employment rate of the country is calculated from the following equation:

$$L = AP - u(AP) \tag{13}$$

In which, L is employment, AP is active population and u is unemployment rate. As is clear from diagram (3), distance of the two diagrams of employment and active population has increased over time. This can be due to the sharp increase in active population and increase of unemployment as well. The unemployment rate at the beginning of the period under review was 10.1 percent which reached 12.1 in 2012, while the active population reached 23476 in 2012 from 8900 in 1973. Thus, the country's employment in 193 was equal to 8008 which raised to 20635 in 2012. The number of unemployed people in 2012 was 2841.

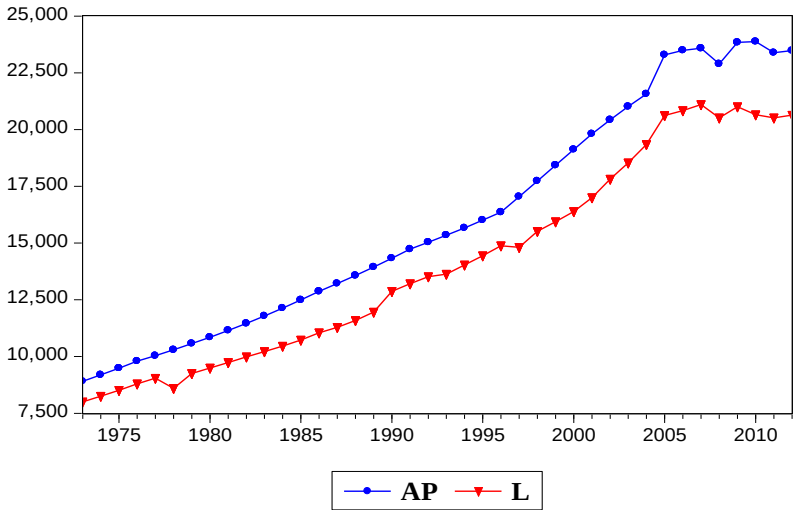

Diagram (3): Time process of active population and employment of the country (in thousands)

According to this data, average rate of employment growth was 2.4 percent per year in the country, however, in 1978, 2008 and 2010, employment growth has been negative. The negative effects of sanctions on the country's employment growth in 2010 is evident. The most positive employment growth in the country returns to the years 1979, 1990 and 2005. Hodric – Prescott filter was also used in order to separate fluctuations of employment from the long term trend. Significant point in this diagram is being similar cycles of employment and GDP, however, its' intensity is different with GDP. In this way, the greatest positive fluctuation in country's employment returns to the period 2004 to 2008 and the greatest negative fluctuation of employment returns to the period 2009 to 2012 so that it has placed lower than long term trend.

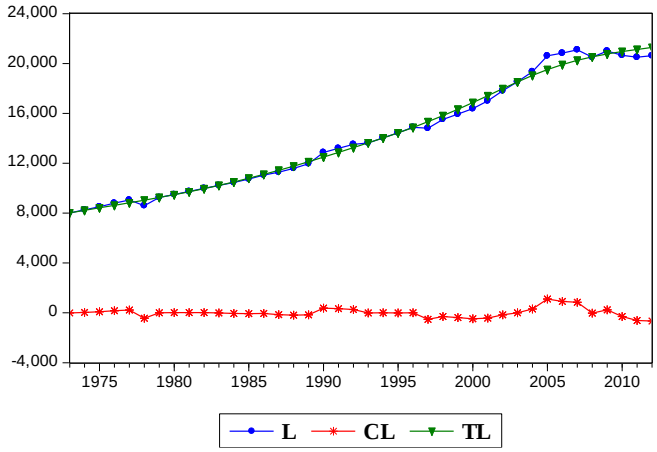

Diagram (4): Time process of employment fluctuations from its' long term trend (in thousands)

6.3. Liquidity

Diagram (5) indicates the liquidity time process of the country based on its' components which means the broad money (currency and checking in people's hand) and quasi-money (long-term deposits). Given that both components of liquidity have been faced with increase, therefore, the country's liquidity has always been facing an increase, so that from 518 billion Rials in 1973 has reached 4606935 billion Rials in 2012. A remarkable point in liquidity components shows that from 1981 to 1987 the broad of money has been more than quasi-money and from 1988 to the end of the period, quasi-money has been sharply more than the broad money to the extent that in 2012, quasi-money was more than three times of the amount of broad money.

