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Original Research Article

Investigating the Effects of Monetary and Financial Shocks on the Key Macroeconomic Variables, Focusing on the Intermediary Role of Banks Using DSGE Models

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This study investigates monetary and financial shocks on macroeconomic variables, focusing on the role of banking intervention. For this purpose, a Keynesian dynamic stochastic general equilibrium (DSGE) model is designed for Iran's economy that involves financial and banking sectors. The results of the model simulation show that the financial accelerator theory works in the Iranian economy. Also, the intermediary role is confirmed by the impulse response function. In other words, economic policies can impress on macroeconomic indicators more when banks intervene in the economy. Therefore, to control the effects of economic shocks on banks' performance, it has been suggested that monetary policymakers pay attention to the important roles of financial markets in the transfer mechanism and monetary policy intensity. On the other hand, because of mandatory rules of interest rates determination, banks have to establish a commission and nonprofit services instead of sharing income to decrease the effect of economic shocks.

Keywords: Monetary Policy, Financial Shock, Financial Accelerator, DSGE Model.
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1 Introduction

After the 1929 financial crisis, new theories, such as Keynes theory, Monetarism school, new classic theory, and the Real Business Cycle theory

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(RBC), were provided to explain, in more detail, the causes of business cycles. Most of these theories considered negligible importance for a financial system in creating business cycles. A problem of these theories was the lack of a general understanding of the impact of microeconomic principles on financial systems and neglecting imperfections in the financial market. These theories emphasized the role of the expectation and fiscal policy (government policy) as causes of the business cycles (Fekri Ershad, 2011).

In the 1980s, introducing new finance theory in the new Keynesian model caused to end the ignoring of uncertainty in the financial market and its importance in the macroeconomic literature. For example, some new theories, provided by Bernanke and Gertler (1989), Bernanke et al. (1998), and Kiyotaki and Moore (1997), analyze the role of credit and other financial variables in business cycles. These theories use models which are mainly based on micro-foundations. Particularly, the financial accelerator model, which focuses on financial systems as the main factor of transmission and propagation of shocks to the whole economy and creating business cycles, has had an essential role in changing the financial, macroeconomic studies.

Following these studies, especially after Southeast Asia's financial crisis in 1997-1998 and the global financial crisis in 2008, broad streams of studies have focused on the role of credit and financial sectors in shaping the business cycles and intensifying economic fluctuations (Cristiano et al., 2010; Christensen & Dib 2008; Gerali et al., 2009; Dib 2010). The accelerator model argues that positive interest rate shocks in the money market raise the household's savings and reduce the household's consumption, decrease the entrepreneur's investment, decline the net trade, reduce the real income, production, and financial assets price. Thus these changes create business cycles (Hammersland & Traee, 2014). Assuming the asymmetric information, a decrease in asset prices in asset markets, such as the capital market, decreases firms' and households' net wealth, increases external financing than internal financing, hence reducing enterprises and households' borrowing capacity and so investment. A drop in asset prices and its balance sheet effects on the household sector may lead to a decline in credits and investments, production capacities, employments, and consumption. This cycle can continuously be repeated.

Furthermore, some studies (for example, Cristiano et al., 2010; Gerali et al., 2009), following the new Keynesian approach, considered the financial sector in their models and investigated the mechanism of transmission shocks into the real economic sector and creation of business cycles through the banking sector. Empirical evidence shows that the credit and financial sectors

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have an essential role in the transmission of shocks to the real sector and business cycles (Shah Hosseini & Bahrami, 2013).

Comparing the size and performance of the Iranian capital market with other countries reveals that this market is underdeveloped in Iran and cannot meet the financial needs of Iran's economic development.

Based on these studies, we investigate the role of the banking sector in the transmission of credit shocks (the interest rate of bank deposits) in Iran's economy. We will also seek whether the financial accelerator and balance sheet effects apply to Iran's economy. In this country, the banking system has had many challenges, including non-performing loans of the public and private sector, considerable banks' liabilities to the central bank, indiscipline in the unorganized money market, and differences in accounting the government's debts and banks' receivables. So, it can say that some most critical weaknesses of Iran's banking system are: 1- increase the credit risk, 2- increase the liquidity risk and freezing of bank assets, 3- banks' debts to the central bank, and 4- faint communication with the international banking system. So, the monetary policy implication through changing the interest rate of bank deposits had continually confronted challenges in Iran's economy. Although it is essential to increase the interest rate of bank deposits in Iran's inflationary conditions, the interest rate of deposits is considered as the cost of investing, because of the bank-based financial system of Iran (Motameni, 2009; Ebrahimi, 2014). For example, in 2011, on one hand, the high inflation led to a negative real interest rate and encouraged the depositors to follow speculative behaviors. Thus, depositors decreased their deposits in banks and dispatched them to financial asset markets such as stock, foreign currencies, gold, and housing markets to maintain the value of their savings. This led to instability and severe volatility in these markets (Shadrokh, 2012). On the other hand, increasing the interest rate meant increasing the cost of the real sector finance causing to rise in prices of goods, decreasing investments, and consequently reducing the output (Abu Nouri et al., 2013).

Answering the question and concerning special conditions of Iran's economy, we try to investigate the effect of the gap between banking deposits' interest rate and the average of other assets' returns on household decisions and some of the real economic variables using dynamic stochastic general equilibrium (DSGE) model that involve the banking and financial sectors. Moreover, we compare the DSGE model results with the basic model without the financial sector to show the importance of financial factors in the transmission mechanism of shocks and examine the financial accelerator theory. To this goal, we review the empirical and theoretical literature in

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section two, after that we present our model in section three. We explain the research method used in this article and analyze our results in section four and finally, some policy advice is proposed in section five.

