Research paper

Banking, monetary target policy and stock market shock

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Abstract:
This research has been investigated, economy and balance-sheet effects of the money growth rate targeting. According to financial statements of the banking network and national accounts, using dynamic stochastic general equilibrium New Keynesian and statistical data for the period 1991-2019.For estimating parameters, is used New Keynesian DSGE model and Bayesian method. This paper verify the validity of the model by analyzing the impulse response functions and Brooks and Goleman test. The results of the model indicate that the effect of negative the money growth rate targeting, reduce deposits, reduce loans interest rates, lead to reducing banks' resources, bank lending and then the health of the banks would compromise. In this way, investment and production will be reduced. Also, the effect of stock prices increasing, deposit, loan decrease and investment and production increase. Therefore, this research suggests the policy of negative the money growth rate targeting coincide with the policy of raising interest rates and stock price rising.

Keywords: Monetary policy, Target policy; Brooks and Goleman test; Stock price;

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Introduction

Banks as financial and service institutions have an important role in the circulation of money and wealth of society and therefore have a special role in the economy of any country. The desirable and effective activity of banks can increase the growth of various economic sectors and the quality and quantity of products. In fact, the main task of banks is to collect deposits, allocate credit, facilitate the flow of payments, provide the necessary information for intermediation, as well as tools for monetary policy. In a sound banking system, central banks define the control of low-level inflation and its stability in various economic conditions as the main goal of monetary policy. One of the models that can indicate the relationship between macroeconomics and banks' balance sheets is the dynamic stochastic general equilibrium model. The main purpose of these models is, explain the collective behavior of the economy, including the effects of monetary and fiscal policies. The difference between this method and other economic models is, this method is derived from the principles of microeconomics, which is in fact the optimization of the behavior of consumer and the producer. The dynamic nature of this method makes it possible to identify the dynamic effects of variables on each other. Given the macroeconomic conditions of Iran, especially in the field of monetary and credit policy, it seems that banks' balance sheets are strongly influenced by monetary policy. The reason for this claim is well known by looking at the trend of monetary and credit variables in different years. High inflation, high fluctuations in lending, the price of assets such as gold coins, currencies and stocks that affect the bank's deposits, are factors that strengthen the instability of the monetary and credit system. Therefore, the adoption of money growth rate targeting will not be ineffective on the balance sheets of banks. So, in this paper we investigate the effect of money growth rate targeting on banks balance sheet and macroeconomic, using dynamic stochastic general equilibrium model.

The contributions of this paper are: Given the fluctuations in the stock market in recent years, the money growth targeting effect despite stock market shocks have been examined. Given the importance of the stock market in recent years, stocks have been included in the utility function

as an asset which the household acquires utility. Stock price and money growth rate are AR(1). Stocks enter the production function as financial capital. The cost of non-asset-liability management has been modeled. For this purpose, this article has been prepared in 7 sections. In the second part, the theoretical framework of the mechanism of the impact of monetary policy targeting on banks' balance sheets and relationship of monetary policy and stock price shocks are stated. The background of the research is explained in the third section and the model is explained in the fourth section, and the model approximation is presented in the fifth section. The analysis of the results and reaction functions is reviewed in the sixth section, and in the final section, summary and policy suggestions are presented.

Literature Review and Background Research

The Mechanism of the Impact of Monetary Policy Targeting on Banks' Balance Sheets

A monetary targeting strategy comprises three elements:1) reliance on information conveyed by a monetary aggregate to conduct monetary policy, 2) announcement of targets for monetary aggregates, and 3) some accountability mechanism to preclude large and systematic deviations from the monetary targets (Mishkin (2000)).
In the existing literature, different channels for monetary policy transfer have been introduced. In fact, the main channels of money transfer are classified into four main sections: interest rate channel, exchange rate channel, durable asset price channel and credit channel (non-neoclassical approach to monetary policy transfer mechanism), which includes two channels of bank lending and balance sheet channels. In this regard, banks play a special role in the economic system in the interest rate channel, durable assets channel and credit channel.
The direct interest rate channel is the most traditional and oldest channel for transferring monetary policy to the real sector, which has been proposed in macroeconomic models. When monetary policy leads to an increase in short-term interest rates, long-term interest rates also tend to increase, because long-term interest rates depend on future short-term

interest rates. As a result of this increase, the cost of using capital increases and the demand for capital decreases.
A decrease in the demand for capital assets reduces investment costs in these assets and, ultimately, leads to a reduction in total costs and demand. Such an interest rate channel is at the center of the analysis of the old Keynesian IS-LM model, which dates back to the work of Hicks (1937). Of course, this channel has recently been shown in some new Keynesian models such as McCallum and Nelson (1996) and Kerr and King (1999).
According to the existing literature lending channel, since banks tend to deal with safe and risk-free borrowers, they are able to largely mitigate the problem of asymmetric information in the credit market. According to the credit channel framework, as a result of the implementation of a contractionary monetary policy by increasing interest rates, access to bank resources becomes more difficult and the cost of raising capital for small enterprises increases. In contrast, larger firms that have greater access to other markets and financial instruments will be less affected by the consequences of monetary policy (Mishkin,1995). Of course, it is believed that the money transfer mechanism by the credit channel not only affects the demand for loans (through interest rate fluctuations), but also is able to affect the supply of bank credit in the market, Also affect investment and consumption. In other words, the money transfer mechanism from the credit channel will affect both borrowers and lenders (Guntner Jochen,2011). In the same context, Bernanke and Blinder (1988) examined the monetary policy transfer credit channel through the statutory reserve ratio and showed that increasing the statutory reserve ratio affects the resources available to the bank and restricts the supply of credits. This effect is transmitted by the level and composition of the bank's assets, which are affected by changes in the interest rate and changes in the money supply. The basic premise of this model is that it cannot easily replace deposits with other sources such as certificates of deposit or issuance of securities.

Monetary Policy and Stock Price Shocks

In recent decades, it is important to examine the effect of the stock market on monetary policy. According to Greenspan (2002) and Bernanke and

Gertler (2001), monetary policy should focus on achieving low inflation and sustainable growth, rather than focusing on the consequences of the stock market bubble. In contrast to another view by Bordo and Jeanne (2002); Borio and Lowe (2002); Cecchetti, Genberg and Wadhwani (2002) argue that the central bank encourages precautionary measures against the bubble when stock prices rise to limit potential costs when the bubble collapses. First of all, it should be emphasized that the issue is not a stock bubble. If macroeconomics are affected by stock price fluctuations only through the wealth effect of aggregate demand, stock market control will not be a concern for monetary policymakers. Also, if the duration of the effect of changes in the stock price index is proportional to the effect of changes in interest rates, monetary policy makers will be able to offset the effect of asset price fluctuations without much change. In contrast, as pointed out by Borio and Lowe (2002) and Bordeaux Jane (2002), stock price bubbles tend to be accompanied by a set of signs including high investment and debt accumulation. The development of a bubble may initially be the result of a supply-side shock, but subsequently over-optimism about future returns increases the value of assets and increases lending to raise more capital. In addition, increasing the value of assets increases the value of collateral and facilitates the accumulation of debt. During the uptrend, the balance sheets appear sound because the increase in the value of the assets offsets the liabilities. But the bursting of the bubble leads to a sharp decline in borrowers' net worth and the possibility of an escalation in credit conditions. Such a credit crunch is likely to affect activity faster than normal. The effect of wealth temporarily reduces the effectiveness of monetary policy. It may therefore be difficult to neutralize the macroeconomic consequences of such financial instability.