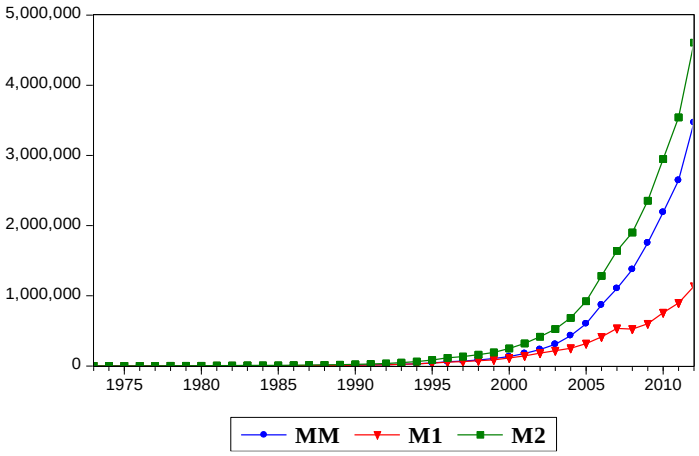

Diagram (5): Time process of the broad money, quasi-money and liquidity of the country (in billion Rials)

Total division of period to period of 1973 to 1985 and 1985 to 2012 indicates the enormous difference of these two periods in the increase of monetary indexes of the country. Diagram (6) shows that in 1984, there was a turning point in the growth of liquidity. As is clear in this picture, liquidity growth rate in 1974 was about 45% which declined to 5 percent in 1984. In other words, it has increased with a reducing rate. After 1984, liquidity increase has been raised with an increasing rate; this trend has been continuing until 1996, so that the liquidity increase with 5 percent growth in 1984, faced with growth of 30 percent in 1996. In 1997, again some policies were taken to reduce the rate of liquidity growth, so that the rate of liquidity growth in this year was about 15 percent and again it was added with an increasing rate. In total, liquidity is an index that has always increased in Iran with very high growth rates.

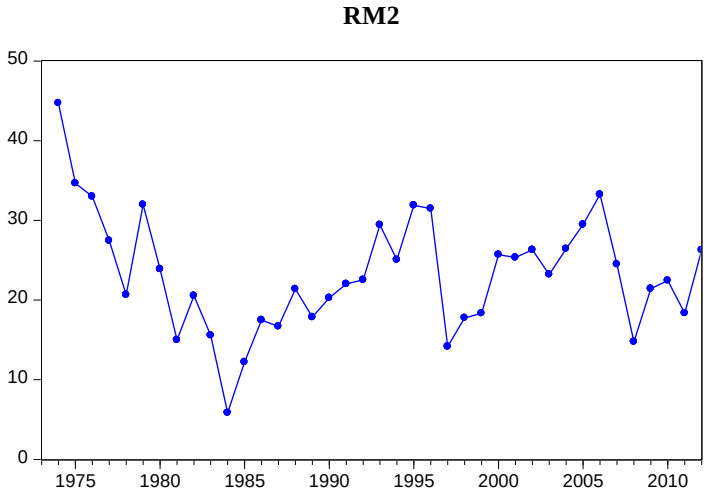

Diagram (6): Time process of liquidity growth (in percent)

6.3.1. Uncertainty of monetary policy

In this research, conditional variance of residuals in average equation of liquidity growth was extracted to introduce a substitute variable for uncertainty of monetary policy using selected model of GARCH family that were described in previous sections. Given that liquidity growth data follow a stochastic time series process, it is necessary to ensure the data to be stationary before estimating the average equation of liquidity growth. The results of Augmented Dickey-Fuller (ADF) test on data of liquidity growth show that these data were Stationary at level. Table (5) indicates the ADF statistic value for this time series along with other variables.