2 Literature Review

Financial and monetary volatilities have long attracted the attention of economists interested in business cycles. Empirical evidence of the recent financial crisis has also shown that the financial sector plays an essential role in the transmission of shocks to the real sector and is critical in emerging business cycles (Jermann & Quadrini, 2009). In this regard, Hollander and Liu (2015) investigate the relationship between real economic activities and the stock market using the new Keynesian DSGE model and introduce the household, producers of wholesale goods, and the banking sectors. Their results showed that the stock prices intensify fluctuations in business cycles through the financial accelerator and banks' capital. Gerali et al. (2009) have also designed a new Keynesian DSGE model with financial and banking sectors. The results showed that shocks with banking sector origin explain production decrease in euro countries, while macroeconomic shocks have an insignificant role. Villa and Yang (2011) also explained England's real production decrease using the DSGE model with banking and financial sectors during the 2008 financial crisis. They showed that banking sector socks could explain about 50 percent of production decline. Hollander and Liu (2015) designed the DSGE model with financial sectors for America's economy. Their results show that financial asset prices can better explain America's business cycles fluctuations.

The financial system is mainly divided into two sections: the banking sector or money market, which finances short-term credits, and the capital market, which funds production and service activities in the long term. Apart from improvements that occurred in financial markets, the banking system is still one of the main financing pillars in Iran's economy. Furthermore, depositors' dependency on banking deposits and other money instruments such as bonds and production dependency on quantity and quality of banking loans are other features of Iran's financial system. we consider two important economic relationships for the banking system: First, for creating money and managing payment arrangements; Second, for bringing investors and savers together or demand and supply of money resources. So, it can be concluded that public and private enterprises' investment decisions and household consumption decisions are closely related to the banking system's functioning. For example, Shah Hosseini and Bahrami (2013) considered banks as

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financial intermediaries in their DSGE model. Their results indicate monetary shocks have weaker effects when the banks' deferred debts are considered. Mehregan and Daliri (2013) examine the banks' reaction to monetary policies in the DSGE model and argue that monetary shocks cause to increase in all nominal variables like wage, interest rate, and price level. Therefore, the financial intermediary cannot collect the added liquidity, and the liquidity will be directed to higher-yielding markets. Bayat et al. (2016) analyze the central bank behavior in financial instability using the DSGE model. They showed that the central bank's mild response to deviations of the total stock price index from its equilibrium level reduces the range of economic fluctuations and increases the overall macroeconomic stability. Mohebbi et al. (2017), using the DSGE model, suggest that the interbank sector has a crucial role in shocks' transmission. Hence the central bank can moderate shocks by injecting liquidity into the interbank market in the short term. Rafiei et al. (2019) consider five sectors in their DSGE model, including households, firms, banks, government, and distributors, to investigate the banks' response to monetary shocks.

One of the stylized facts of Iran's economy is the small share of the capital market and the dominant role of the banking sector in the financing system. For example, according to the central bank database, about 35 and 10 percent of financial market value has been allocated to the stock market and debt market, respectively. Also, banks still dominate a significant volume of the financial market. According to the experiences of developed countries, market-based financial systems have a positive impact on economic endogeneity and performance. Economic agents generally consider the stock market as an economic predictive indicator. So its trends, fluctuations, and dynamics indicate how to adjust the economic agents' expectations, policy changes, and unforeseen and fundamental factors; hence it can affect the optimal decisions of agents.

After the 2007-2008 financial crisis and the global sustainable recession, economists and policymakers again focused on the functions of the financial market in the economic system (Taylor, 2009; Mishkin, 2011; and Woodford, 2012). For example, Merola (2014) examined the role of financial sectors in America's DSGE model during the 2008 financial crisis. Their result showed that the financial accelerator theory, provided by Bernanke et al. (1998), applied in the US economy during the financial crisis. Hafstead and Smith (2012) also investigate the financial accelerator theory by introducing a competitive and monopolistic banking sector and interbank lending.

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As reflecting the economic uncertainties, the stock market's dynamics play a critical role in monetary transmission mechanism in different ways, especially through borrowing and banks' balance sheet channel. Additionally, Nistico (2012) indicated that the stock market affects macroeconomics variables through the wealth-consumption relationship and aggregate demand. They indeed studied the monetary policymakers' behavior in the face of big jumps in stock prices. Among other studies that examined the role of financial socks in business cycles creation can refer to Iacoviello (2005); Curdia and Woodford (2015); Dib (2010); Gertler and Karadi (2011); Gertler and Kiyotaki (2010); Zanetti (2012); Pesaran and Xu (2013); and Hammersland and Traee (2014).

A comparison between Iacoviello (2005) and Curdia and Woodford (2015) shows that although Iacoviello (2005) entered borrowing constraints into the DSGE model, Curdia and Woodford (2015) examined the implications of interest rate margin change to manage monetary policy. Dib (2010) also modeled the interbank market by assuming the interaction of banks. Gertler and Karadi (2011) applied endogenous constraints to leverage ratios. This study includes the interbank market section in the model. Zanetti (2012) used a DSGE model with bank sectors to examine monetary policy's role in the US's business cycles. Pesaran and Xu (2013) also studied the effects of credit shocks on Canada's business cycles in a DSGE model. Hammersland and Traee (2014) examined the dynamic relationship between credit sectors, financial asset prices, and real sector activities in dynamic stochastic general equilibrium and structural vector autoregressive models for Norway. The results show that the model's financial sectors and financial feedback mechanism improve the predictive power of the model. Some studies also considered the central bank's mild reaction to stock market index deviations to reduce the range of economic fluctuations, which leads to increased overall macroeconomic stability (Bayat et al., 2016). Other studies argued that financial frictions in the economy increase the effect of various shocks on labor market fluctuations and strengthen and expand shocks' effects to other sectors (Farzinvash et al., 2015).

Reviewing these studies show their weaknesses that this article tries to cover: First, in none of the internal studies, the financial sector and its related variables are embedded in the model, while due to the relationship between financial markets and the banking sector, the presence of financial variables in the model is inevitable. Second, financial shock effects are divided into supply-side financial shocks and demand-side financial shocks in the present study. Additionally, the model is simulated with and without the presence of

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financial shocks. Third, this study examines the financial accelerator test in Iran's economy through the DSGE model. Fourth, this study explains banks' behavior in lending and determining the optimal interest rate.

