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Effect of Credit Easing Policy on Recovery of Iran's Economy: Stochastic Dynamic General Equilibrium Model Approach

Mohseni, H.[1], Shahiki Tash, M. N.[2], Pahlavani, M.[3], Mirjalili, S. H.[4]

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Abstract

By utilizing the new Keynesian stochastic dynamic general equilibrium model, this paper examines the effects of credit easing policy on macroeconomic variables with or emphasizing on production. For this purpose, a model has been design including 5 sectors of household, enterprises, banks, government and central bank. Considering the dominance of fiscal policy over monetary policy in the Iranian economy, the integrated constraint of the government and the central bank has been used. The model has been estimated using Bayesian method and quarterly time series data during 1991 to 2017. The results of Impulse Response Function show that implementation of this policy has increased consumption, investment, government spending and ultimately production, which indicates the effectiveness of this unconventional monetary policy to get the economy out of recession. Also, in response to the positive impulse of the central bank's credit line to banks and the negative impulse of legal reserves, bank facilities increase, which is in line with theoretical expectations. The impact of the negative impulse of interbank market rate has also led to an increase in production credits.

Keywords: Recession, Credit Easing, DSGE Model, Credit Line, Bayesian Method.
JEL Classification: E12, E42, E58.

1. Ph.D. in Economics, Department of Economics University of Sistan and Baluchestan, Faculty of Economic and Management, Zahedan, Iran.
2. Associate Professor, Department of Economics, Faculty of Economics and Management, University of Sistan and Baluchistan, Zahedan, Iran (Corresponding Author).
Email: mohammad_tash@eco.usb.ac.ir
3. Associate Professor, Department of Economics, Faculty of Economics and Management, University of Sistan and Baluchistan, Zahedan, Iran.
4. Professor of Economics, Faculty of Economics, Institute of Humanities and Cultural Studies, Tehran, Iran.

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1. Introduction

From the mid-2001s to 2019, the Iranian economy has faced several recession during the years 2007-2008, 2010-2011, 2014-2015 and 2018-2019. Comparison of GDP components in different economic activities shows that the negative growth of the agricultural sector and the decline in oil production and exports caused a significant reduction in GDP growth in 2007-2008. The significant and unprecedented decrease in GDP growth in the years 2010-2011 was due to exchange rate fluctuations and increased international sanctions. The economic growth in Iran in 2011, including oil production, has been reported at -8.6%. In 2014, a positive economic growth was experienced and a rate of 2.3% was recorded for GDP growth, including oil production. Economic growth in 2015 decreased again to -0.1% and marked the third economic recession during the years 2006 to 2015. In 2019, after two periods of positive GDP growth, the GDP growth was reported as -6.9% (Fig 1).

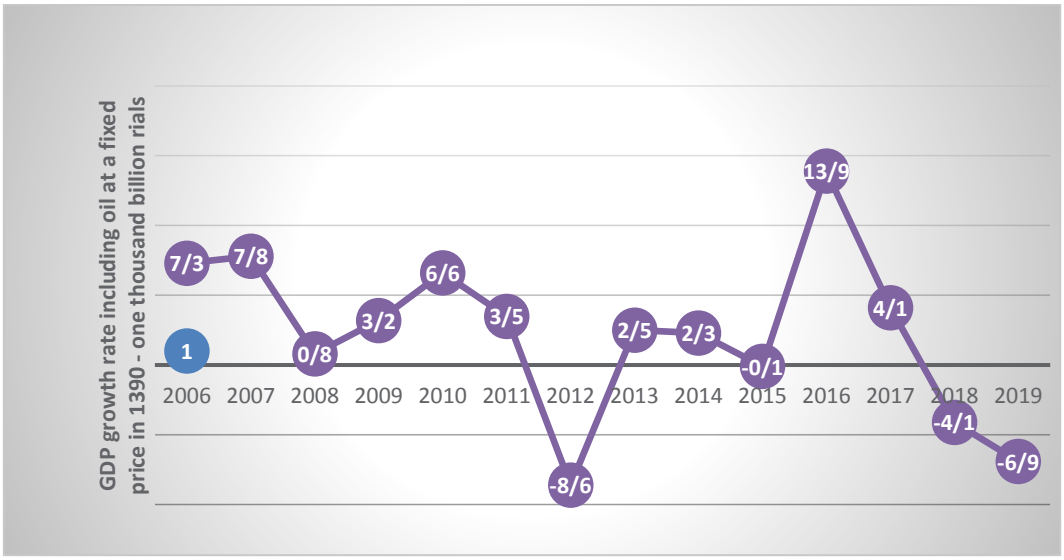

Fig. 1: Business cycles in the Iranian economy during the period 2006-2019 (Source: Central Bank of Iran, data site).

In the financial crisis of 2007-2009, central banks adopted unconventional monetary policies such as credit easing to exit the recession. One of the features of the new monetary policy tools is the use of the central bank balance sheet (by providing the necessary liquidity for lending to financial institutions), which requires the expansion of the "assets" column of the central bank balance sheet, while the Quantitative Easing Policy is focused on the central bank's liabilities column in the balance sheet. The purpose of credit easing is to support the

performance of financial markets, especially during a crisis, and to provide additional financial resources to the economy during a recession. According to the Fed, credit easing complements central banks' monetary policy by providing financial assets and stimulating turbulent markets during financial crises. In the global financial crisis, the Fed made the lending process easier to prevent banks from going bankrupt. Their solution during the crisis was to provide more credit (auction mechanism) by a combination of more available collaterals, which was known as a credit easing. Credit easing is actually providing liquidity through the following: lending to financial institutions, providing liquidity to major credit markets, and buying long-term bonds.

Given the recessionary conditions faced by the Iranian economy in recent years, measures taken by the Iranian Central Bank to ease credit provision in order to exit the recession and recovery included reduced statutory reserve requirement rate, reduced interbank market rate and the central bank credit line for the banks. In this study, we examined the effect of central bank credit easing on macroeconomic variables (investment and national product, bank lending, liquidity, inflation and exchange rate).

In this study, in order to analyze the effect of credit easing, we employed the DSGE model and quarterly data in the period 1991 to 2017. Section 2 provides literature review and the necessity of conducting the research. In Section 3, the theoretical background, model specification and test results are reported. In Section 4, the effects of credit easing on the Iranian economy and overcoming recession are examined. Section 5 is devoted to conclusions and suggestions.

2. Instruments of credit easing policy in Iran

The most important tools of credit easing policy in Iran to finance investment and productive activities in a recession are as follows:

2-1. The credit line of the Central Bank to the banks:

The credit line of the Central Bank to the banks is in fact the claims of the Central Bank from the banks, which, in the periodic financial reports, are recorded in the balance sheet of the Central Bank as assets and in the balance sheets of the banks as liabilities.

Using central bank resources in the form of overdrafts requires an additional penalty clause of the banks from the central bank at the rate of 34%, which was turned into a credit line with a lower rate by the central bank in the credit easing policy. The Central Bank has reduced the overdraft penalty rate by implementing the credit easing policy in order to increase the banks' resources to provide more

facilities and increase production. Accordingly, banks will be fined for overdraft at a rate of 16% with the collateral and at a rate of 18% without[1].

Table 1: The credit line of the Central Bank to the banks

	balance			Balance growth at the end of the year	
	August 2019	February 2019	August 2020	August 2020 to the August 2019	August 2020 to the February 2019
Central bank receivables from banks	1218.8	1106.9	1291.9	6.0	16.7

Source: Balance Sheet of the Central Bank of the Islamic Republic of Iran, 2020, pages 4 and 5.