Then, according to the descriptions of previous sections, the time series model of liquidity growth is estimated using autoregressive integrated moving average (ARIMA) process. Given that liquidity growth data are Stationary at level, therefore, in this condition, an ARMA is estimated. Also, the lag orders in this process are determined based on minimum statistic value of Schwarz information criterion (SIC) according to table (2).

Table (2): Selecting the average equation based on Schwarz statistic

AR MA	0	1	2
0	-	6.680	6.774
1	6.705	6.774	6.820
2	6.794	6.842	6.893

Source: The study findings

Based on the values of table (2), the process AR (1) has the least amount of Schwarz's criteria, but since this process has not a heteroskedasticity, extracting conditional variance for explaining uncertainty of liquidity growth is not possible. That is why here the process MA (1), which has the lowest value after the process AR (1) based on Schwarz Information Criterion and also has Heteroskedasticity, is used as the most suitable average equation for extracting conditional variance time series of liquidity growth. Table (3) indicates heteroskedasticity in MA (1) which is estimated using the test of ARCH effects.

Table (3): Results of ARCH test for MA (1) process

Statistic	χ^2		F	
Lag	Value	Probability	Value	Probability
1	5.228	0.022	5.743	0.021
2	12.887	0.001	9.086	0.0007

Source: The study findings

According to the results of table (3), null hypothesis of constant conditional variance of residuals in MA (1) process is reviewed up to 2 lags and has been rejected in both lags without exception. Hence, with a confidence level higher than 95%, the existence of Heteroskedasticity in residuals of the equation of liquidity growth is confirmed. So, using the models of GARCH family is justifiable for estimating conditional variance of residuals of MA (1). The results of estimation of mentioned models are given in table (4).

Table (4): Estimating conditional variance of liquidity growth using models of GARCH family

Variable	**GARCH**	**TGARCH**	**EGARCH**
α_0	4.961	10.328	3.109
	(0.070)	(0.324)	(0.000)
α_1	-0.252	-0.168	-1.506
	(0.191)	(0.341)	(0.000)
β_1	1.079	-0.131	0.245
	(0.001)	(0.726)	(0.178)
γ_1	-	0.844	0.434
		(0.056)	(0.000)

Source: the study findings

Based on the results of table (4), in GARCH model, α_1 the coefficient related to ε_{t-1}^2 have been negative, thus, the limitation of being non-negative of coefficients in GARCH model is not achieved. Given that significance of coefficients is not achieved in TGARCH model, the predictability power of this model will also be very low. Nevertheless, EGARCH model is selected as the most appropriate model to estimate and extract the variable of conditional variance of liquidity growth in Iran due to the significance of coefficients in EGARCH model and non-mandatory of the condition of being non-negative of coefficients in it. However, in estimated EGARCH model, β_1 the coefficient related to h_{t-1} have not become significant in

common probable levels in statistics and econometric, but being positive of this coefficient indicates non-damping of monetary policy uncertainty. It means that uncertainty of monetary policy in Iran is transmitted from one period to the next. In addition, significance of γ_1 the coefficient related to asymmetry in EGARCH model confirms the asymmetric effect of positive and negative shocks to liquidity growth on uncertainty of monetary policy.

Diagram (7) indicates the conditional variance of liquidity growth as constitute for uncertainty of Iran's monetary policy which is estimated using EGARCH model. Based on this diagram, liquidity growth has faced the most uncertainty in the years 1974, 1979, 1983, 1995, 1997 and 2012 and in the period 1985 to 1992 has had the lowest uncertainty.

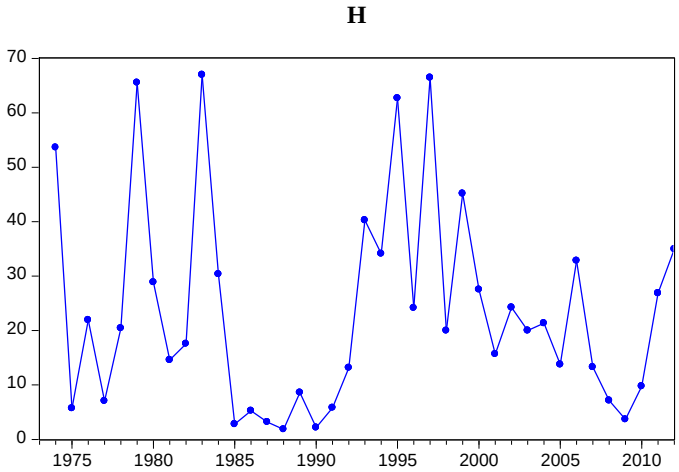

Diagram (7): Time period of conditional variance of liquidity growth as uncertainty index of monetary policy