In the literature, to show the reaction of monetary policy to the stock price bubble, stock prices have been included in Taylor's rule. Therefore, monetary policymakers, in addition to considering inflation stability and sustainable growth, must also consider financial stability. Price bubbles are the result of financial instability and production contraction. Therefore, a central bank that seeks stability in inflation and production over a certain time horizon must wait for the long-term adverse consequences of the asset price bubble in determining its policies (Bean 2003, 2004).

Monetary policymakers considering of the long-term effects of stock price index growth on output and inflation is important, but there are some fun-

damental problems in implementing. First, the policymaker must judge whether the increase in asset prices is due to the performance of the financial market or whether it is due to unrealistic expectations. Also, is rising stock prices a threat to macroeconomic stability in the future? The answer that stock price increases due to whatever factor should be controlled does not seem appropriate. Given that stock price boom occurs when there is improvement in the basic cases. It is easier to control stock price increases in the early stages of growth (Bean,2004).
Second, whenever the price bubble is large enough to be recognizable, a delay in the monetary policy transmission mechanism complicates the adoption of an appropriate monetary policy. If the bubble bursts, an increase in the official interest rate will not have a positive effect, as the economy will be exposed to the dual shocks of inflation, falling asset prices and the effect of intensifying the contractionary policy. Therefore, if the policymaker knows that the fall in asset prices is imminent, an expansionary monetary policy will be proposed instead of a contractionary monetary policy (Bean,2004).
Third, a small increase in interest rates may slightly prevent stock prices rising. But a large increase in interest rates will destabilize stock prices and have the opposite effect on economic activity. Therefore, policymakers must ensure that short-term costs can be offset by the long-term benefits of the monetary policy adopted (Bean (2004)).
The decline in stock prices is often associated with declines in economic activity and financial instability. A sharp drop in stock prices will not only have a wealthy effect on consumption, but will also reduce the value of collateral. The devaluation of collateral leads to a decrease in the supply of bank facilities, a sharp decline in stock prices, and a decline in economic activity and economic growth (Bean, 2004).
In this section, considering that the existing empirical studies have not specifically addressed the effects of money growth rate targeting, studies that have modeled money growth rate or introduced the banking network into a dynamic stochastic equilibrium model are introduced. In the present empirical studies, which use a dynamic stochastic general equilibrium framework to model money growth rate targeting, four sectors of household, firm, government and central bank have entered the model and has been used interest rate policy as a monetary policy tool. In these studies, it is assumed that the interest rate follows the Taylor rule. Thus, the interest rate has been a function of the interest rate in previ-

ous period, the deviation of inflation from the inflation targeted and the deviation of production from the stable situation. Some studies have also used money growth targeting.
Other studies have modeled the phenomenon of money growth in the context of a stochastic dynamic general equilibrium model. Based on this group of studies, the welfare effects of money growth targeting policy have been investigated. The results of the study show that the rule of money growth rate has an important role in stabilizing inflation and improving welfare, and controlling the growth rate of money can reduce inflation and instability of production. On the other hand, controlling the growth rate of money should be accompanied by targeting interest rates, to prevent imbalances in the banks' balance sheets. Stability in the balance sheets of banks due to their pivotal role in the economy can contribute to economic stability(Berg, Andrew; Portillo, Rafael and Unsal,D. Filiz(2010), Hwang & Ho,2012).
Moradi, et al (2021) investigate the effects of macroeconomic variables on stock price crash risk in the economically uncertain conditions of Irans market. This study also seeks to examine whether there is a significant relationship between some firm characteristics and falling stock prices. The sample of the study includes 152 Iranian companies listed on the Tehran Stock Exchange (TSE) between 2014 and 2019. Furthermore, the research model has been estimated using a fixed effect pattern, and the DUVOL (down-to-up volatility) measure is defined as a proxy for stock price crash risk. Consistent with their expectations, the results show that there is a positive association between the inflation and unemployment rates and stock price crash risk, whereas the GDP and exchange rates are correlated negatively with crash risk. In fact, with rising inflation and unemployment, on the one hand, the amount of savings and the purchasing power of the people have decreased, and on the other hand, it has reduced the sales of companies due to the increase in the pricing of manufactured products. In Irans economically uncertain situation due to sanctions, managers are trying to overstate financial performance and conceal bad news to have better access to financing; so, when the total amount of bad news accumulated over time reaches a tipping point, it leads to a stock crash. It also appears that when the exchange rate rises, Iranian investors prefer to buy companies shares to maintain the purchasing power of their money. Outcomes also confirm that larger firms and those with higher Return on Assets (ROA) are more sensitive to crash

risk.
Arabi (2020) compares the economic effects of money targeting with exchange rate targeting. Results indicate that the Sudan's central bank (CBS) is practicing less radical change in the formulating monetary policy, and is achieving slight progress in combating inflation and fostering economic growth. The nominal interest rate and the general price level have the same effect on the terms of monetary policy. The relationship between inflation and real marginal cost is weak. However, the position of interest rate in monetary policy is weak compared with the exchange rate. Finally, a one-point reduction in nominal interest reduces the output gap by 3%. The shock of inflation has the greatest effect on the endogenous variables, followed by shock to the consumer preference, real money supply, and finally shock to the general level of prices.
Albulayhi and Khawaja (2020) investigatesthe reaction of Saudi Arabia stock market to changes in the prices of crude oil. Considering the nonlinear relationship in the stock market to determine the asymmetric response in the result of positive and negative changes in crude oil by applying NARDL model. The study utilizes crude oil weekly price (the OPEC crude Basket price), and Saudi stock index TASI expressed in the US dollar, in weekly period basis starting at January 1995 until December 2018. The empirical analysis outcomes show that the Saudi Arabia stock market (index TASI) is affected by the shock's crude oil price in the long-term. Also, the Saudi Arabia stock market and shocks crude oil price show asymmetric cointegration. The research is significant for the Government of Saudi Arabia, as an OPEC policy maker, where fluctuations in crude oil prices affect its overall economy and financial markets. In addition to researchers, regulators and participants in the Saudi stock market will find this research useful in order to predict the movement of shares and the expected returns from them.
Arimurti and Morley (2020) determine if capital flows can account for the international effects on domestic monetary policy, using an augmented Taylor rule model. In addition to the standard
determinants of nominal interest rates, they include capital flow measures to show how central banks consider this important factor when deciding on the most appropriate monetary policy. Using a panel of inflation targeting economies and the dynamic panel approach, this study finds that capital inflows and outflows are an important determinant of nominal interest rates.