2-2. Reducing the statutory reserve requirement rate

Reducing the statutory reserve requirement rate is one of the credit easing measures employed by the Central Bank. Banks are required to deposit a proportion of their debts (amounts received from the public as deposits) with the central bank. Since the fourth quarter of 2015, the statutory deposit rate of banks and credit institutions was determined to be between 10% and 13% based on performance, and the Central Bank has set different ratios for them depending on the combination and type of activities of the banks.

Reduction of the statutory reserve requirement rate has provided the banks with 177.610.0 billion Rial during the years 2008-2017 for lending and credit.

Table 2: Reducing the statutory reserve requirement rate

Title	2008	2009	2010	2011	2012	2013	2014
	rate						
current account	20/۰٪	17/۰٪	17/۰٪	13/5%	13/۰٪	13/۰٪	13/۰٪
deposit account	12/۰٪	10/۰٪	10/۰٪	10/۰٪	10/۰٪	10/۰٪	10/۰٪
saving account	17/۰٪	16/۰٪	15/5%	13/5%	13/۰٪	13/۰٪	13/۰٪

[1]. Report of the Monetary and Credit Council on the policy-regulatory criteria of the country's banking operations.

Cash Deposit Guarantees (Public and Private Sector)	20/۰٪	17/۰٪	17/۰٪	13/5%	13/۰٪	13/۰٪	13/۰٪
Letter of credits (public and private sector)	20/۰٪	17/۰٪	17/۰٪	13/5%	13/۰٪	13/۰٪	13/۰٪
Deposit (billion Tomans)	194328	242444	318767	819276	1061901	1272836	1646405
Deposits after deducting statutory deposit (billion Tomans)	167577	213162	282318	725703	957393	1137409	1474188
The ratio of total deposits to deposits after deduction of statutory deposit (percentage)	86	88	89	89	90	89/5	89/5
Changes in resources released as a result of the reduction in statutory reserve requirement	-	4848	9563	24578	42476	44549	51596

Source: Central Bank of Iran data site.

2-3. Reduction in the interbank market rate

The interbank market is one of the components of the money market and bank financing methods that allows transactions between banks and tries to meet their short-term needs by using surplus resources of one another, eliminating the need to refer to the central bank. In these markets, borrowing is performed through interbank interest rates. The interbank market offers two important functions in financial systems. First, it causes the central bank to play an active and effective role in the implementation of monetary policy by managing interest rates, and second, it causes the transfer of liquidity in a favorable manner from financial institutions with surplus funds to financial institutions with deficit funds. Changes in interbank market interest rates can be effectively increase and decrease bank interest rates. In recent years, the central bank has implemented a credit easing policy by reducing interbank interest rates, thereby making it easier for banks to provide funds and facilities.

Table 3. Summary of interbank market performance

Year	Transaction volume (billion Rials)	Interest rate (percentage)	Number of transactions (Item)
2009	120020	15.5	210
2010	435299	14.4	1258
2011	1400041	18.2	3544
2012	1213200	21.4	2110
2013	3110219	23.02	5886
2014	11389544	27	17370
2015	21969148	24.47	22975
2016	30957154	18.62	31403
2017	64055680	18.69	38101
2018	107149635	19.72	40663
2019	18688200	18.95	40341

Source: Central Bank of Iran, data site.

3. Theoretical background and literature review

Since the global financial crisis, which pushed the world economy into a deep recession, central banks have cut short-term interest rates to near zero to exit the recession, while also using unconventional monetary policies, including credit easing. The main goal of policymakers was first to help interbank and credit markets and then help the economy as a whole to prevent the cease of lending activities and production reduction (Marco Bruno, 2015). The need for an unconventional monetary policy also becomes apparent when, for some reason, the central bank is unable to further reduce the nominal interest rate and therefore uses other tools to determine its monetary policy stance.

Highlights and distinctions of the current research are as follows:

1- Using credit easing as an unconventional monetary policy in the country

2- Using a DSGE model and examining the instantaneous response of shocks to the recessionary gap in the Iranian economy

3- Using the combined constraint of the government and the central bank due to the lack of independence of the central bank and the dominance of fiscal policy over monetary policy in the Iranian economy.

Mirjalili (2016) examined "A Comparative Study of Conventional vs. Unconventional Monetary Policies", and introduced credit easing as an unconventional monetary policy, which has been used as a tool to get out of the recession after the global financial crisis. Major central banks used

unconventional monetary policy tools during the global financial crisis to exit the recession, and pursued monetary policy through quantitative easing, credit easing, and bank reserve changes.

Woodford (2003) states that until 2003, few central banks directly regulated the flow of capital through markets and financial institutions, but used credit controls or other methods. Until then, such controls were believed to divert relative budget expenditures to different sectors of the economy, affecting the overall interests of central banks. Recent events have led to important unconventional monetary policies.

Woodford and Cordia (2010) state that, given the recession caused by the global financial crisis, conventional monetary policies are insufficient to stabilize economic growth and enhance the GDP. Credit easing has been effective in developing economies during the global financial crisis of 2008-2009.

Jacome (2012) describes the use of credit easing as one of the most unconventional monetary policies in Latin America, as many central banks employed credit easing during the global financial crisis. The purpose of implementing this policy is to stabilize the financial system in order to prevent the collapse of financial markets and thus prevent a sharp decline in production.

A study by Ishi et al. (2009) also showed that in emerging and developing economies, credit easing has been used to reduce financial risk in the banking system at times of crisis. The experience of countries in the field of credit easing shows that it has been effective in strengthening economic activity.

Khalid EI-Fayoumi (2019) examined the effect of credit easing on employment and production in the United States and calculate the interaction between financial friction and the labor market using the SVAR model, which includes heterogeneous companies and a financial sector. He shows that the effect of credit fluctuations on employment growth is more severe for industries that face higher borrowing costs. In industries that are included in credit easing policies prefer to create assets, thereby reducing the recession. The results indicate that credit easing should not target companies that have a high potential for hiring or paying higher wages, so as not to put pressure on the workforce.

Jacome et al. (2018) examined whether credit easing is a monetary policy tool to deal with banking crises in emerging economies. They find that emerging and developing economies should be cautious when using credit easing, as they may lead to increased liquidity and inflation and higher exchange rates in the economy.

William (2015) explores the effect of lower bank interest rates, as a credit easing policy tool, on the composition and size of the Federal Reserve balance

sheet assets. The results show that in the financial crisis of 2007-2009, the implementation of credit easing policy has prevented financial collapse.

Bruno (2015), examined the effect of unconventional monetary policy and evaluates credit and quantitative easing tools as components of unconventional policy as well as the portfolio rebalancing channel. Since the oil crisis of the 1970s and the Great Depression, economists have focused on ways to account for the effects of these shocks and crises on the transmission of monetary policy and the real sector of the economy. The model includes households, Firms, and the integration of government and the central bank. The results of the new Keynesian DSGE model, indicate that unconventional monetary policies has affected the real sector of the economy.

Berkmen (2012), explored the impact of Credit and Quantitative Easing by the Bank of JapanUsing the structural VAR model. The results indicated that the credit easing measures of the Bank of Japan (Central Bank) during 1998-2010 affected economic activities. This study leads to better results than the studies conducted before 2006 in Japan and considers the credit easing as a policy with good results in the banking sector and in big corporations.

Gertler and Karadi (2009),investigated Unconventional Monetary Policy using DSGE model to evaluate the effects of central bank measures to deal with the financial crisis. The central bank, as a financial intermediary, raises more capital than the private sector by issuing government risk-free debt, and also raises balance sheet restrictions for the private sector, thereby it increases benefits from intermediation. They conclude that even if the central bank's intermediation profit was reduced to zero, they could make a profit by implementing an unconventional monetary policy.

Mohseni et al. (2019) investigated the effect of credit easing policy on economic variables using the VAR model. They estimated the variables of immediate action and reaction in the period 2005-2006. The results show a positive and significant effect of credit easing on GDP growth, private sector investment and non-oil exports as well. This will reduce the unemployment rate and the exchange rate too. They also indicated that if the credit easing policy is strengthens, it will be accompanied by improvements in the banking system and increased investment in the economy.