3 Research Model

The present research model has six sectors: the household, producer of intermediate and final goods, banking sector, financial sector, the government, and the central bank. The household maximizes the expected discounted utility function subject to the intertemporal budget constraint. Intermediary firms minimize their production cost function, and the final goods producers, in the framework of the theory of price stickiness provided by Calvo (1983), set the prices of goods. To maximize their expected profit function, the banks determine the optimal interest rates for deposits and loans for both the household and corporate sectors. The financial sector, along with the banking sector, affects the production sector. Finally, the government and the central bank are faced with intertemporal budget constraints. The conceptual model of the present study is described in Figure (1).

– **Banking sector's monopolistic competition**

There are numerous heterogeneous banks in the banking system that provide services of different quality but follow the goal of determining the gross interest rate $r_{t+1}^{d}(i)$. So the total saving function of bank deposits and loans is:

$$D_t = \left[\int D_t(i)^{\frac{\eta_d - 1}{\eta_d}} d_i\right]^{\frac{\eta_d}{\eta_d - 1}}$$

$$B_t = \left[\int B_t(i)^{\frac{\eta_b - 1}{\eta_b}} d_i\right]^{\frac{\eta_b}{\eta_b - 1}}$$

The total nominal gross interest rate is

$$(r_{t+1}^{d})^{-1} = \left[\int (r_{t+1}^{d}(i)^{-1})^{1-\eta_d} d_i\right]^{\frac{1}{1-\eta_d}}$$

$$r_{t+1}^{b} = \left[\int r_{t+1}^{b}(i)^{1-\eta_b} d_i\right]^{\frac{1}{1-\eta_b}}$$

in which η_d and η_{b} are substitution elasticity of deposit and loan markets, respectively.

The basic model of monopolistic competition has been taken from Dixit and Stiglitz (1977). The demand function of bank deposits and individual

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loans that have a downward slope and can consider a function of aggregate demand and prices can present as:

$$D_{t+1} = D_{t+1}(\frac{r^d_{t+1}}{r^d_{t+1}(i)})^{-\eta_d}$$
$$B_{t+1} = B_{t+1}(\frac{r^b_{t+1}}{r^b_{t+1}(i)})^{\eta_b}$$

To create entrepreneurial loans and accept savings deposits for households, banks use the labor force. So, for simplicity, the banks' production function can be considered as a linear form. So H^d_t and H^b_t are optimal labor force of deposit and loan which can define as:

$$H^d_t(i) = \gamma^d(i)D_{t+1}(i)$$
$$H^b_t(i) = \gamma^b(i)B_{t+1}(i)$$

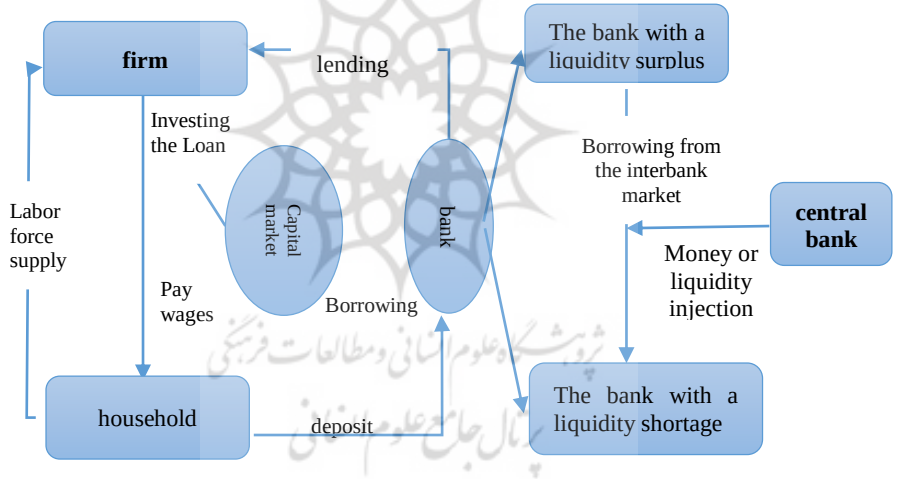

Figure 1. Conceptual model of research
Source: Research Findings

in these equations γ^d and γ^b indicate the heterogeneous bank behaviors, so the banks' steady-state path is:

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$$\gamma^b(i) - \gamma^d(i) = \rho_{\gamma^b}\left(\gamma^b_{t-1}(i) - \gamma^b_t(i)\right) + e^{\gamma^b}_t(i)$$

in which ρ_{γ^b} is a set of shocks that include the total banking system, and $e^{\gamma^b}_t$ is a shock that is considered as a random variable with the same distribution. Banks are allowed to operate in the deposit and loan market at the nominal interest rate r^L_{t+1}. The interbank loan rate is a function of the nominal interest rate r^{cb}_{t+1} determined by the central bank. To maximize the profit function, banks face a constraint as:

$$B_{t+1}(i) \leq D_{t+1}(i) + L_{t+1}(i)$$

Regarding the constraint mentioned above, banks maximize their profits, so have:

$$\Pi^B_t(i) = \left(1 - F_{t-1}(\bar{\omega}_t)\right)r^b_t(i)B_t(i) + \left(\frac{B_t(i)}{B_t}\right)(1-\mu)\bar{\varphi}^y_t - r^d_t(i)D_t(i) - r^L_t(i)L_t(i) + D_{t+1}(i) + L_{t+1}(i) - B_{t+1}(i) - w_t\gamma^b_t(i)B_{t+1}(i) - w_t\gamma^d_t(i)D_{t+1}(i)$$

in which $\pi^B_t(i)$ is the total profit that conveys to the households at the end of the period. w_t is nominal wage, and $F_{t-1}(\bar{\omega}_t)$ is the volume of loans the entrepreneurs have received in period t-1 but have not been able to repay in period t. μ is the cost of monitoring borrowers. $\bar{\omega}_t$ is the value of entrepreneurs' assets that have received the loan in period t-1 but have not been able to repay it in period t. $\pi^B_t(i)$ is the total profit conveyed to the households at the end of the period.