Kelikume and Omotato (2019) examined the impact of oil price on African stock markets. Using quarterly data from five selected oil producing countries with stock market presence, from Q1:2010 to Q4:2018, the study deployed dynamic panel analysis technique for a model comprising stock returns, real gross domestic product growth rate, exchange rate and OPEC basket price. From the findings, an adverse effect of oil prices existed on stock markets in Africa, attributable to fragmented and underdeveloped capital markets. Also, real gross domestic product growth rate had a positive impact on African stock markets, thus, confirming that economic growth positively influences stock returns in the African stock markets. The relationship exhibited by stock markets and the oil price has an immediate implication of shifting foreign direct investments in and away from stock markets in African oil-dependent economies. Based on the empirical findings, the study recommended that oil-exporting developing countries should devise strategies that can ensure stability in their capital markets by vigorously pursuing pro-growth policies irrespective of the shocks in oil price and other exogenous macroeconomic indicators.
Broni, Hosen and Saiti (2018) determine which financial sector leads, the stock market or banking sector. Using standard time series econometric method, monthly data covering a period of about 22 years were analyzed. The results indicate that stock market Granger-causes banking sector development, with GDP, sandwiched between them. Policy-makers who are desirous of developing the banking sector may do so through influencing (hitting) the stock market or economic growth. However, to develop the stock market, the main option available is to try and influence interest or exchange rates.
Schwandt (2018) exploit the booms and busts in the US stock market as a naturaexperiment that generated considerable gains and losses in the wealth of stock-holding reirees. Using datafrom the 1998-2011 health and retirementstudy, he construct wealth shocks as the interaction of stock holdings with stock market changes and strongly affect health outcomes. A 10 percentwealth loss leads to anof 2-3 percent of a standard deviation in physical health, mental health and survival rates.
Junying Han and Zhang (2018) study the impact of Chinese monetary and fiscal policy shocks and the interaction of the two policies on stock markets. They find that, first, when they focus on the contemporaneous correlation, Chinese fiscal policy has significant, negative contemporaneous relationships with stock market performance, while monetary policys

impact on stock market performance varies, depending on the fiscal policy. Second, with respect to the lagged variables, Chinese monetary and fiscal policy both have a significant and direct positive effect on stock market performance. Meanwhile, interaction between the two policies plays an extremely important role in explaining the development of stock markets.

Mishkin (2000) examines the effects of inflation targeting and monetary policy targeting in industrialized countries. The results show that monetary targeting is more successful in controlling inflation than inflation targeting. Inflation targeting has better economic effects than monetary targeting in countries that choose independent domestic monetary policy. Comparing the economic and inflationary effects of m2 and m3 in Barthelemy, Clerc and Marx (2011) indicates that m3 has a better role than m2 in creating economic stability and controlling inflation in ECB. Pakdeesana (2016) explore the optimal monetary policy under different disturbances in the economy. There exist three candidates in this policy debate, namely Conventional Inflation Targeting (CIT), Exchange rate and Inflation rate Targeting (EIT), and Exchange rate-Based Inflation Targeting (EBT). The objective of this research is to study the role of exchange rate in monetary policy, to test the effectiveness of each policy under alternative shocks by employing welfare analysis using Taylor Curve, impulse response function analysis, and the cyclical properties of macroeconomic variables analysis. The analysis using Taylor curves shows that Conventional Inflation Targeting, which targets only inflation and output gap, outperforms other policies under internal shocks, domestic production and labor preference shock. Conversely, under external shocks, such as foreign inflation and foreign domestic commodity demand shock, adding exchange rate to the reaction function improves welfare. Moreover, utilizing exchange rate as the main policy tools instead of interest rate is not preferable for the small open economy with an intermediate level of openness as it is inferior to other regimes. Overall, there is no clear-cut evidence which regime performs best from the welfare perspective as it depends on the type of shocks.

Bashiri, Pahlavani and Boostani (2017) investigate the movement between stock market bubbles and fluctuations in aggregate variables within a DSGE model for the Iranian economy. They apply a new Keynesian monetary framework with nominal rigidity in wages and prices, which is developed with appropriate framework for the Iranian economy. They

consider central bank behavior different from Taylor Rule, and they suppose an economy with oil export. In order to study the role of money in economy, we apply Money in Utility approach. They study the TFP shock, the monetary policy shock, the government spending shock, the oil income shock and the sentiment shock. Bubbles in their model emerge through a positive feedback loop mechanism supported by self-fulfilling beliefs. Moreover, a sentiment shock drives the movements of bubbles that explain most of the stock market fluctuations and variations in real economy. The result of calibrated model reveals a relation between moments of variables in the model and moments of real data in the economy. Ravn (2013) studies the effects of such a policy in a DSGE model. The asymmetric policy rule introduces an important non-linearity into the model: Booms in output and inflation tend to be amplified, while recessions are dampened. Moreover, such a policy gives rise to expectations-driven booms in asset prices. They further investigate to what extent an asymmetric stock price reaction could be motivated by the desire of policymakers to correct for inherent asymmetries in the way stock price movements affect the macro economy.
Gali and Monacelli (2005) lay out a small open economy version of the Calvo sticky price model, and show how the equilibrium dynamics can be reduced to a simple representation in domestic inflation and the output gap. They use the resulting framework to analyse the macroeconomic implications of three alternative rule based policy regimes for the small open economy: domestic inflation and CPI-based Taylor rules, and an exchange rate peg. They show that a key difference among these regimes lies in the relative amount of exchange rate volatility that they entail. They also discuss a special case for which domestic inflation targeting constitutes the optimal policy, and where a simple second order approximation to the utility of the representative consumer can be derived and used to evaluate the welfare losses associated with the suboptimal rules.

Methodology and Model

In this paper, we using DSGE model to explain the effects of money growth rate targeting and stock price shocks on banks balance sheet and macroeconomic. Banking system has been modeled using Dib (2010).

Money growth targeting has been modeled using Arabi (2020). Stock market has been modeled using Bashiri, Pahlavani and Boostani (2017). The model consists of six sections: households, firms, banks, government, oil and monetary authority. The model of this article is based on the prevailing reality of Iranian central bank The bank interest rate determination tool, which shows the channel for transferring monetary policy to the banks' balance sheets, has been used as a monetary policy tool. Also, considering that one of the goals of the Iranian central bank is price stability, so it has been tried to model the money growth rates targeting as goals that can help the central bank to achieve price stability.
Contribution of this model is:

(i) Stock enter in the production function as financial capital.