Akhbari and Gholizadeh (2017), explored quantitative easing policy as a kind of unconventional monetary policy during the recession. They find that the implementation of unconventional monetary policy is common due to the effectiveness of policy instruments. The necessity of this policy and its effectiveness depends on macroeconomic conditions, the tools available to the central bank and the economic structure of the implementing countries. The

results indicate that the establishment of appropriate institutional mechanisms and the identification of eligible firms can transfer financial resources to productive economic activities.

Mehrabian and Shafaei (2010) examined the effect of bank loans on economic growth. In this regard, they employed the VAR model and data from 1980 to 2008. The results indicated that granting loans to the non-governmental sector have a positive effect on the economic growth.

4. Methodology

As aforementioned earlier, whenever the monetary policy transmission channel is disrupted, conventional monetary policy instruments will not be effective enough to achieve macroeconomic goals. In such circumstances, central banks will be able to achieve macroeconomic goals through unconventional monetary policies. On the other hand, considering the structure and mechanism of the Central Bank in Iran, the most important credit easing tools available to policymakers in Iran include Central Bank credit line to banks, reduction of the interbank market rate and reduction of the statutory deposit rate. The outcome of this policy has been tested empirically using the new Keynesian DSGE model for the Iranian economy.

The DSGE model consists of five sections: household, enterprise, banks, government and central bank. Due to the fiscal dominance over monetary policy, we employed a consolidated constraint of government and central bank. To clarify the household sector, the study of Hollander and Liu (2016) has been used and the household utility function and its constraints have been adjusted according to the needs of the present study. For the definition of the banking sector,we benefited from Atta-Mensah and Dib (2008), Gerali et al. (2010), Hollander and Liu (2016) and Falagiarda and Saia (2017). For the government and its integration constraint with the Central Bank, the approaches of Falagiarda and Saia (2017) and Khiabani and Amiri (2014) have been followed. Taghipour (2014) used to model the National Development Fund. in designing the DSGE model, the Bruno (2015) has been followed and considering the fact that the monetary and financial structure of the country have distinct features, we made adjustments in Bruno (2015) model structure. First, with the dependence of the country's economy on oil revenues, these revenues, like tax revenues, bonds and government expenditures, have been consolidated between the government and the central bank. Second, since part of the oil revenues are deposited in the National Development Fund, in times of recession it can be used for the implementation of credit easing policy. Third, by adding the banking sector alongside the government-central bank consolidation clause, it is possible to examine changes in banks' statutory reserves as another

tool of credit easing policy, which is not a feature of the Bruno (2015) study. Fourth, in the household utility function, in addition to consumption, money retention and leisure, the issue of household utilization from bank deposits is also included, which is not included in the utility function of the Bruno (2015). Fifth, Bruno's (2015) study used the Rotemberg (1982) approach to model price stickiness, but in this study, we used calvo (1983) for the pricing mechanism.

- Households

Given that the household seeks to maximize utility, first the discounted inter-period utility function is defined for the household:

$$E_t \sum_{t=0}^{\infty} \beta^t \varepsilon_t^{\beta} \left\{ \frac{1}{1-\sigma_c}(C_t)^{1-\sigma_c} - \frac{1}{1+\sigma_N}(N_t)^{1+\sigma_N} + \frac{\kappa_M}{1+\sigma_M}(M_t)^{1+\sigma_M} + \hbar_t^D \ln(\frac{D_t}{P_t}) \right\}$$

In this utility function, the household gains utility from consumption(C_t), holding real money balance(M_t) and bank deposit as a financial asset(D_t) and loses utility by working(N_t) . Also, $\hbar_t^D$ the level of bank deposits in the household investment portfolio, the factor of mental discount with the parameter β shown and σ_c the inter-period consumption elasticity; σ_N the inverse of labor force elasticity; σ_M inverse of cash balance elasticity; κ_M liquidity preference coefficient and ε_t^{β} the momentum of household preferences. On the other hand, the household budget constraint to which the utility function is optimized is also specified as follows:

$$C_t + \frac{p_t^I}{p_t} I_t + \frac{M_t}{P_t} + \frac{B_t}{P_t} + \frac{D_t}{P_t} + \frac{i_{t-1}^l L_{t-1}}{p_t} + T_t = \frac{W_t}{P_t} N_t + R_{t-1}^b \frac{B_{t-1}}{P_t} + \frac{M_{t-1}}{P_t} + \frac{i_{t-1}^d D_{t-1}}{P_t} + \frac{L_t}{P_t} + r_t^k K_t + \Pi_t \quad (2)$$

The household budget constraint indicates that the total household income and expenditure must be equal. The left-hand side of Eq(2) represents expenditures (C_t), investment ($\frac{p_t^I}{p_t} I_t$), liquidity balance ($\frac{M_t}{P_t}$), purchase of bonds ($\frac{B_t}{P_t}$), deposits ($\frac{D_t}{P_t}$) , repayment of loan received in the previous period($\frac{i_{t-1}^l L_{t-1}}{p_t}$) and tax payments($T$), which are financed by household income through on the right-hand side of Eq. (2), including the supply of labor($\frac{W_t}{P_t} N_t$), interest of bonds of

the previous period($R^b_{t-1}\frac{B_{t-1}}{P_t}$), liquidity of the previous period($\frac{M_{t-1}}{P_t}$), income from deposits in the previous period($\frac{i^d_{t-1}D_{t-1}}{P_t}$), loan receipt in the current period ($\frac{L_t}{P_t}$) , capital income($r^k_t K_t$) and other household incomes from the economic activity of system enterprises in the economy(Π_t). Also, households in each time period are faced with the equation of physical capital formation. According to the literature, the subject of general equilibrium models is specified as follows:

$$K_t = (1-\delta)K_{t-1} + [1 - S(\frac{I_t}{I_{t-1}})]I_t \qquad (3)$$

In Equation (3), while δ representing the depreciation of fixed capital, it $S(\frac{I_t}{I_{t-1}})$ also represents the investment cost adjustment function that depends on the current investment and its interruption. The cost mediating function is convex and incremental, which indicates that it is costly to change the level of investment (Christiano et a, 2004). After examining the problem of household optimization and specifying the structure of the utility function and the constraints of household progress, the Lagrange function is specified as Eq. (4) for extracting the first-order conditions resulting from the optimization process, in which, the first-order conditions are extracted through investment, capital stock, labor, consumption, bonds, money demand and bank deposit supply and linearized using the Taylor expansion process of logarithmic equations.

$$\begin{aligned}\ell_t = {} & E_t\sum_{t=0}^{\infty}\beta^t\varepsilon_t^{\beta}\left\{\frac{1}{1-\sigma_c}(C_t)^{1-\sigma_c} - \frac{1}{1+\sigma_N}(N_t)^{1+\sigma_N} + \frac{\kappa_M}{1+\sigma_M}(M_t)^{1+\sigma_M} + \hbar_t^D \ln(\frac{D_t}{P_t})\right\} \\ & + \lambda_t\left[\begin{array}{l}\frac{W_t}{P_t}N_t + R^b_{t-1}\frac{B_{t-1}}{P_t} + \frac{M_{t-1}}{P_t} + \frac{i^d_{t-1}D_{t-1}}{P_t} + \frac{L_t}{P_t} + r^k_t K_t + \Pi_t \\ -C_t - \frac{p^I_t}{p_t}I_t - \frac{M_t}{P_t} - \frac{B_t}{P_t} - \frac{D_t}{P_t} - \frac{i^l_{t-1}L_{t-1}}{p_t} - T\end{array}\right] \\ & + Q_t\left[(1-\delta)K_{t-1} + [1 - S(\frac{I_t}{I_{t-1}})]I_t - K_t\right]\end{aligned} \qquad (4)$$