A bank has to choose one of three rates r^L_{t+1} ,$r^d_{t+1}(i)$, and r^b_{t+1}. In order to find the optimal rate, it is necessary to make the Lagrangian function between its constraints and its goal, as:

$$\mathcal{L}_t(i) = \mathbb{E}\sum_{k=0}^{\infty}\lambda_{t+k}\frac{\Pi^b_{t+k}(i)}{P_{t+k}} + \hat{\mu}_{t+k}(i)(D_{t+1+k}(i) + L_{t+1+k}(i) - B_{t+1+k}(i))$$

in which λ_{t+k} is equal to $\beta^k(\frac{C_t}{C_{t+k}})$, which shows the households' consumption substitution in different periods. If for simplicity, assume $\lambda_t = 1$, so the first-order condition will be:

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$$\frac{1-\gamma_t^d(i)w_t}{P_t} + \hat{\mu}_t(i) = (\frac{\eta_d+1}{\eta_d})\mathbb{E}\left[\lambda_{t+k} r_{t+1}^d(i) P_{t+1}^{-1}\right]$$
$$\frac{1-\gamma_t^b(i)w_t}{P_t} + \hat{\mu}_t(i) = \mathbb{E}\left[\lambda_{t+1}\left(1-F_t(\bar{\omega}_{t+1})\right)\left(\frac{\eta_b-1}{\eta_b}\right) r_{t+1}^b(i) P_{t+1}^{-1} + B_{t+1}^{-1}(1-\mu)\bar{\varphi}_{t+1}^y P_{t+1}^{-1}\right]$$

By simplifying the initial conditions, have:

$$P_t^{-1} + \hat{\mu}_t(i) = \mathbb{E}[\lambda_{t+1} r_{t+1}^L(i) P_{t+1}^{-1}]$$
$$\bar{r}_{t+1}^e = \left(\frac{\eta_b-1}{\eta_b}\right)\left(1-F_t(\bar{\omega}_{t+1})\right) r_{t+1}^b(i) + B_{t+1}^{-1}(1-\mu)\bar{\varphi}_{t+1}^y$$

in which $\bar{r}_{t+1}^e$ is the expected net nominal return of money unit of entrepreneurship loans. With substituting these relations in the first equation, have:

$$\mathbb{E}\left[\lambda_{t+1} r_{t+1}^d(i)\pi_{t+1}^{-1}\right] = \frac{\eta_d}{\eta_d+1}\left[\mathbb{E}[\lambda_{t+1} r_{t+1}^L(i)\pi_{t+1}^{-1}] - \gamma_t^d(i)w_t\right]$$
$$\mathbb{E}[\lambda_{t+1}\bar{r}_{t+1}^e(i)\pi_{t+1}^{-1}] = \frac{\eta_d}{\eta_d+1}\left[\mathbb{E}[\lambda_{t+1} r_{t+1}^L(i)\pi_{t+1}^{-1}] + \gamma_t^b(i)w_t\right]$$

– **Entrepreneurs**

Some assumptions about entrepreneurs are: they have their capital, hire labor force, supply their work, and do wholesale. They have a neutral risk-taking behavior and live for a limited number of periods. Entrepreneurs have a fixed probability of the survival of $\frac{1}{1-\gamma}$. At the end of period t, entrepreneurs buy the capital K_{t+1} and use it at t+1. Q_t is the price of each unit of capital. A part of capital purchase finance through an entrepreneur's own financial (internal financing) N_{t+1}, and its other part finances through borrowing from banks (external financing),B_{t+1}. Capital purchased in period t will be combined with the labor force employed in period t + 1 to produce the output in that period.

– **Producers**

Each entrepreneur uses both its capital and the labor rented to produce the wholesale goods using it. The technical production function with constant returns to scale in period t is:

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$$Y_t = A_t K_t^{\alpha}((H_t^p)^{\Omega}(H_t^e)^{1-\Omega})^{1-\alpha}$$

in which Y_t is total output, A_t is technological shock, K_t is total capital, H_t^p is households' labor force, and H_t^e is entrepreneurs' labor force. A_t follows a linear form as:

$$logA_t = \rho_a logA_{t-1} + e_t^a$$
$$\rho_a \in (0,1)$$

in which e_t^a has a normal distribution with mean 0 and variance σ_e^a.

The wholesale price considers as P_t^w. For converting it to real prices, it must divide by P_t. So have:

$$\alpha(\frac{P_t^w}{P_t})\frac{Y_t}{K_t}$$

Equating the cost of the labor force with its final product provides the initial condition of the labor market as:

$$w_t = \Omega(1-\alpha)\left(\frac{Y_t}{H_t^p}\right)\left(\frac{P_t^w}{P_t}\right)$$
$$w_t^e = (1-\Omega)(1-\alpha)A_t K_t^{\alpha}(H_t^p)^{(1-\alpha)\Omega}\left(\frac{P_t^w}{P_t}\right)$$

in which w_t is the labor force's real wage and w_t^e is the entrepreneurs' real wage.

– **Government and the monetary policies**

Real government spending follows a first-order autoregressive process as:

$$G_t - G = \rho_g(\mathrm{G}_{t-1} - \mathrm{G}) + \mathrm{e}_t^g$$

in which e_t^g has a normal distribution with mean 0 and variance σ_e^g.