(ii) Stock prices are considered as an AR(1).

(iii) Given the reality of the Iranian's economy that firms need to receive loans from the banking network to provide working capital, this issue has been considered in modeling.

(iv) Banking system has been modeled using Dib(2010). But in this model, the cost of non-asset-liability management has been added to the Dib(2010).

(v) For debt to the central bank, debt to the banking network and receivables from the banking network, behavioral functions are defined based on the facts of the Iranian economy and the banking network.

(vi) In the government budget, government debt to the central bank has been used.

Household

The economy is assumed to consist of similar households that live indefinitely and choose the consumption of goods and services c_t , real money m_t^h , the supply of labor N_t that$N_t = \int_0^1 N_{j,t} d_j$, the deposits D_t that $D_t = \int_0^1 D_{jt} d_t$, shares s_t and the holding of bonds B_t using relationship (1) to maximize utility function. These households receive interest rates

$R_t^d = 1 + r_t^d$ and receipts $R_t^b = 1 + r_t^b$, respectively, in return for depositing in banks and buying bonds. The present value of the utility that the household acquires will be as follows.

$$\sum_{s=0}^{\infty}(\beta^h)^s E_t\Big[\frac{(c_t)^{1-\sigma_c}}{1-\sigma_c} - \frac{(N_t)^{1+\sigma_n}}{1+\sigma_n} + \frac{(m_t^h)^{1-\vartheta}}{1-\vartheta} + \frac{(s_t)^{1-\sigma_s}}{1-\sigma_s}\Big] \tag{1}$$

Where E_t is The expectation factor , β is the discount factor, σ_c the inverse of the inter-time substitution elasticity, σ_l the inverse of the inter-temporal substitution elasticity, σ_s is elasticity of stock porice. ϑ is elasticity of money demand.
The household maximizes its preferences over its budget constraint (Equation (2)) and its capital stock relationship (Equation (3)).

$$\begin{aligned} m_t^h + c_t + b_t + s_t + d_t = w_t N_t + (1 + r_{t-1}^b)(\frac{b_{t-1}}{\pi_t} + r_t^k k_t) + (\frac{m_{t-1}^h}{\pi_t}) \\ + (p_t^s + D_t)(\frac{s_{t-1}}{\pi_t}) + (1 + r_{t-1}^d)(\frac{d_{t-1}}{\pi_t} + \frac{\pi_t^f}{p_t} + \frac{\pi_t^b}{p_t}) \end{aligned} \tag{2}$$

m_{t-1}^h is the actual amount of money in previous period, T_t is the tax paid to the government,i , is the actual investment, k_t is the capital balance, $d_t = \frac{D_t}{P_t}$ is the amount of the actual deposit, $b_t = \frac{B_t}{P_t}$ is the actual bonds, s_t is actual stock.

$$K_{t+1} = (1-\delta)K_t + i_t - \frac{\phi_k}{2}\Big(\frac{K_{t+1}}{K_t} - 1\Big)^2 K_t \tag{3}$$

$\frac{\phi_k}{2}\Big(\frac{K_{t+1}}{K_t} - 1\Big)^2 K_t$ is the cost of capital adjustment. An autoregressive function is defined for stock prices and dividends (Equations (4) and (5)).

$$\begin{aligned} p_t^s = \rho_s p_{t-1}^s + \varepsilon_{t,ds} \qquad & \rho_s \in (0,1) \\ & \varepsilon_{t,s} \sim N(0, \sigma_{p_t^s}) \end{aligned} \tag{4}$$

$$\begin{aligned} d_t = \rho_{ds} d_{t-1} + \varepsilon_{t,ds} \qquad & \rho_{ds} \in (0,1) \\ & \varepsilon_{t,ds} \sim N(0, \sigma_{d_t}) \end{aligned} \tag{5}$$

The household tries to maximize its utility function according to the budget constraint. After the constrained optimization by the household, the first-order conditions of the household optimization problem with respect to $c_t, n_t, k_t, m_t, b_t, s_t$ and d_t .

Firms

There is a representative firm that buys j intermediate goods and produces the final product using the Dixit - Stiglitz function.

$$Y_t = \Big(\int_0^1 Y_{jt}^{\frac{\theta-1}{\theta}} d_j \Big)^{\frac{\theta}{\theta-1}} \tag{6}$$

Y_{jt} is the intermediate commodity j and θ is the elasticity of constant substitution between the intermediate commodities and $\theta > 1$. The final commodity producer tries to determine its purchase of intermediate goods according to the price of the distinctive intermediate goods in such a way that its profit is maximized, and as a result the demand function for the distinctive product produced by each intermediary firms is:

$$Y_{jt} = \big(\frac{P_{jt}}{P_t}\big)^{-\theta} Y_t \tag{7}$$

That the demand for commodity $j \frac{P_{jt}}{P_t}$ is a function of the relative price (the ratio of its price to the price of the final commodity) and the production of the final commodity. The price of the final product will be:

$$P_t = \big(\int_0^1 P_{jt}^{1-\theta} d_j \big)^{\frac{1}{1-\theta}} \tag{8}$$

Each producer produces intermediate goods with a combination of physical capital and stock and labor and sells them in the conditions of imperfect competition. $\alpha \in (0,1)$ is the share of capital and stock in production, and A_t represents the technological shock that follows the first-order autoregressive process in Equation 10.

$$Y_{jt} = A_t N_{jt}^{1-\alpha} (K_{jt} S_{jt})^{\alpha} \tag{9}$$

$$A_t = \rho_A A_{t-1} + (1-\rho_A)\overline{A} + \varepsilon_{A,t} \qquad \rho_A \in (0,1), \varepsilon_t^A \approx N(0, \sigma_{\zeta^A}) \tag{10}$$

The Rotemberg (1982) rule is used for cost adjustment price.

$$PAC_t^j = \frac{\varphi_f}{2} \Big(\frac{P_{jt}}{(\overline{\pi}) P_{jt-1}} - 1 \Big)^2 Y_t \tag{11}$$

$\varphi_f \geq 0$ is, the parameter of the adjustment cost or the degree of price stickiness $\overline{\pi}$ is the inflation rate in a stable equilibrium state.