- Firms

In order to clarify the mechanism of firms from the New Keynesian point of view, a chain of firms producing intermediate goods in an environment of monopoly competition is considered whose goods are demanded by the

companies producing the final goods and are offered to the consumers as the final goods. Therefore, the intermediate goods are combined under a Dixit-Stiglitz collector and offered as the final product. This issue can be specified as follows:

$$Y_t = [\int_0^1 (Y_t^i)^{\frac{1}{1+\varepsilon_t^p}} di]^{1+\varepsilon_t^p} \tag{5}$$

Where Y_t^i is the amount of production of the i^{th} firm and ε_t^p indicates the elasticity of substitution between different goods in the current period and in the context of monopolistic competition. These firms minimize costs according to the use of intermediate inputs. Therefore, the optimization process will be performed by minimizing the cost function in Eq. (6) relative to the constraint specified in Eq. (5).

$$\min_{Y_t^i} \int_0^1 P_t^i Y_t^i di \tag{6}$$

According to the New Keynesian perspective, it is also assumed that the intermediary producer uses a combination of capital and labor inputs in the production process, which is specified in the Cobb-Douglas production function:

$$Y_t = A_t (K_{t-1})^{\alpha} (\mathrm{N}_t)^{1-\alpha} - \Phi \tag{7}$$

While (Φ) represents the firm's fixed cost, A_t also represents the productivity momentum that follows a first-order autoregressive process. The problem of optimizing the intermediate goods firm is minimization of the cost of the firm, taking into account the constraint of the production function in which the firm pays the rent(r_t^k) and wages (W_t) for using capital(K_t) and labor (N_t), respectively:

$$\min_{N_t, \mathrm{K}_{t-1}} \frac{W_t N_t}{P_t^d} + r_t^k K_{t-1} \tag{8}$$

In the following, by forming the Lagrange function and performing the optimization process, the first-order conditions are extracted in relation to capital and labor, and the Lagrange function is specified as follows:

$$l_t = \frac{W_t N_t}{P_t^d} + r_t^k K_{t-1} + \zeta_t A_t (K_{t-1})^{\alpha} (\mathrm{N}_t)^{1-\alpha} - \Phi \tag{9}$$

By extracting the first-order conditions and simplification, the final cost function of the firm can be extracted as follows:

$$MC_t = \frac{1}{A_t}\left(\frac{1}{1-\alpha}\right)^{1-\alpha}\left(\frac{1}{\alpha}\right)^{\alpha}\left(\frac{W_t}{P_t^d}\right)^{1-\alpha}(r_t^k)^{\alpha}$$

(10)

After examining the optimization problems of firms producing intermediate and final goods, it is necessary to consider the pricing mechanism and price stickiness in the model based on Calvo's (1983) approach. Since not all firms in each period have the ability to re-optimize prices due to the theory of price stickiness, according to this theory, it is assumed that in each period they have a pricing power of $1-\omega d$ and firms who do not have the pricing power use an indexing process as follows:

$$P_t^d = (\pi_{t-1})^{\tau_d} p_{t-1}^d \qquad (11)$$

In the above equation, τ_d is the price rating order. Given the fact that in each time period some firms can adjust their prices optimally and other firms use the indexing process based on past inflation rate, the dynamic price relationship can be specified:

$$(P_t^d)^{1-\varepsilon_t^p} = \omega d\,(P_{t-1}^d)^{1-\varepsilon_t^p} + (1-\omega d)(P_{i,t}^*)^{1-\varepsilon_t^p} \qquad (12)$$

In the above relation, $P_{i,t}^*$ indicates the price level of firms that are able to optimize their prices. Next, the issue of optimization of firms with pricing capabilities should be considered. To this end, the expected discounted profit of the firm is optimized by the producers of the final goods in relation to the demand function of intermediate goods. After the optimization process and simplification, the Hybrid New Keynesian Phillips Curve is specified as follows:

$$\hat{\pi}_t^d = \frac{\beta}{1+\beta\tau_d}E_t\hat{\pi}_{t+1}^d + \frac{\tau_d}{1+\beta\tau_d}\hat{\pi}_{t-1}^d + \frac{1}{1+\beta\tau_d}\frac{(1-\omega d\,\beta)(1-\omega d)}{\omega d}\hat{MC}_t + \xi_t^p \qquad (13)$$

- Bank

Since the credit easing policies of the central bank are implemented by the banking system, it is necessary to model the banking sector in order to determine the transmission mechanism of these unconventional monetary policies. Credit received by banks from the central bank can be considered the main channel for implementing the credit easing policy. For this purpose, the banking sector is considered as a chain of banks in the framework of monopoly competition and their balance sheets are specified as follows:

$$B_t^p + L_t = L_t^{CB} + D_t + Z_t \qquad (14)$$

In the balance sheet of the banking sector specified in Eq. (14), it is shown that granting loan provided to households (L_t) and the purchase of government bonds (B_t^p) is possible though credits received from the Central Bank (L_t^{CB}), public deposits (D_t) and the net value of the bank's capital (Z_t). In the following, the expected discounted profit function of the banking sector is specified:

$$max\ E_t \sum_{t=0}^{\infty} i_t^l L_t + r_t^b B_t^G - i_t^d D_t - i_t^{ib} L_t^{CB} - \frac{\gamma^b}{2}\left(\frac{Z_t}{L_t} - \upsilon^b\right)^2 Z_t \quad (15)$$

Where, $i_t^l L_t$ is the income from loan granted by the banking system, $r_t^b B_t^G$ is the income from holding public sector Musharaka Sukuk, $i_t^d D_t$ is the profit paid on household sector deposits, $i_t^{ib} L_t^{CB}$ is the profit paid on credits received from the central bank at the interbank market rate and υ^b is the minimum capital-to-debt ratio of the banking sector determined by the regulations of the Central Bank. Therefore, by optimizing the profit function of the banking sector (Eq. 15) in relation to the balance sheet constraint (Eq. 14), the first-order conditions of the banking sector in relation to bank deposits, facilities granted by the banking sector and credits received from the central bank are provided in Eqs. (16), (17), and (18) respectively.

$$\beta_t^B \{-i_t^d + \lambda_t^B\} = 0 \quad (16)$$

$$\beta_t^B \{i_t^l - \gamma^b Z_t \left(\frac{Z_t}{L_t} - \upsilon^b\right)\left(-\frac{Z_t}{L_t^2}\right) - \lambda_t^B\} = 0 \quad (17)$$

$$\beta_t^B \left\{-i_t^{ib} + \lambda_t^B\right\} = 0 \quad (18)$$

Therefore, the banking sector has been set out in a way that the role of banks' debt to the central bank is specified and it is possible to evaluate the credit easing policy through this channel. It should also be noted that the banks' debt to the central bank is also considered in the form of a combined constraint between the government and the central bank in order to examine its comprehensiveness and dominance on the overall economy of the country.

- Government

Considering the role of the government and its fiscal policies in the Iranian economy, it seems necessary to include this sector in the theoretical framework of the designed model. On the other hand, government fiscal policies are formed

within the framework of government revenues and expenditures, which justifies the use of budget constraints in the governments to review fiscal policies.

$$\frac{B_{t+1}^{p}}{(1+r_t^b)}+B_{t+1}^{CB}+T_t+GD_t^{CB}+Oil_t=G_t+GD_{t-1}^{CB}+B_t^{p}+sub_t \quad (19)$$

In this equation, G_t is the total current and development expenditures of the government, B_t^{p} is the retained securities, sub_t is the government transfer payments, T_t is the tax revenues, GD_t^{CB} is borrowing from the banking system and Oil_t is oil revenues.