The government finances its real expenditure through money creation or nominal income tax as:

$$G_t = \frac{(\mathrm{M}_t - \mathrm{M}_{t-1}) + \mathrm{T}_t}{P_t}$$

The government can target the benchmark nominal interest rate, r_{t+1}^{cb}, through monetary policy. The monetary policy that targets the level of inflation and the output gap is as follows:

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$$\frac{r_{t+1}^{cb}}{r^{cb}} = (\frac{r_t^{cb}}{r^{cb}})^{\rho_r}(\frac{\pi_t}{\pi})^{\psi_\pi}(\frac{y_t}{y})^{\psi_y}\exp(e_t^m)^{-1}$$

in which e_t^m has a normal distribution with mean 0 and variance σ_e^m.

In the DSGE model literature, the Taylor rule is commonly used to explain the monetary policy. Since the Taylor rule does not apply in the Iranian economy due to the law on interest-free banking, drawing an exclusive competition environment for the Iranian banking sector will not be appropriate. So, following other studies, it is assumed that the central bank's monetary policy tool is the monetary base's growth rate, which is determined in a discretionary manner to achieve the economic goals such as reducing deviation of current production from potential production or of the current inflation rate from target rate.

Therefore, it is assumed that the reaction function of monetary policies in the Iranian economy determines the monetary base growth respecting the deviation of current production from potential production and inflation from their target values. Additionally, it is assumed that the monetary reaction function is a log-linear form as follows:

$$\hat{\theta}_t = \rho_\theta \hat{\theta}_{t-1} + \theta_\pi(\hat{\pi}_t - \hat{\pi}_t^*) + \theta_y \hat{y}_t + \varepsilon_t^\theta$$
$$\hat{\pi}_t^* = \rho_{\pi^*} * \hat{\pi}_{t-1}^* + u_t^{\pi^*}$$
$$u_t^{\pi^*} \sim N(0, \delta_{\pi^*}^2)$$
$$\varepsilon_t^\theta = \rho_\theta \varepsilon_{t-1}^\theta + u_t^\theta$$
$$u_t^\theta \sim N(0, \delta_\theta^2)$$

in which $\hat{\theta}_t$ is the nominal growth rate of the monetary base. $\hat{\pi}_t$ and $\hat{y}_t$ are respectively logarithms of the inflation and output deviation from their steady-state level. θ_π and θ_y are the importance coefficients that policymaker considers for the inflation gap and output gap, respectively. $\hat{\pi}_t^*$ is the targeted inflation rate that is assumed to follows a first-order autoregressive process. ε_t^θ is the shock of monetary policy which follows a random process AR(1).

– **Oil sector:**

With regards to the special feature of the Iranian economy, the export incomes from crude-oil export, inserting the oil sector in the model is necessary to take into account this sector's shocks, too. Given exogenous crude oil production based on existing oil reserves and the quota set by OPEC, the process of oil production $O_t$is a first-order autoregressive process with coefficient $\rho_0 \in (-1,1)$ as follows:

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$$Log(O_t) = (1-\rho_0)Log(\bar{O}) + \rho_0 Log(O_{t-1}) + \varepsilon_{Ot}$$

O is this sector's shocks that randomly and exogenously affect the equilibrium values of oil revenues. We assume that all crude oil produced in the domestic economy is exported at world prices. Therefore, revenues from crude oil exports can be considered exogenous, given the exogenous global price of crude oil.

– **Market clear condition**

In our model, there is two equilibrium condition:

$$Y_t = C_t + C_t^e + G_t + \Phi(\frac{I_t}{K_t})K_t + \mu\phi_t^y$$
$$H_t = \mathrm{H}_t^P + \mathrm{H}_t^D + \mathrm{H}_t^b$$

The first equation is the market clear condition for the final goods. According to this condition, the total output must be exactly equivalent to the sum of the households and entrepreneurs' consumption, government expenditure, the resources used to create new capital goods, and the Bankruptcy cost. The second condition is the labor force market clearing's condition, which is satisfied when the labor force's demand and supply are equal.

4 Research Method and Model Estimation

In this research, the model used to estimate the parameters is the Bayesian method. In this method, the initial values of parameters combined with the maximum likelihood estimation results based on real data are determined as the prior distribution. If the initial information of prior distribution is complete and accurate, and the maximum likelihood estimate fails to aid the model estimate, the Bayesian method becomes the calibration method. Nevertheless, the Bayesian method becomes the maximum likelihood if the prior distribution information was entirely incorrect and inaccurate.

To calculate the log-linear variables (deviation from the steady-state of the variables), the logarithm of the data was extracted using the Blanchard-Kahn and the Hedrick-Prescott filter (HP) method with cyclical sectors λ = 677. Calibrating the parameters and indicators which are parabolic or do not need to be estimated before estimating the model parameters is necessary. These parameters are obtained through the values of the variables in the steady state. The average data of these ratios are considered values of their steady state, and there is no need to estimate them. The prior parameters like distribution, mean, and standard deviation must first be determined to estimate the

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Bayesian parameters. In Table 1, the prior and posterior means of model parameters and their distribution are provided. The posterior mean values display the model parameters estimated using the Bayesian method.

Table 1
The prior and posterior distribution of the model parameters

	quantity	parameter	posterior mean	prior mean	distributions of Parameters
Panel I: The retail sales' household and government					
Seasonal discount factor	0.9875	β	.967	0.968	*Beta*
The leisure tool parameter, 8 hours equivalent to one-third of a day	1.936	ξ	1.583	1.662	Gamma
marginal rate of substitution of final goods	0.5	η	0.531	0.493	Gamma
Calvo parameter	0.750	θ	0.78	0.772	Gamma
government's total expenditure (a proportion of total production)	0.2*Y	G	0.191	0.194	Gamma
Panel II: Production					
Capital share of production	0.66	α	0.6134	0.59	Beta
Household share of labor income	0.990	Ω	0.782	0.8	Beta
Capital adjustment cost	0.5882	χ	0.565	0.56	Beta
Annual depreciation 10%	0.1	δ	0.0878	0.0879	Beta
Panel III: Entrepreneurs					
Entrepreneurs success	0.9745	γ	0.951	0.949	Beta
Bankruptcy cost	0.1318	μ	0.124	0.123	Beta
Entrepreneurship shock distribution variance	0.6966	σF	0.72	0.719	normal
Panel IV: Banking sector					
The final cost of savings	0.0008356	γd	-2.34	-2.967	normal
The final cost of the loan	0.0004954	γb	0.00046	0.0004270	Inversion Gamma
Deposit's substitution elasticity	(4450.8) 7154.56	ηd	0.043	0.0927	Inversion Gamma
loan's substitution elasticity	(260.23) 260.36	ηd	0.0509	0.05	Inversion Gamma