6.4. Inflation

Inflation is a status in which the level of general prices is increasing constantly and gradually. In this research, the rate of inflation is calculated based on consumer price index. As seen in diagram (8), inflation in Iran has been always positive. The average of inflation rate in Iran under the study period was 16.5 percent. The lowest inflation rate in this period relates to the year 1974 in which the inflation rate is equal to zero percent and the highest inflation rate relates to the year 1995 which experienced the rate of 49.5 percent. In reviewing period, just in the years 1974, 1979, 1984, 1985 and 1990, the inflation rate was single-digit and in other cases, the country's inflation has been double-digit.

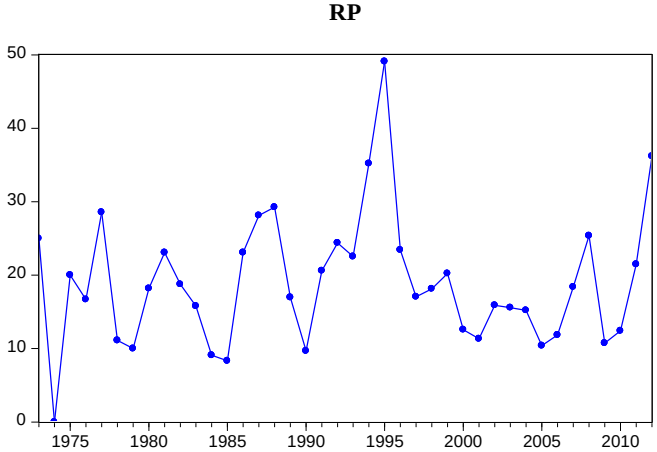

Diagram (8): Time process of the country's inflation (in percent)

7) Static test

Each stationary series of data means that the mean, variance and covariance series are not a function of time. If this is not true, a false or spurious regression is created from estimation of regressive equation. In the present study, according to time series characteristics, Augmented Dickey-Fuller method is used for data stationary test. The results of this test are given in table (5).

Table (5): stationary test of the research variables by Augmented Dickey-Fuller method

Variable	Dickey - Fuller Statistic	Probability of null hypothesis	Results
H	-3.031	0.041	Stationary
CGDP	-4.374	0.001	Stationary
CL	-3.123	0.033	Stationary
RM2	-4.068	0.003	Stationary
RL	-6.062	0.000	Stationary
RGDP	-4.290	0.001	Stationary
RP	-4.168	0.002	Stationary

Source: the study findings

According to the results of table (5), all parameters used in this research were stationary at level, thus, estimations in the next parts are not obtained from false regressions.

8. Causal analysis of monetary policy uncertainties and the research variables

In this section, the causal relationship of monetary policy uncertainty on GDP fluctuations, employment fluctuations and inflation are considered. To this purpose, a conditional variance of liquidity growth extracted from an EGARCH model is used as monetary policy uncertainty. Table (6) has provided the results of Granger causality test.

Table (6): Granger causality test to review the causal relationship between the research variables

Null hypothesis	F Statistic	Probability of null hypothesis
Monetary policy uncertainty is not Granger causality of GDP fluctuations	3.248	0.078
Monetary policy uncertainty is not Granger causality of employment fluctuations	2.144	0.103
Monetary policy uncertainty is not Granger causality of inflation	2.128	0.097

Source: the study findings

Granger causality test results in Table (6) show that the null hypothesis of all tests stating that monetary policy uncertainty is not Granger causality of GDP fluctuations, employment fluctuations and inflation, is rejected at significant level of 10 percent (with 90% confidence). In

other words, according to this result, uncertainty of monetary policy can be a disorder factor in three main variables of macroeconomic in the country. In Iran, disorders from the type of uncertainties of monetary policy in addition to the effect on price level, can also be an agent of fluctuations of real product and employment in the economy.