Government expenditure is specified in Eq. (20) as a function of oil revenues, tax revenues, and other revenues.

$$\log(G_t)=\mu_T \log(T_t)+\mu_{OI} \log(OI_t)+\mu_{OIL} \log(Oil_t)+\varepsilon_t^{G} \quad (20)$$

Tax revenues are considered as a function of national income in Eq. (21), other government revenues as a first-order autoregressive process in Eq. (22) and the rial value of oil revenues are also considered as a function of oil prices, oil exports and exchange rates in Eq. (23). It is noteworthy that in order to facilitate the process, the oil prices, oil production and exchange rates have been included as a self-regression process in the model.

$$\log(T_t)=\rho_T \log(Y_t)+\varepsilon_t^{Tax} \quad (21)$$

$$\log(OI_t)=\rho_{OI} \log(OI_{t-1})+\varepsilon_t^{OI} \quad (22)$$

$$\log(oil_t)=\log(er)+\log(poil)+\log(yoil) \quad (23)$$

It is noteworthy that following the study of Taghipour (2014) in Eq. (24), the National Development Fundfunction of the balance of has specified that a DF_t transfer resources of the fund from the previous period, payment of principal and interest on granted facilities LB_t and foreign exchange earnings from oil exports.

$$DF_t=DF_{t-1}+LB_t+(1-\omega)oil_t \quad (24)$$

- Central bank

To include the role of monetary authorities, the sources of the monetary base are used, according to which the monetary base includes gold reserves (Gol_t), foreign reserves of the central bank (FR_t), government debt to the central bank

(GD_t^{CB}), central bank credit line to banks (L_t^{CB}) and securities held by the central bank (B_t^p).

$$M_t = Gol_t + FR_t + GD_t^{CB} + L_t^{CB} + B_t^p \quad (25)$$

Given that banks' profit rates in Iran are set by the Monetary and Credit Council and the policies of the central bank are affected by the government budget deficit, it is assumed that increasing the rate of the monetary base is a policy-making tool for the central bank. The monetary authorities use monetary policy tools to reduce production deviation from potential one and inflation deviation from inflation target rate. The monetary policy tools are defined as follows:

$$MH_t = \rho_t^{mh} MH_{t-1} + \rho_\pi^{mh}(\pi_t - \pi_t^T) + \rho_y^{mh} y_t + \Omega_t \quad (26)$$

$$\pi_t^T = \rho_{\pi t} \pi_{t-1}^T + \varepsilon_t^{\pi T} \quad (27)$$

$$\Omega_t = \rho_\Omega \Omega_{t-1} + \varepsilon_\Omega ; \varepsilon_\Omega \square N(0, \sigma_\Omega) \quad (28)$$

- **Consolidation of the government and the central bank**

Due to the dependence of monetary policy on government fiscal policy, the use of the consolidated constraint of the government and the central bank can reveal some of the realities of the Iranian economy based on the dominance of fiscal policy. For this purpose, the consolidated constraint of the government and the central bank is specified as follows:

$$\frac{B_{t+1}^P}{(1+r_t^b)} + M_{t+1} - Gol_{t+1} - GD_{t+1}^{CB} - L_{t+1}^{CB} - e_{t+1} FR_{t+1} + T_t + Oil_t$$
$$= G_t + B_t^P + M_{t+1} - Gol_{t+1} - GD_{t+1}^{CB} - L_{t+1}^{CB} - e_{t+1} FR_{t+1} - sub_t \quad (29)$$

Public sector debts to the central bank and banks' debts to the central bank are defined in Eq. (30) and (31) as part of a first-order autoregressive process. Also, the retained securities variable, which is a function of past values and exchange rate variables, inflation and production, and the variable of foreign reserves of the Central Bank, which is specified as a function of exchange rate, inflation and oil revenues, are specified in Eq. (32) and (33), respectively.

$$\log GD_t^{CB} = \rho_{GD} \log GD_{t-1}^{CB} + \varepsilon_t^{GD^{CB}} \quad (30)$$

$$\log(B_t^P) = \gamma_{PE} \log(e_t) + \gamma_{P\pi} \log(\pi_t) + \gamma_{PY} \log(Y_{t-1}) + \gamma_{PP} \log(B_{t-1}^P) + \varepsilon_t^{B^P} \quad (31)$$

$$\log(FR_t) = \lambda_E \log(e_t) + \lambda_\pi \log(\pi_t) + \lambda_{oil} \log(oil_t) + \lambda_{FR} \log(FR_{t-1}) + \varepsilon_t^{FR} \quad (32)$$

In the first place, the model parameters are quantified and simulated, after which, the results of the Impulse Response Function resulting from the banks' debt impulse to the central bank will be examined. Then, the model is estimated based on the real data of Iran's economy during the period of the first quarter of 1991 to the fourth quarter of 2017 using the Bayesian method and Monte Carlo Metropolis-Hasting algorithm, in which, the subsequent distribution of parameters and impulse response functions of the variables including production (y), consumption(c), capital(k), bank lending(i), bank deposits(d), liquidity(m), inflation(pai), exchange rate(ner) and government expenditures(go) in response to the central bank's credit facilitation policy impulse are examined and evaluated.

Basic model linearization

$$\hat{I}_t = \frac{\hat{q}_t}{1+\beta} + \frac{1}{1+\beta}\hat{I}_{t-1} + \frac{\beta}{1+\beta}\hat{I}_{t+1}$$ Investment dynamics (1)

$$\hat{q}_t = \frac{\beta \bar{R}^K}{\bar{q}}(\hat{R}^K_{t+1}) + \beta(1-\delta)\hat{q}_{t+1} - (\hat{R}^b_t - \hat{\pi}_{t+1})$$ Capital price dynamics (2)

$$\hat{N}_t = \frac{\hat{W}_t}{\sigma_N} - \frac{\sigma_C}{\sigma_N}\hat{c}_t$$ Labor supply (3)

$$\hat{r}^b = \sigma_c \hat{c}_{t+1} - \sigma_c \hat{c}_t$$ Demand for bonds (4)

$$\hat{m}_t = \frac{\sigma_c}{\sigma_m}\hat{c}_t - (\frac{\sigma_c}{\sigma_m})(\frac{\hat{r}^b}{\bar{r}^b})$$ Demand for money (5)

$$\hat{c}_t = \hat{c}_{t+1} - \frac{1}{\sigma_c}(\hat{R}^b_t - \pi_{t+1})$$ Euler equation of consumption (6)

$$\hat{k}_t = (1-\delta)\hat{k}_{t-1} + \delta \hat{i}_t$$ Capital accumulation equation (7)

$$\hat{Y} = \frac{1}{\bar{Y}/\bar{Y}+\bar{\Phi}}\left[\hat{A}_t + \alpha \hat{K}_{t-1} + (1-\alpha)\hat{N}_t\right]$$ Production function (8)

$$\hat{A}_t = \rho_a \hat{A}_{t-1} + \varepsilon_t^A$$ Technology auto regression process (9)

$$\hat{R}^k_t = \hat{w}_t + \hat{n}_t - \hat{k}_{t-1}$$ Capital return rate (10)

$$\hat{\pi}^d_t = \frac{\beta}{1+\beta\tau_d}E_t\hat{\pi}^d_{t+1} + \frac{\tau_d}{1+\beta\tau_d}\hat{\pi}^d_{t-1} + \frac{1}{1+\beta\tau_d}\frac{(1-\omega d\,\beta)(1-\omega d)}{\omega d}\hat{MC}_t + \xi^p_t$$ New Keynesian hybrid Philips curve (11)

$$m\hat{c}_t = -\hat{A}_t + (1-\alpha)\hat{w}_t + \alpha \hat{R}^k$$ Marginal cost of production (12)

$$\hat{d}_t = \sigma_c \hat{c}_t + \frac{\bar{i}^d}{\bar{r}^b - \bar{i}^d}\hat{i}^d$$ Bank deposit (13)