Firms in Iran need to receive loans from the banking network to provide working capital, it is assumed that each firms receives L_{jt} loan from the bank at the beginning of each period and finances cost of capital and labor γ . The amount of loan received is:

$$L_{jt} = \gamma(P_{jt} r_t^k K_{jt} + P_{jt} W_t N_{jt}) \tag{12}$$

r_{jt}^l is the loan repayment rate at the end of the period.
The firm seeks to maximize the total current and future real profits:

$$E_t \sum_{s=0}^{\infty} \left[(\beta^s) \frac{\pi_{t+s}^f}{P_{t+s}} \right] \tag{13}$$

In which the nominal profit function using the model of Agnor et al. (2012) is:

$$\pi_{jt}^f = P_{jt} Y_{jt} - P_t mc_t Y_{jt} - PAC_t^j \tag{14}$$

The firm maximizes the expected profit according to the relations (6) to (12) and in relation $K_{jt}, S_{jt}, N_{jt}, P_{jt}$.

Bank

It is assumed that there is a representative bank that carries out intermediation operations in the conditions of monopoly competition, by allocating deposits to credits. Despite the existence of a monopoly competitive market in the banking system, the bank does not determine the deposits interest rate and it is set by the central bank as a monetary authority. The balance sheet of the representative bank is divided into two parts: assets and liabilities. In the asset sector, it is assumed that there are loans L_t^b to the non-banking sector with interest rate r_t^l and loan to the banking sector l_l^i with interest rate r_t^i . The bank may face default rates α^b due to non-repayment of loans and revenue is $(1-\alpha^b)(1+r_t^l)L$ if the bank repays in full. On the debt side, deposits interest rate is r_t^d . Bank borrows from the interbank market D_t^i at interest rates r_t^i and debt to the central bank D_t^c is at interest rates r_t^c. In the Iranian's banking network, the following relationship is established between the existing interest rates.

$$r_t^d < r_t^i < r_t^l < r_t^c \tag{15}$$

Considering that borrowing from the banking network and the central bank for banks, has cost of non-asset-liability management, Therefore, in this article, the second degree cost is considered for adjusting the debt to the banking network and the debt to the central bank.

$$\frac{1}{2}\Big[\varphi_{di}(D_t^i)^2 + \varphi dc(D_t^c)^2\Big] \tag{16}$$

Therefore, the bank's profit function is:

$$\begin{aligned}\pi_t^b = {} & (1-\alpha^b)(1+r_t^l)L_t - (1+r_t^d)D_t - (1+r_t^i)D_t^i \\ & - \frac{1}{2}\Big[\varphi_{di}(D_t^i)^2 + \varphi dc(D_t^c)^2\Big] - (1+r_t^c)D_t^c\end{aligned} \tag{17}$$

Which is maximized according to:

$$l_t = d_t^i + (1-\eta)d_t + d_t^c - l_t^i \tag{18}$$

According to the realities of Iran's economy and the Iran's banking network, facilities to the interbank market, debt to the banking network and debt to the central bank are defined as relations (19), (20) and (21). Interbank is affected by bank deposits and the amount of loans offered to the interbank market of the previous period. So that it can lend part of the deposits to the interbank market and as a result, with the increase of deposits, lending to the interbank market will increase.

$$l_t^i = (l_{t-1}^i)^{\varphi_{li1}^{li}}(d_t)^{\varphi_{lii}^{d}} \tag{19}$$

Debt to the banking network is a function of the debt to the banking network of the previous period and production, so that increasing production will increase the demand for loans and banks will be borrow from the interbank market if resources are insufficient. On the other hand, debt to the banking network of previous periods will have a positive effect on current period debt.

$$d_t^i = (d_{t-1}^i)^{\varphi_{d1}^{di}}(y_t)^{\varphi_{di}^{y}} \tag{20}$$

Insufficient bank resources and negative bank accounts have forced banks to borrow from the central bank to compensate for the lack of resources. Due to the recession in the Iran's economy, the Iran's banks have turned to the interbank market. They prefer to move from lending to the non-banking sector to lending to the interbank market, and if resources are

insufficient, they borrow from the central bank. Accordingly, for debt to the central bank in the Iranian's banking network is:

$$d_t^c = (l_t^i)^{\varphi_{dc}^{li}} (d_t^i)^{-\varphi_{dc}^{di}} \tag{21}$$

After the constrained optimization by the bank, the first order conditions of the bank optimization problem respect to d_t^c, d_t^i, d_t, l_t are obtained.

Central Bank, Government, Oil Sector

The central bank is the monetary authority and one of the economic policymakers. Given that in Iran interest rates obtain by the Central Bank. So in this article monetary authority is able to adjust the deposit interest rate. In modeling central bank behavior, it is assumed that the monetary authority follows the adjusted Taylor rule in setting policy rates. In Equation 22, the deposit interest rate depends on the difference between the deposit interest rate of the pre-steady period, the current period inflation and the inflation in steady state, the difference between GDP and steady state GDP and the difference between money growth in the current period and target money growth.

$$(1 + r_r^d) = \Big(\frac{1 + r_{t-1}^d}{1 + \overline{r}^l}\Big)^{w_r} (\frac{1 + \pi_t}{1 + \overline{\pi}})^{w_\pi} (\frac{y_1}{\overline{y}})^{w_y} (\frac{\mu_t}{\mu_t^*})^{w_{\mu^*}} \varepsilon_{t,r} \tag{22}$$

$$\tilde{\mu}_t = \frac{\tilde{m}_t}{\tilde{m}_{t-1}} \tilde{\pi}_t \tag{23}$$

Where $\overline{r}^d, \overline{\pi}, \overline{\mu}, \overline{y}$ respectively, are interest rates, inflation, money growth rates and production in equilibrium. As a result, the central bank determines the deposits interest rate according to the growth rate of production and inflation. ρ_π, ρ_y, ρ_r and ρ_μ are respectively the weights related to the variables of inflation, production, past interest rate and growth rate of money in monetary policy. $\varepsilon_{t,r}$ is also due to a mistake in the central bank's policy in determining bank interest rates. This shock enters directly into the monetary policy rule and, as an exogenous and random variable, affects the interest rate. In this study, μ^* is money growth target . In Iran, the central bank has no explicit goals to be announced to the public.