Source: Research Findings

The Markov Chain Monte Carlo Diagnostic Test (MCMC) results show that there is no problem in estimating the model parameters. Dynare software simulates the Metropolis-Hasting algorithm several times, starting from a point each time. If the results of these chains are logical, they must behave similarly or converge toward each other. Extracted charts shown below are the same charts with the exact nature that provide a general understanding based on each parameter's variance-covariance matrix's specific values. Using these

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figures can give evidence for convergence and relative stability at all parameter moments. In all these figures, the horizontal axis represents the number of Metropolis-Hastings repetitions, and the vertical axis represents the parameters' moment. As shown in these figures, these two curves converge towards each other, which indicates a good fit for the model.

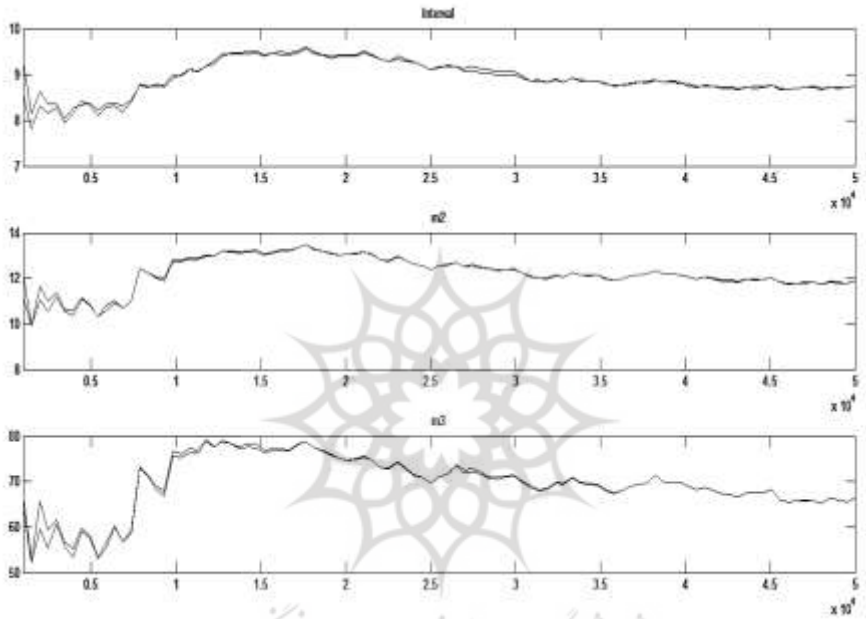

Figure 2. Brooks and Gelman multivariate diagnostic test.
Source: Research Findings

In the following, the dynamics of macroeconomic variables are investigated using the impulse response function of some important variables of the model against the shocks, including monetary policy (or liquidity volume) shock, productivity shock, fiscal policy (or government spending) shock, stock market demand-side (or demand increase) shock, stock market supply-side (or supply increase) shock, and bank loan shock.

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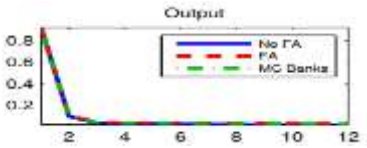
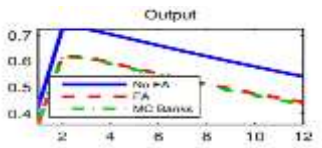
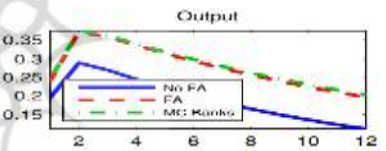
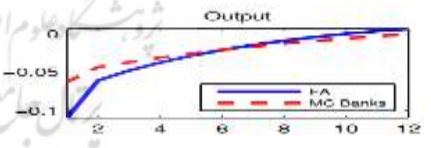
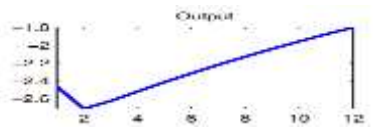
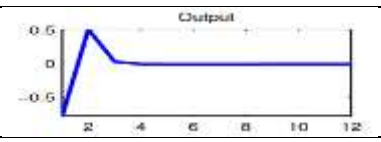
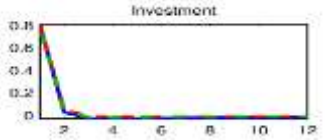
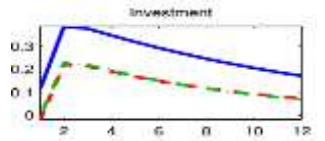
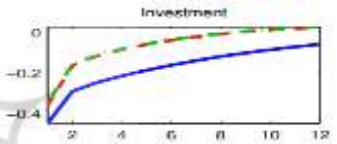
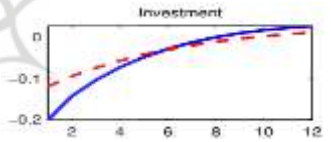
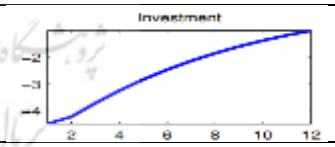
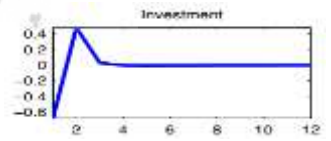
Table 2
The output[1] responses to different shocks