$$\frac{\bar{i}^{l}\hat{i}_t^{l}}{\bar{i}^{d}-\bar{i}^{l}}-\frac{\bar{i}^{d}\hat{i}_t^{d}}{\bar{i}^{d}-\bar{i}^{l}}=(۲+\frac{۱}{۱-\upsilon^{b}})Z_t-(۲+\frac{۱}{۱-\upsilon^{b}})\hat{L}_t$$ The relationship between loan interest and profit (14)

$$\bar{Z}\hat{Z}_t+\bar{D}\hat{D}_t+\bar{L}^{CB}L_t^{CB}=\bar{L}\hat{L}_t+\bar{B}^{p}\hat{B}_t$$ Banking balance sheet (15)

$$L_t^{CB}=\rho_{lcb}\hat{L}_{t-1}^{CB}+\varepsilon_t^{lcb}$$ Debt of the banking sector to the central bank (16)

$$G\hat{D}_t^{CB}=\rho_{GD}G\hat{D}_{t-۱}^{CB}+\varepsilon_t^{GD^{CB}}$$ Government debt to the central bank (17)

$$\hat{B}_t^{p}=\gamma_{PE}\hat{e}_t+\gamma_{P\pi}\hat{\pi}_t+\gamma_{PY}\hat{Y}_{t-۱}+\gamma_P\hat{B}_{t-۱}^{p}+\varepsilon_t^{B^{p}}$$ Equation of Sukuk (18)

$$F\hat{R}_t=\lambda_E\log\hat{e}_t+\lambda_\pi\hat{\pi}_t+\lambda_{oil}oi\hat{l}_t+\lambda_{FR}F\hat{R}_{t-۱}+\varepsilon_t^{FR}$$ Foreign reserves of the Central Bank (19)

$$MH_t=\rho_t^{mh}MH_{t-1}+\rho_\pi^{mh}(\pi_t-\pi_t^{T})+\rho_y^{mh}y_t+\varepsilon_t^{mh}$$ Rule of monetary policy (20)

$$\pi_t^{T}=\rho_{\pi t}\pi_{t-1}^{T}+\varepsilon_t^{\pi T}$$ Target inflation (21)

$$\hat{G}_t=\mu_T\hat{T}_t+\mu_{OI}O\hat{I}_t+\mu_{OIL}Oi\hat{l}_t+\varepsilon_t^{G}$$ Government Expenditure (22)

$$\hat{T}_t=\rho_T\hat{Y}_t+\varepsilon_t^{Tax}$$ Tax revenues (23)

$$poil=\rho_{po}\hat{p}_{t-1}^{oil}+\varepsilon_t^{poil}$$ Oil prices (24)

$$DF_t=DF_{t-1}+LB_t+(1-\varpi).oil+\varepsilon_t^{oil}$$ National Development Fund (25)

$$yoil=\rho_{yo}\hat{y}_{t-1}^{oil}+\varepsilon_t^{yoil}$$ Oil exports (26)

$$O\hat{I}_t=\rho_{OI}O\hat{I}_{t-1}+\varepsilon_t^{OI}$$ Other government revenues (27)

$$GD\hat{P}_t=\frac{\bar{C}}{GD\bar{P}}\hat{C}_t+\frac{\bar{I}}{GD\bar{P}}\hat{I}_t+\frac{\bar{G}}{GD\bar{P}}\hat{G}_t$$ Market clearing condition (28)

5. Estimation of model parameters

Table (4) introduces the parameters included in the model with their previous values and distribution. By calibrating the model in terms of debt impulse of banking sector to the central bank, reduced interbank market rate and reduced statutory deposit rate, the model solved and simulated using the Dinar software, based on MATLAB.

Table 4: Quantification and estimation of model parameters

parameters	Description	Distribution	Previous average	Retrieved from	Late average

μ_T	Coefficient of tax revenues in government expenditures	Beta	۰/540	Research calculations	۰/5362
μ_{OI}	Coefficient of other revenues in government expenditures	Beta	۰/20	Research calculations	۰/2172
ρ_T	Income coefficient in the tax equation	normal	۰/45	Research calculations	۰/4630
ρ_{OI}	The first-order auto-regression coefficient of other government revenues	normal	۰/80	Research calculations	۰/6853
ρ_{yo}	Autoregressive coefficient of oil exports	normal	۰/75	Research calculations	۰/8055
ρ_{po}	Autoregressive coefficient of oil price	normal	۰/92	Research calculations	۰/8897
λ_E	Exchange rate coefficient of foreign assets of the Central Bank	normal	۰/12	Research calculations	۰/0553
λ_π	Inflation Coefficient of foreign assets of the Central Bank	normal	۰/03	Research calculations	۰/029
λ_{oil}	Coefficient of oil revenues in foreign assets of the Central Bank	normal	۰/08	Research calculations	۰/0786
λ_{FR}	Central Bank Foreign Assets Interrupt Coefficient	normal	۰/88	Research calculations	۰/6437
β	Consumer time preference rates	Beta	۰/96	Komijani and Tavakolian (2012)	۰/9616
δ	Depreciation rate	normal	۰/042	Motevasel et al. (2010)	۰/0075
σ_C	Reverse of elasticity of Substitution for Intertemporal consumption	Gamma	1/52	Komijani and Tavakolian (2012)	1/519
σ_N	Reverse of labor supply elasticity	Gamma	2/21	Komijani and Tavakolian(2012)	2/1527
σ_M	Reverse demand of money	Gamma	2/24	Komijani and Tavakolian(2012)	2/2298

	elasticity				
α	Capital share of production	Beta	۰/42	Komijani and Tavakolian(2012)	۰/4467
ρ_a	Technology autoregression coefficient	Beta	۰/92	Moshiri et al(2011)	۰/9167
τ_d	Degree of indexing	normal	۰/5	Saidpour et al(2018)	۰/4317
ωd	Degree of adhesion	Beta	۰/6	Saidpour et al(2018)	۰/5698
γ_{PE}	Exchange rate coefficient of Musharaka Sukuk	normal	۰/06	Khiabani and Amiri(2012)	۰/0542
$\gamma_{P\pi}$	Inflation coefficient of Musharaka Sukuk	normal	۰/53	Khiabani and Amiri(2012)	۰/5219
γ_{PY}	Income coefficient of Musharaka Sukuk	normal	۰/18	Khiabani and Amiri(2012)	۰/1829
γ_P	Interruption of Musharaka Sukuk	normal	۰/97	Khiabani and Amiri(2012)	۰/9983
ρ_π^{mh}	Inflation significance coefficient in the monetary policy rule	normal	-۰/98	Komijani and Tavakolian(2012)	-1/0593
ρ_y^{mh}	The coefficient of importance of production in the rule of monetary policy	normal	-2/96	Komijani and Tavakolian(2012)	-2/9351
υ^b	Debt to bank capital ratio	Gamma	۰/10	Falagiarda, and Saia(2017)	۰/1238
β_B^t	Discount in Banking sector	Beta	۰/97	Falagiarda, and Saia (2017)	۰/9798

The model is estimated by Bayesian method using Monte Carlo Metropolis-Hasting algorithm and the results of impulse response functions are reported. The positive impulse of the central bank credit line to the banks as a standard deviation is considered as one of the channels of influence of the credit easing policy in the model. The response of the variables in the model of impulse response functions is reported in Fig. (2). As can be seen, in response to the positive impulse, the variables of consumption, capital and GDP have deviated from their stable

position. It is noteworthy that, in the economy, the increase in capital is more than consumption, which indicates that the flow of financial resources is created in the direction of investment. On the other hand, the size of liquidity in the economy has positively deviated from its long-term stable state and the impact of this variable on the implementation of the mentioned policy is more than other variables. The size of bank deposits and the amount of loan granted have also deviated positively from their long-term status, which is considered to be the result of the implementation of this credit easing policy. In general, it can be said that the results are in line with the theoretical expectations and realities of the Iranian economy. Therefore, adopting a credit easing policy can be fruitful to get out of the recession and affect both demand and supply.