9. Dynamics of the research variables response to monetary policy shocks

In this stage, chart of impulse response function of each variable towards the shock to liquidity growth is extracted and examined. These charts indicate the size and timing of response of the pattern variables including economic growth, employment growth and inflation against a unit (standard deviation) of shock or momentum to liquidity growth separately. In this way, manner and extent of each variable response to the shocks to liquidity growth is determined as another index of monetary disorder in this research. Given that impulse response functions are highly sensitive to the order of vector autoregressive, so, obtained dynamics are estimated in optimal lag of VAR models. The results of this research show that the value of Akaike information criterion (AIC) in optimal lag was equal to 24.591, and thus the lag one is recommended as optimal lag for the model. It is noteworthy that the largest root of the model VAR (1) is equal to 0.934. Hence, estimating the VAR model has a static condition and its' results will be satisfactory. Thus, the reaction of economic growth, employment growth and inflation rate to the shock entered to liquidity growth will be in form of Diagrams (9), (10) and (11).

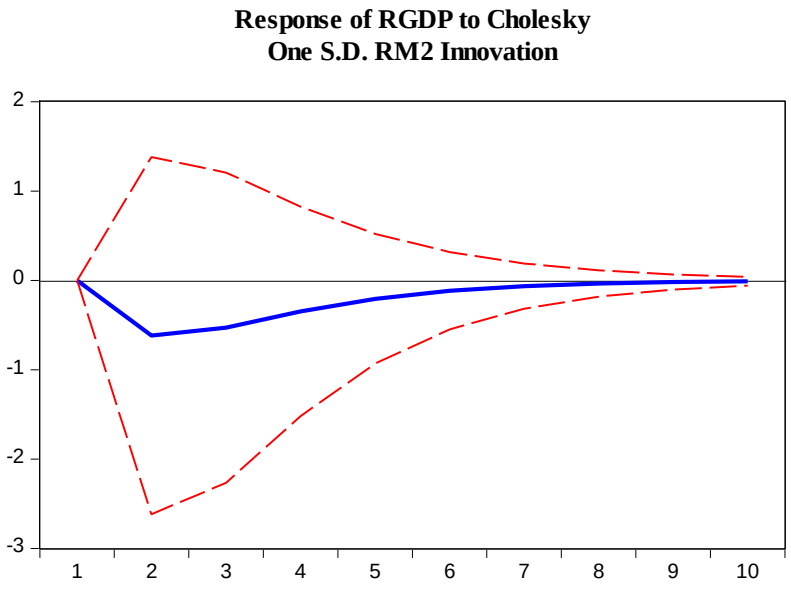

Diagram (9): Response of economic growth to the shock entered to liquidity growth

As is shown in diagram (9), short time and single period response of economic growth is negative to the shock to liquidity growth. In other words, if a shock with one standard deviation is entered to liquidity growth, it will reduce the economic growth after a period. The impact of this shock on economic growth reduction will continue to six periods and then will be fully moderated.