In Iran, the central bank has no explicit goals to be announced to the public. However, due to the goal setting in development plans, policymakers always try to pursue an implicit goal. Accordingly, in the reaction

function presented in this paper, it is assumed that money growth rate target is invisible variables that is only available to policy makers and other economic agents are not aware of it. It has been hypothesized, as in the studies of Kadank (2012) and Khan and Kenatek (2012) that the implicit goals are AR(1).

$$\mu_t^* = \rho_{\mu^*}\mu^*{}_{t-1} + (1-\rho_{\mu^*})\overline{\mu}^* + \varepsilon_{\mu^*} \qquad \rho_{\mu^*} \in (0,1) \quad \varepsilon_{\mu^*} \approx N(0,\sigma^2_{\mu^*}) \tag{24}$$

The balance sheet of the Central Bank is:

$$mg_t + d_t^c = m_t^h + d_t = m_t \tag{25}$$

Where m_t is money supply, d_t^c bank debt to the central bank, mg_t government debt to the central bank, m_t^h liquidity in the hands of the people, and d_t total deposits. In this article, like
Revenues from oil exports are defined by an AR (1) process:

$$or_t = \rho_{or} or_{t-1} + (1-\rho_{or})o\overline{r} + \varepsilon_{or,t} \qquad \varepsilon_{t,or} \approx N(0,\sigma_{\varepsilon_t,or}) \tag{26}$$

or_t is, the actual oil revenue in period t and $o\overline{r}$ is a steady state of oil revenue. Oil revenue is determined to be obtained. The government budget is:

$$g_t = or_t^{v1} t_t^{v2} mg_t^{v3} \tag{27}$$

Tax is:

$$t_t = \phi_t^y y_t \tag{28}$$

Market settlement condition

The settlement condition of the final commodity market is:

$$y_t = c_t + i_t + g_t + ac_t \tag{29}$$

Model Estimation

Solve the Model

The model of this paper, using the first-order conditions of households, firms, banking network and also considering the behavioral functions of

government, central bank and oil sector, market settlement conditions and various shocks has 32 equations and 32 parameters. Then, by applying the assumption of symmetry, the variables k_{jt} , N_{jt}, y_{jt} , P_{jt}, l_{jt}, l^i_{jt}, d_{jt}, d^i_{jt} ,d^c_{jt} are considered equal to k_t , $N_t, y_t, P_t, l_t, l^i_t, d_t, d^i_t, d^c_t$ respectively. Next, the equations extracted from the first-order optimization conditions are linearized using the Ohlig method. In fact, in this research, based on Ohlig's method and model, the parameters specified by weight (w) based on the equation of monetary policy (interest rate) and its coefficients have been extracted (estimated) using EViewseconometrics software version (9) and then those extracted estimated coefficients have been used as calibration criteria in the Bayesian method. In the next part, i.e., in the part of solving the model, the coefficients (r), sigma (σ) and (w) extracted according to the equation, and its results are also shown in table number (1) (Tavakolian and Sarmi, 2016).

Before estimating the parameters, it is necessary to calibrate the parameters that do not need to be estimated. To calculate the steady state value of the hypothetical series X_t , the equation $\log(X_t) = C' + r'$ trend is first estimated according to the ordinary least squares method for this series, in which C' and r' is intercept and the coefficient of the trend, respectively, and the antilog intercept gives the value of this series in the steady state of equilibrium.

The previous values of the parameters have been calibrated to reflect the main characteristics of the Iranian economy during the period 1981-2019. Discount factor and depreciation rate have been selected according to the model solution conditions. Some parameters such as capital adjustment cost, price adjustment cost, central bank debt adjustment cost and banking network debt adjustment cost have been quantified based on previous studies and others such as weight of variables. Monetary policy, the weight of the debt function to the banking network, debt to the central bank, and receivables from the banking network and taxes are calculated using Eviews9 software according to the behavioral function defined for them. The selection of the process parameters of oil shock and money growth rate targeting shock has been done using de-trended data for the mentioned variable in the Iranian economy during the period 1981-2019 and estimating the following pattern:

$$\log(X_t) = c + \rho \log(X_{t-1}) + \varepsilon_{x_t} \tag{30}$$

The value is entered as the autoregression coefficient and the standard deviation of the regression residual is entered as the variable standard deviation in the model. The exogenous process parameters of productivity shock and stock price shock are selected according the model structure. Then the parameters are estimated using Bayesian method and Metropolis-Hastings model. Using the Metropolis-Hastings algorithm, a parallel chain with a volume of 300,000 is extracted to obtain the posterior density of the parameters. Next, to estimate the other parameters, the distribution, mean, and standard deviation of the previous parameters must be determined. By considering the initial values for the mean and standard deviation of the parameters, the parameters can be estimated using the Bayesian method. It should be noted that the previous distribution for each parameter was selected based on the characteristics of parameter and the characteristics of distribution.
The very close similarity between the prior and posterior densities means that either the mean prior probability density is correct or that no more information can be extracted from the probability function and the initial data. If the second case is correct, Bayesian results mean that these parameters have been calibrated. Two univariate and multivariate diagnostic tests by Brooks, S. P. and A. Gelman. (1998) are used to evaluate the accuracy of Bayesian method estimates. Based on the univariate test of variance within the sample and between samples, all parameters are close to each other and finally converge to a fixed value. Using Bayesian method have good accuracy. The conformity of the calculated view with the maximum posterior density logarithm for all parameters indicates the accuracy of the estimates. Table 1 indicate some prior and posterior.

Table 1: Prior and Posterior

Parameters	Prior distribution		Calibrated from	Posterior distribution	
	Mean	deviation		mean	deviation
w_r	0.802	0.01	Author calculations	0.6292	0.05
w_π	0.89	0.01	Author calculations	0.6292	0.05
w_y	0.36	0.01	Author calculations	0.3951	0.03
w_{μ^*}	0.81	0.01	Author calculations	0.85	0.01
ρ_{μ^*}	0.65	0.01	Author calculations	0.69	0.03
σ_s	0.90	0.01	Author calculations	0.89	0.001
ρ_{pis}	0.75	0.01	Author calculations	0.7063	0.001

Reaction Function

In this section, according to the purpose of the article to investigate the economic and banking effect of targeting money growth in term of stock market instability, the designed model is estimated despite targeting money growth and stock market shock. In the following, the banking and economic effects of the shock of increasing stock prices, the banking and economic effects of the shock of reducing the money growth rate targeting are examined. In this article, it is assumed that the central bank, despite increasing money, money growth rate targeting is less than the real growth.
Figure 1 shows the effect of stock price shock on banking variables. With stock prices rising and the stock market booming, households are withdrawing deposits from banks and investing in the stock market. With the withdrawal of deposits and its reduction, the ability of banks to offer facilities decreases. In response to this phenomenon, the central bank will increase the deposits interest rate, consequently, the loan interest rate, the loan to the banking network interest rate and debt to the central bank interest rate will also increase. In response to rising interest rates, deposits and loans rise. Banks increase lending to the banking network by increasing interest rates of loans to the banking network.

Consumption is expected to increase based on the wealth effect hypothesis of rising stock prices. But household consumption increases on the one hand as stock prices rise and household wealth improves, and on the other hand it decreases as deposits interest rates increase. Since the increase in deposits interest rates is mainly greater than the increase in stock prices, total consumption decreases. But investment improves as stock prices rise. As firms are forced to increase dividends as stock prices rise, their final costs increase. But because the effect of increasing investment is greater than the effect of increasing final cost, production increases. As stock prices rise and firms' final costs rise, so prices increase.