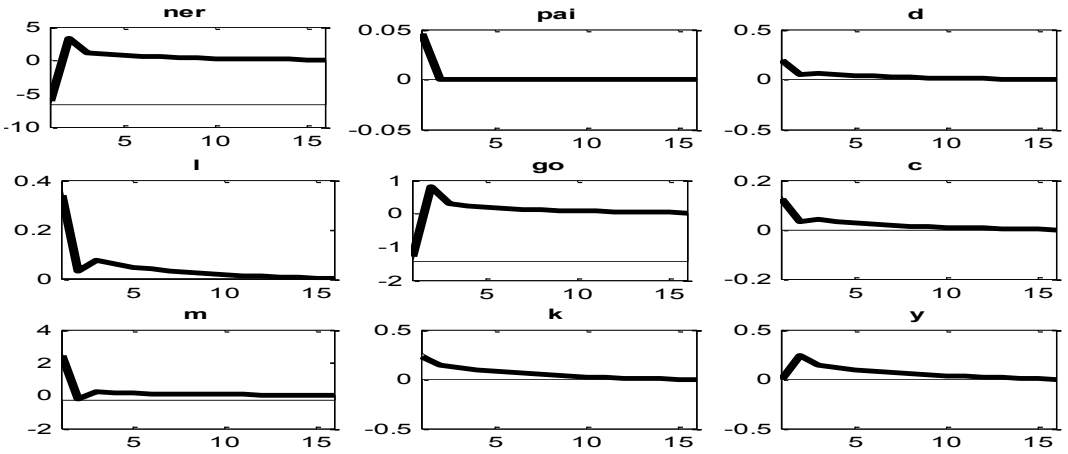

Fig. 2: Results of the reaction functions of the Central Bank credit line to banks

The estimated results of the impulse response functions show the negative momentum of the interbank market rate as a standard deviation in Fig. (3). Production, consumption and investment have positively deviated from the long-term state and after three to four periods, the effects of this impulse have been evacuated and the variables mentioned have converged to their long-term state. Another point is that capital is more strongly affected by the implementation of this policy compared to consumption, which indicates that the reduced interbank interest rates is in the direction of increasing investment and economic prosperity in the country. In response to the implementation of this policy, the amount of bank deposits and loan granted by banks has decreased. Given the fact that the reduction of the interbank market rate will also reduce the interest rate on bank deposits, the reduction in the amount of bank deposits is a reaction to the implementation of this policy. Increasing the size of liquidity is another effect of lowering the interbank market rate, which is affected by banks' access to cheap

financial resources. Due to the reduction of bank deposits, the entry of these resources into the economic environment on the one hand, and the increase in liquidity on the other, caused the formation of inflation in the economy. After a short period of time the effects of this impulse are discharged and it will be stable again. While the results show that the implementation of this policy is effective for economic prosperity, its effectiveness is higher compared to the reduction of banks' statutory reserves requirement and lesser, compared to the central bank credit line.

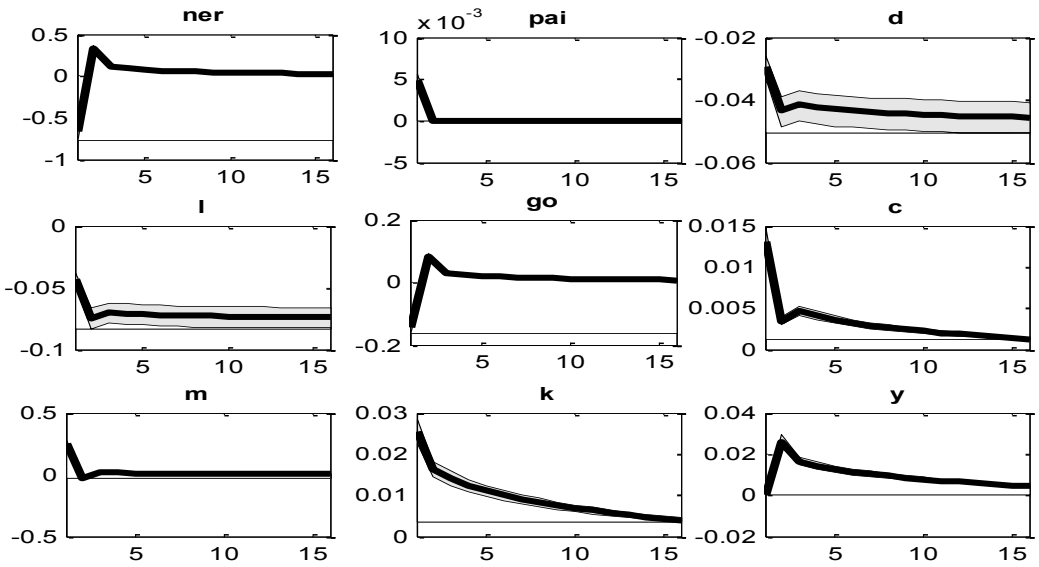

Fig. 3: Estimated results of interbank market interest rate shock

Reducing the statutory reserve requirement rate is one of the most important tools available to the central bank, which can provide a good platform to increase the banking sector's access to financial resources for lending and injecting into the manufacturing sector. The impulse response functions resulting from the estimation of the negative momentum of the statutory reserve requirement are reported as a standard deviation in Fig. (4). As a result of this policy, the variables of production, consumption and capital have been positively deviated from the long-term stable state. The greater influences and longer process of mediating the effects of this shock on capital than consumption implies that the investment is central and the economy has gotten out of recession. Although the most influential among the studied variables is liquidity, but the process of mediation and return to long-term stability in this variable takes two to three time periods. The size of bank deposits also reacted positively to the shock and returned to the long-term equilibrium after 4 to 5 time periods. The amount of loan granted by the banking sector has also increased, which is an expected result of the implementation of this

policy. Although the inflation variable also increased, all the effects of this shock were quickly eliminated after one to two periods of time. Government spending and the exchange rate also reacted negatively to this impulse in the first period, but after one time period, they reacted positively to the implementation of this policy and all the effects of this impulse were quickly evacuated. The results are in line with theoretical expectations and it can be said that the adoption of credit easing policy through reducing the statutory reserve requirement of banks, provides the possibility of economic growth or getting out of the recession. Increasing the size of loan granted by banks as well as the liquidity are the obvious consequences of implementing this unconventional monetary policy.

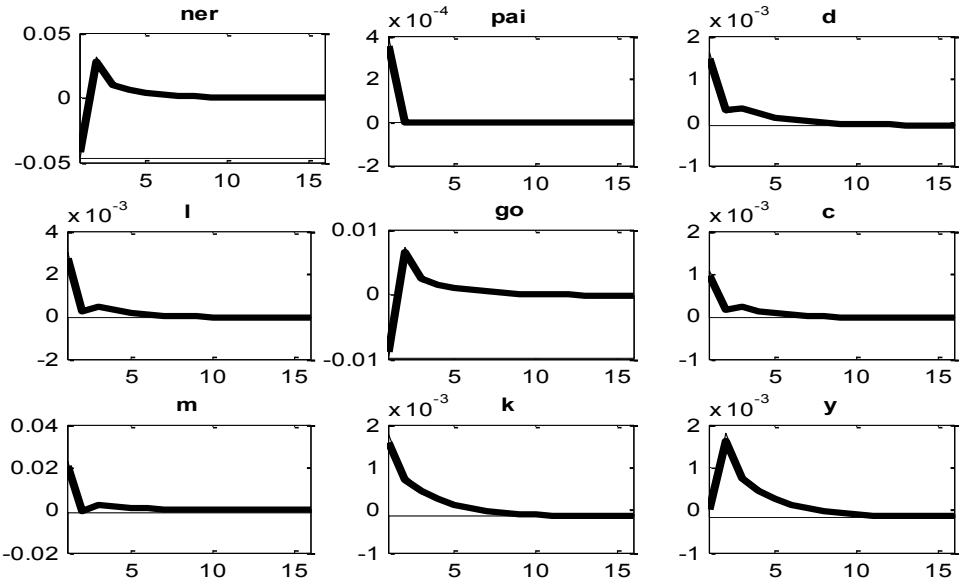

Fig. 4: Estimated results of statutory reserve requirement impulse

In general, it can be said that the results of estimating the model are in line with theoretical expectations, according to which the credit easing policy paves the way to take the economy out of the recession through increasing the credit line of the central bank to banks, reducing the statutory reserve requirement rate and reducing the interbank market rate.