Results	**Type of shocks**	**the output responses to the examined shocks**
Monetary policy shock has a positive effect on GDP for up to 4 periods. The monetary policy shock does not influence the policy's effectiveness in the presence of a financial accelerator and monopoly banks.	expansionary monetary policy	
Productivity shock affects positively GDP. Based on the estimated results, the financial accelerator effect has reduced the effect of productivity shock on GDP. The presence of monopoly banks does not considerably induce the effect of the productivity shock on production.	positive productivity shock	
Fiscal policy shock has a positive effect on GDP. According to the results, the financial accelerator's effect has increased fiscal policy's effect on GDP. The presence of monopoly banks does not considerably induce the effect of the fiscal policy shock on production.	expansionary fiscal expenditure policy	
stock market demand-side shock has a positive effect on GDP. The presence of monopoly banks positively induces the effect of the stock market demand-side shock on production.	Stock market demand-side shock	
The effect of stock market supply-side shock on GDP is negative up to two periods and positive until the end of the period.	Stock market supply-side shock	
The effect of bank loan shock on GDP is positive for up to four periods.	the increase in the level of bank loans' shock	

Source: Research Findings

[DOI: 10.29252/jme.16.4.477]

Table 3
The investment responses to different shocks

Results	**Type of shocks**	**the investment responses to the examined shocks**
Monetary policy shock has a positive effect on investment for up to 3 periods. The monetary policy shock does not influence the policy's effectiveness in the presence of a financial accelerator and monopoly banks.	expansionary monetary policy	
Productivity shock impacts the investment in a positive way The results show that the financial accelerator effect has reduced the effect of productivity shock on investment. The presence of monopoly banks has the same effect as the financial accelerator on investment.	positive productivity shock	
Fiscal policy shock has also a positive effect on investment. Based on the results, the financial accelerator's effect has increased fiscal policy's effect on investment. The presence of monopoly banks has the same effect as the financial accelerator on investment.	expansionary fiscal expenditure policy	
stock market demand-side shock has a positive effect on investment. The presence of monopoly banks induces the effect of the stock market demand-side shock on investment for up to 6 periods and reduces it from the sixth to the end.	Stock market demand-side shock	
Stock market supply-side shock has an increasingly negative effect on investment up to the end of the period.	stock market supply-side shock	
The effect of bank loan shock on investment is positive for up to four periods.	the increase in the level of bank loans' shock	

Source: Research Findings

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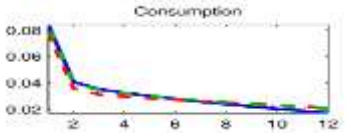
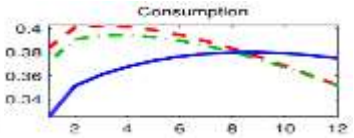
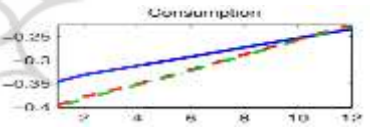
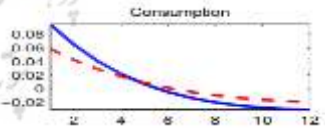
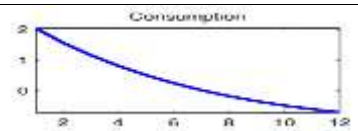
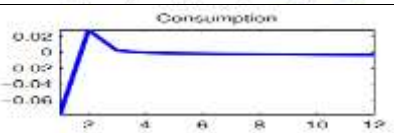
Table 4
The consumption responses to different shocks

Results	**Type of shocks**	**the consumption responses to the examined shocks**
Monetary policy shock has a positive effect on consumption for up to 4 periods. The monetary policy shock does not influence the policy's effectiveness in the presence of a financial accelerator and monopoly banks.	expansionary monetary policy	
Productivity shock has the same effect on consumption as it does on GDP and investment. The results indicate that the financial accelerator effect increases the effect of productivity shock on consumption for up to 8 periods and decreases it from the eighth to the end of the period. The presence of monopoly banks has a similar but stronger effect on consumption than the financial accelerator.	positive productivity shock	
Fiscal policy shock has an increasingly negative effect on consumption. According to the results, the financial accelerator's effect has increased fiscal policy's effect on consumption. The presence of monopoly banks has the same effect as the financial accelerator on consumption.	expansionary fiscal expenditure policy	
Stock market demand-side shock has a decreasingly positive effect on consumption. The presence of monopoly banks decreases the stock market demand-side shock effect on consumption up to the fifth period and strengthens it after that.	Stock market demand-side shock	
The effect of stock market supply-side shock on consumption is negative but decreasing.	stock market supply-side shock	
The effect of bank loan shock on consumption is positive for up to four periods.	the increase in the level of bank loans' shock	

Source: Research Findings

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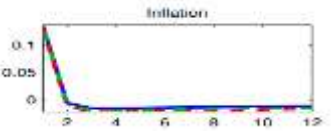
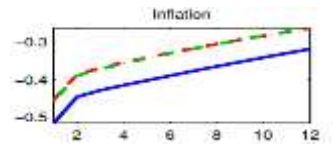
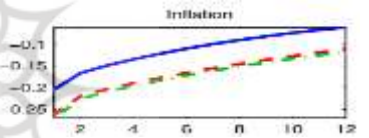
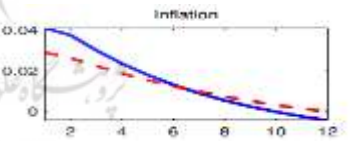
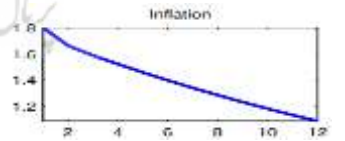
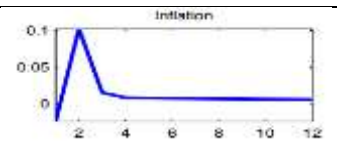
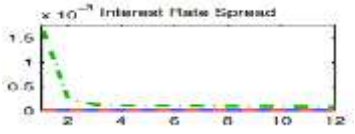
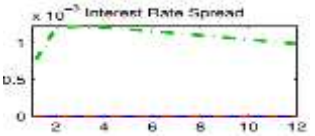
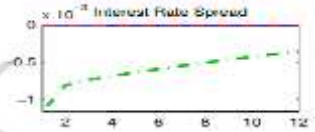
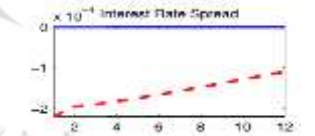
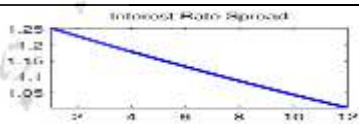
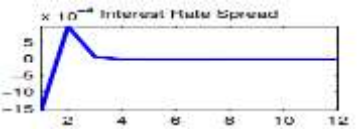
Table 5
The inflation responses to different shocks