By reducing the money growth rate targeting, the central bank reduces interest rates. As the deposits interest rate decreases, so loan the interest rate decrease. On the other hand, due to the reduction of interest rates on deposits and loans, banks also reduce the interest rate on the interbank market, and the central bank reduces the interest rate of debt of banks to the central bank. Reducing interest rates on deposits will cause

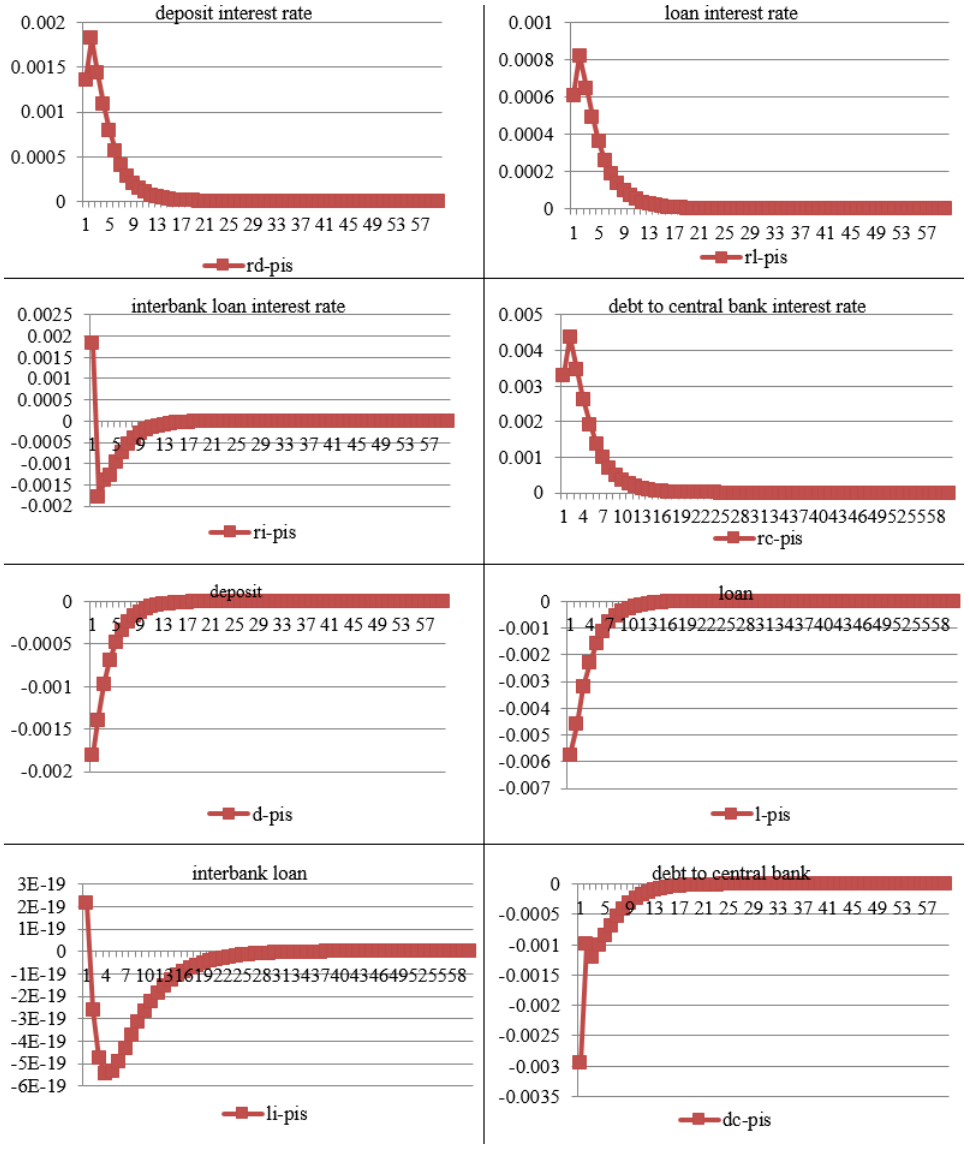

Figure 1: Banking and Stock Price shock

resources to flow out of banks. Due to the reduction of resources due to the reduction of interest rates on deposits, the lending power of banks is reduced. Although reducing the lending power of banks reduces the likelihood of non-performing loan, because the supply of loans generates interest income for the bank, the bank's income and thus profitability