Since in Bayesian method different Markov chains are used to simulate the pattern, therefore, for each chain, we can observe variance within as well as between chains. In the standard case, it is expected that by increasing the sample size, the variance within the chain tends to a constant value and the variance between the chains tends to zero (Keyumarsi et al., 2018). Therefore, if variable Q indicates the weight combination of variance between and within the chains, then the model estimation is reliable if the time path of the variable C is a stable and

without fluctuation and converges path Q to the path C. This test is known as the Gelman-Brooks test in the context of the Monte Carlo-Markov (MCMC) chain statistic. The results are reported for the first three moments including mean (Interval), variance (m2) and skewness (m3) and its diagram for the present model is as diagram (5). As can be seen, the results obtained from this diagnostic test indicate the accuracy and reliability of the results.

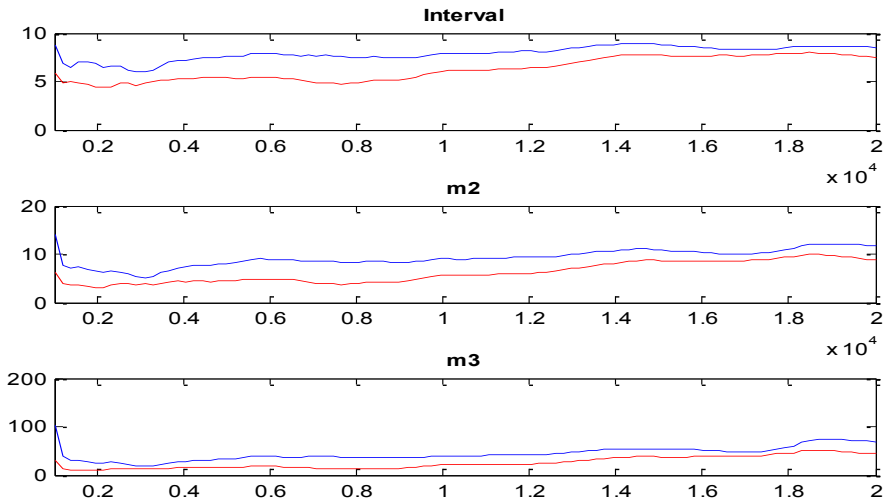

Fig. 5: MCMC Statistic for estimated model

6. Conclusions and policy recommendations

The financial crisis of 2007-2008 plunged the world into a deep recession. Many central banks in developed and developing countries have used unconventional credit easing policies to enhance economic prosperity. The main goal of policymakers is to help interbank and credit markets to increase financial stability and growth in production. The banking system communicates with the households, corporations, government and the central bank and can play a role in transferring the various economic shocks to the different economic agents and to macroeconomic variables. Given the recessionary conditions of Iran's economy, the central bank adopted a credit easing policy as an unconventional monetary policy to provide credit for the prosperity of the real sectors of the economy. One of the tools used in the Central Bank of Iran is the policy of the Central Bank credit line to banks, reducing the interbank market rate as well as reducing the statutory reserve requirement. In this study, the effect of central bank credit line shocks, statutory reserve requirement and interbank market rate has been investigated. The positive momentum of the central bank credit line and the negative momentum of the statutory reserve requirement give rise to increase the

production, consumption, investment, banking loan and liquidity in the economy, and the negative momentum of the interbank market rate increases the consumption, production, capital and banking loan. Overall, it seems that in the framework of the three channels examined based on economic data and economic realities of the country, the credit easing policy has been effective in stimulating production in the country's economy.

If the policy-maker's preference is to be more effective in supplying and increasing the country's production potential, using the tools of the National Development Fund and statutory reserve requirement will perform better than the central bank credit line and interbank interest rates. Because the use of these tools increases investment more than consumption, which while increasing demand in the short term, increases production capacity in the long run.

Therefore, in order to have a quick and short-term effect on getting out of the recession, it is preferable for banks to use the tools of the interbank market rate and the central bank credit line. Because these tools have a greater impact on consumption as a stimulus to demand to get out of the recession and create propensity.

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اثر سیاست تسهیل اعتباری بر خروج از رکود در اقتصاد ایران: کاربرد مدل تعادل عمومی پویای تصادفی

حدیثه محسنی[۱]، محمدنبی شهیکی‌تاش[۲]، مصیب پهلوانی[۳]، سید حسین میرجلیلی[۴]

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چکیده

این مقاله با استفاده از مدل تعادل عمومی پویای تصادفی کینزی جدید به بررسی تأثیر سیاست تسهیل اعتباری بر متغیرهای کلان اقتصادی با تأکید بر تولید پرداخته است؛ بدین‌منظور الگویی شامل پنج بخش: خانوار، بنگاه، بانک، دولت و بانک مرکزی طراحی شده است. با توجه به سلطهٔ سیاست مالی بر سیاست پولی در اقتصاد ایران از قید تلفیقی دولت و بانک مرکزی استفاده شده است. تخمین الگوی طراحی شده با استفاده از روش بیزین و داده‌های سری زمانی فصلی طی دورهٔ ۱۳۷۰ تا ۱۳۹۶ انجام شده است. نتایج حاصل از توابع عکس‌العمل آنی نشان می‌دهد که اجرای این سیاست باعث افزایش مصرف، سرمایه‌گذاری، مخارج دولت و درنهایت تولید شده است که بیانگر اثربخشی این سیاست پولی نامتعارف برای خروج اقتصاد از شرایط رکودی است؛ همچنین در واکنش به تکانهٔ مثبت خط اعتباری بانک مرکزی به بانک‌ها و تکانهٔ منفی ذخیرهٔ قانونی، تسهیلات بانکی افزایش یافته است که همسو با انتظارات نظری می‌باشد. اثر تکانهٔ منفی نرخ بازار بین بانکی نیز منجر به افزایش اعتبارات تولیدی شده است.

کلیدواژگان: تسهیل اعتباری، رکود، مدل تعادل عمومی پویای تصادفی، روش بیزی، خط اعتباری.
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۱. دانشجوی دکتری اقتصاد، دانشکدهٔ اقتصاد و مدیریت، دانشگاه سیستان و بلوچستان، زاهدان، ایران.
Email: hadiseh12@yahoo.com
۲. دانشیار گروه اقتصاد، دانشکدهٔ اقتصاد و مدیریت، دانشگاه سیستان و بلوچستان، زاهدان، ایران (نویسندهٔ مسئول).
Email: mohammad_tash@eco.usb.ac.ir
۳. دانشیار گروه اقتصاد، دانشکدهٔ اقتصاد و مدیریت، دانشگاه سیستان و بلوچستان، زاهدان، ایران.
Email: m.pahlavani9@gmail.com
۴. استاد اقتصاد، دانشکدهٔ اقتصاد، پژوهشگاه علوم انسانی و مطالعات فرهنگی، تهران، ایران.
Email: h.jalili@yahoo.com

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