Results	**Type of shocks**	**The inflation responses to the examined shocks**
Monetary policy shock has a positive effect on inflation for up to 4 periods. The monetary policy shock has not considerably influenced the policy's effectiveness in the presence of a financial accelerator and monopoly banks.	expansionary monetary policy	
Productivity shock has a positive effect on inflation. According to the results, the financial accelerator has decreased the effect of productivity shock on inflation. The presence of monopoly banks has not considerably induced the productivity shock' effect on inflation.	positive productivity shock	
Fiscal policy shock has an increasingly negative effect on inflation, So that this effect has become positive at the end of the period. According to the results, the financial accelerator's effect has reduced fiscal policy's effect on inflation. The presence of monopoly banks has reduced the affecting of the fiscal policy shock on inflation.	expansionary fiscal expenditure policy	
stock market demand-side shock has a positive but decreasing effect on inflation. The presence of monopoly banks decreases the stock market demand-side shock effect on inflation up to the sixth period and increases it after that.	Stock market demand-side shock	
The effect of stock market supply-side shock on inflation is positive but decreasing.	stock market supply-side shock	
The effect of bank loan shock on inflation is positive for up to the third period.	the increase in the level of bank loans' shock	

Source: Research Findings

[DOI: 10.29252/jme.16.4.477]

Table 6
The interest rate responses to different shocks

Results	**Type of shocks**	**The interest rate responses to the examined shocks**
Monetary policy shock has not significantly affected the interest rate. The monetary policy shock increases the policy's effectiveness in a financial accelerator's presence but does not affect it in monopoly banks' presence.	expansionary monetary policy	
Productivity shock has no significant effect on the interest rate. According to the results, the financial accelerator has decreased the effect of productivity shock on inflation. The presence of monopoly banks has not induced the productivity shock' effect on the interest rate.	positive productivity shock	
Fiscal policy shock does not affect the interest rate. According to the results, the financial accelerator's effect has induced fiscal policy's effect on the interest rate. The presence of monopoly banks has no significant influence on affecting the fiscal policy shock on the interest rate.	expansionary fiscal expenditure policy	
Stock market demand-side shock has no significant effect on the interest rate. The presence of monopoly banks increases the stock market demand-side shock effect on the interest rate. In other words, if the stock market return is positive, the loan demand and hence the interest rate increases.	stock market demand-side shock	
The effect of the stock market supply-side shock on the interest rate is positive but decreasing.	stock market supply-side shock	
The effect of bank loan shock on the interest rate is negative for up to two periods. It becomes positive from the second to the third period, and it is in the balance after that.	the increase in the level of bank loans' shock	

Source: Research Findings

5 Summaries and Policy Recommendations

This study examines the changes of the key macroeconomic variables caused by monetary and financial shocks with regard to the intermediary role of

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banks. Although the banking industry plays a key role in different economies, it is more important in the Iranian economy because of capital market deficiencies. Therefore, choosing an appropriate monetary strategy is essential for economies such as Iran which is exposed to various shocks. It should not be disregarded that the fluctuations of macroeconomic variables affect the banking system's performance, and one of the most critical challenges for the banking industry in any economy is the industry's response to economic shocks. It is so important because, in recent years, the banking industry in many developed economies has not been able to withstand economic shocks, and given banks' role in the money transfer mechanism, it has extended these shocks to other sectors of the economy. The following is a summary of the research results:

- Monetary policy shock has the greatest impact on output and investment variables and the least impact on interest rate variables.
- Productivity and Fiscal policy shocks have the greatest impact on the output variable and the least impact on the interest rate variable.
- The stock market demand-side shock has the greatest, decreasing positive effect on consumption and inflation variables. Also, the least effect of stock market demand-side shock is on the interest rate variable.
- The stock market supply-side shock has the greatest effect on consumption, inflation, and interest rate variables and the least effect on investment variables.
- Bank loan shock has the most positive effect on the inflation variable and the least on the investment variable.

The results show that the financial accelerator theory in the Iranian economy is true; based on the impulse response functions, banks' intermediary role was confirmed. In other words, banks' presence in the economy has increased the impact of economic policies on macroeconomic indicators. In other words, banks' presence in the economy has increased economic policies' impact on macroeconomic indicators. Accordingly, it is suggested that monetary policymakers pay attention to financial factors' role in the transfer mechanism and monetary policy intensity to control the effects of economic shocks on banks' performance. The results show that the demand-side shock does not significantly affect the interest rate, but the supply-side shock increases the interest rate. In other words, with the supply-side shock in the stock market, the negative total stock price index and hence exiting the money is possible. Therefore, considering that the stock market and the bank act as two parallel markets, the bank's interest rates will increase. However, there is no expected significant change in interest rates in a positive market with the

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demand-side shock. In other words, the inflow of liquidity into the banking system and, consequently, changing interest rates is not observed in this condition. In the Iranian banking system, there is the fact that the interest rate is imperatively determined, and banks do not optimize it. So it is recommended that banks try to develop a commission, not profit, for services, instead of sharing income to mitigate economic shocks' effects.

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