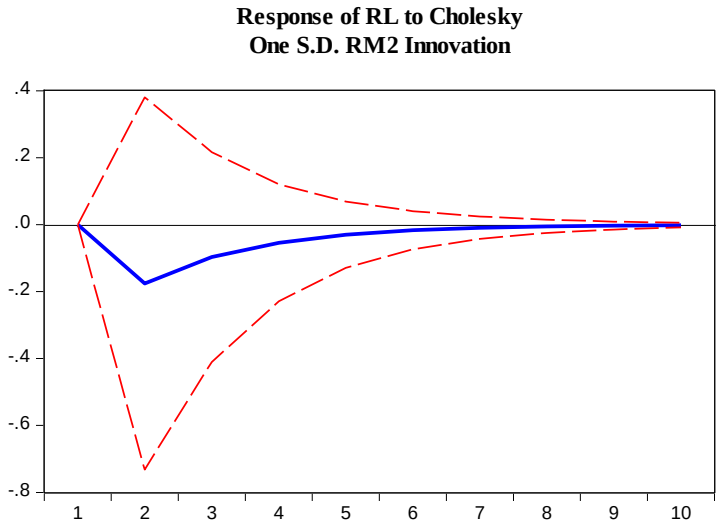

Diagram (10): Response of employment growth to shock to liquidity growth

Estimation results in diagram (10) show that dynamics and response of employment growth to the shock entered to liquidity growth is exactly similar to economic growth and a kind of same direction between employment growth and economic growth, so that the employment growth response to the shock with a size of one SD entered to liquidity growth within a period is negative and reducing. However, sensitivity of economic growth to the shock entered to liquidity growth is sharply more than the response of employment growth. This result is not far-fetched, because a large part of Iran's economy is governmental and according to the contracts, employment is not amended to the speed of product reduction. Also, it should be noted that negative response of GDP growth and employment to the shock entered to liquidity growth doesn't mean the reduction of the level of these variables, but also their growth rate is reduced. As economic growth, here it also takes about 6 period to eliminate completely the effect of shock. This way, the monetary disorders from the type of the shock to liquidity growth affect economic real variables in short term, but its' effects in long term is fully adjusted and will have no effect on growth of economic real variables.

According to slash tapes specified on both sides of the dynamics of employment growth and economic growth, it can be concluded that variance and negative fluctuations in economic growth is more compared with employment growth over the shock to liquidity growth. Therefore, vulnerability of economic growth in poor decisions on displaced monetary policy about liquidity determination is evident in the country.

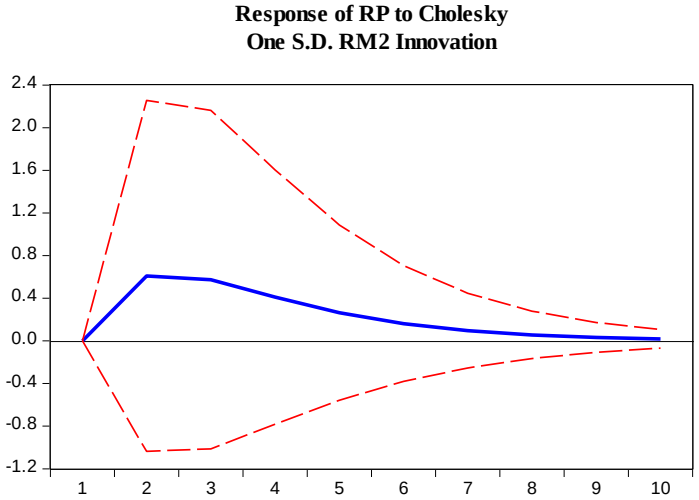

Diagram (11): Response of inflation towards shock to liquidity growth

The estimation of impulse response function in the diagram (11) shows that the inflation response to the shock to liquidity growth is exactly in the opposite direction of employment growth and economic growth. So that by a shock to liquidity growth with one SD, inflation will be increased after a period. The effect of this shock on inflation in Iran lasts about 9 period and after that completely is eliminated.

10) Summary and Conclusion

Although many studies have been conducted on the impact of fiscal and monetary policies on real economy of Iran, few studies have focused on the role monetary disorders in forming business cycles in Iran. In this study, we evaluated the effect of monetary disorders in form of uncertainties and shocks from monetary policies on economic real variables including real GDP, employment and inflation. Most of the research variables were not received directly from one database and they were calculated using some mathematical and econometric relations. Then, stationary test was done using ADF method to ensure the absence of pseudo regressions and the results indicate that all the variables were stationary at level. In continue, Granger causality was done for evaluation between GDP fluctuations, employment fluctuations and inflation which in this research was extracted from time series conditional variance of liquidity growth derived from an EGARCH model. The results of this test show a one way causal relationship from monetary policy uncertainty to three mentioned variables. In the last stage, the dynamics of the response of economic growth, employment growth and inflation to the shock to liquidity growth to one SD were estimated. Estimation results showed negative and same direction of economic growth and employment growth and positive response of inflation to the shock to liquidity growth after a period. Accordingly, the hypothesis of the effect of monetary disorders on business cycles in Iran's economy cannot be ignored in the research period.

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