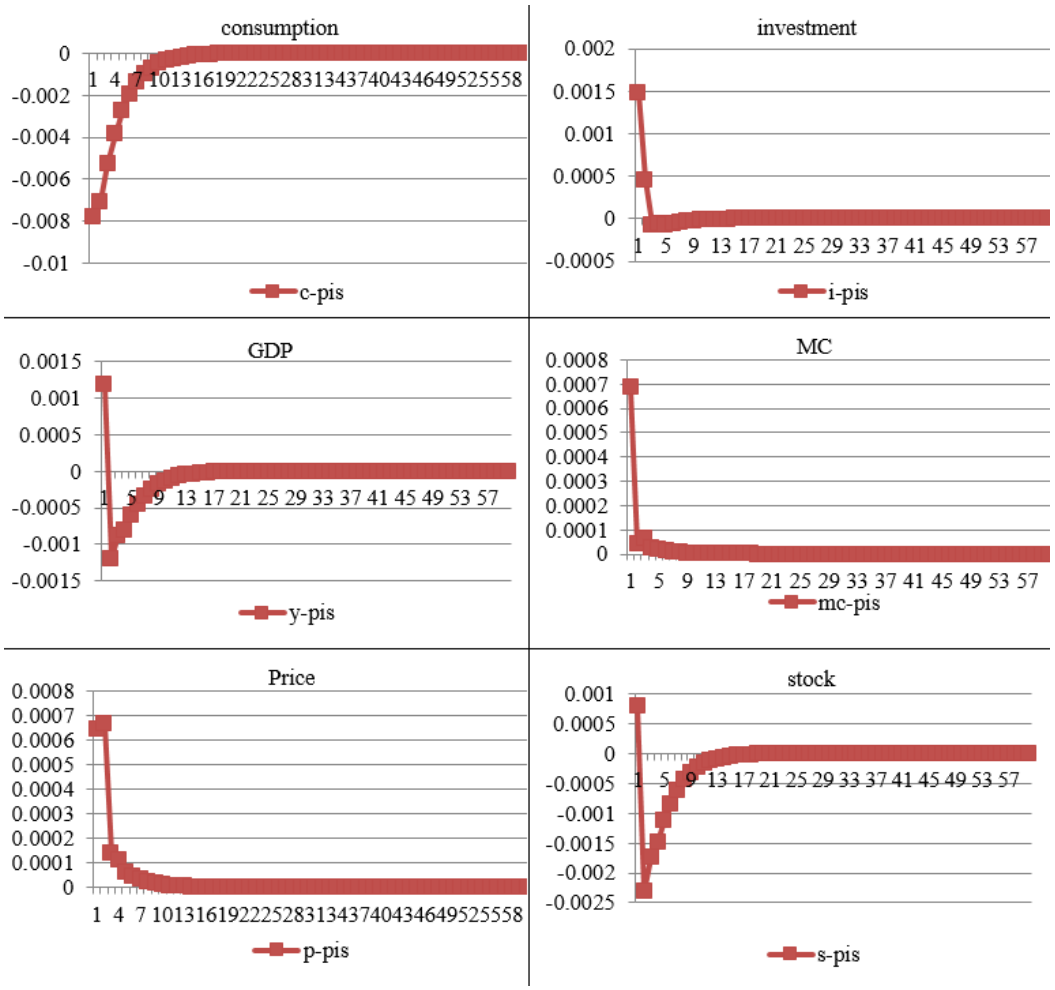

Figure 2: Macroeconomic and stock price shock

decreases. Since profitability is one of the indicators of banking health, so money growth targeting will be accompanied by a decrease in bank health and an increase in the destruction of banks' balance sheets. Also, the reduction of bank resources will reduce the supply of loans to the interbank market. Therefore, the share of the interbank market will decrease. On the other hand, due to the reduction of resources, banks will try to increase borrowing from the central bank to compensate for the lack of liquidity. For this reason, although the debt to the central bank decreases in the initial reaction to the shock of money growth targeting, but in response to the reduction in interest rates on debt to the central

bank, banks' borrowing from the central bank increases.

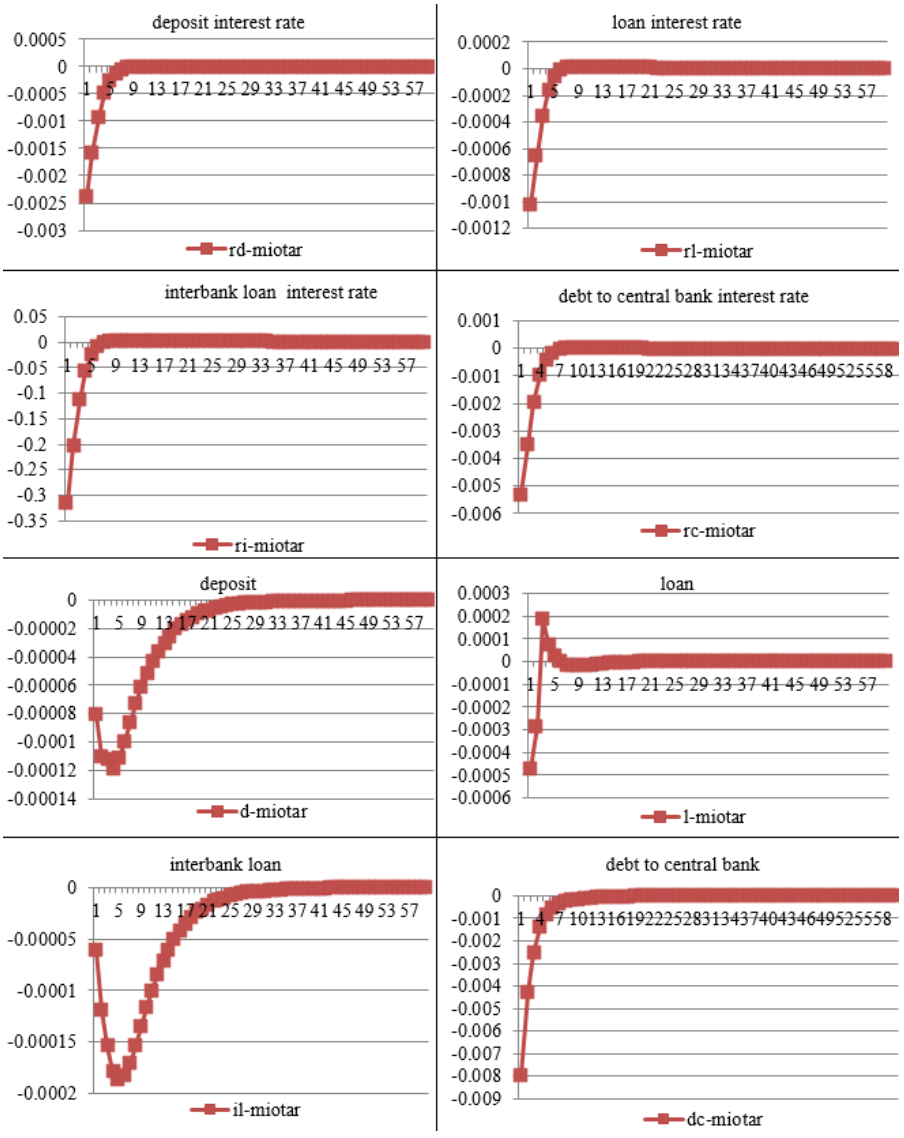

Figure 3: Banking and money growth targeting shock

Since loans are one of the sources of financing for a firm, lowering interest rates increases the demand for loans. However, due to lack of resources and reduced lending power of banks, therefore, firms access to credit is reduced and investment is reduced as a result. On the other hand, with the reduction of interest rates on deposits and the withdrawal

of deposits from banks, it seems that part of the resources will be spent on the purchase of consumer goods. Therefore, with the reduction of interest rates on deposits, private consumption will increase. Since the interest rate is one of the factors affecting the final cost of the firm, reducing the interest rate on the loan will reduce the final cost and consequently the prices will decrease. Targeting money growth can create a positive outlook for the stock market. Thus the stock price rises.

Conclusion

Price stability is considered to be the main goal of monetary policy in almost all countries. Achieving this requires the creation of a precise and purposeful mechanism of the monetary policy-making process, which in its standard form includes forecasting, targeting and finally policy-making. In this regard, there is the money growth rate targeting to achieve this goal without affecting that It will be effect on economy. Meanwhile, banks, as the most important part of financing various production sectors, will also be affected by this policy. On the other hand, the combination of this type of targeting with stock market shock can have different effects. Iran's economy has also been accompanied by various stock market shocks in recent decades.

Due to the importance of the issue, in this paper, using the dynamic stochastic general equilibrium model, the negative shock of money growth rate targeting with the approach of examining the economic effects and balance sheets of money growth rate targeting despite stock market shock is modeled for the first time in Iran. Therefore, in explaining the behavior of the central bank, using the Taylor rule, a behavioral function to determine the interest rate was considered that the interest rate is a function of the previous interest rate, the difference between the growth rate and the targeted growth rate and the difference between production and production in a steady state. A vector autoregressive function was also defined for the money growth rate targeting. Then, money growth targeting shock and stock price shock on banks balance sheet were examined.

The contributions of this paper are: Given the fluctuations in the stock market in recent years, the money growth targeting effect despite stock market shocks have been examined. Given the importance of the stock

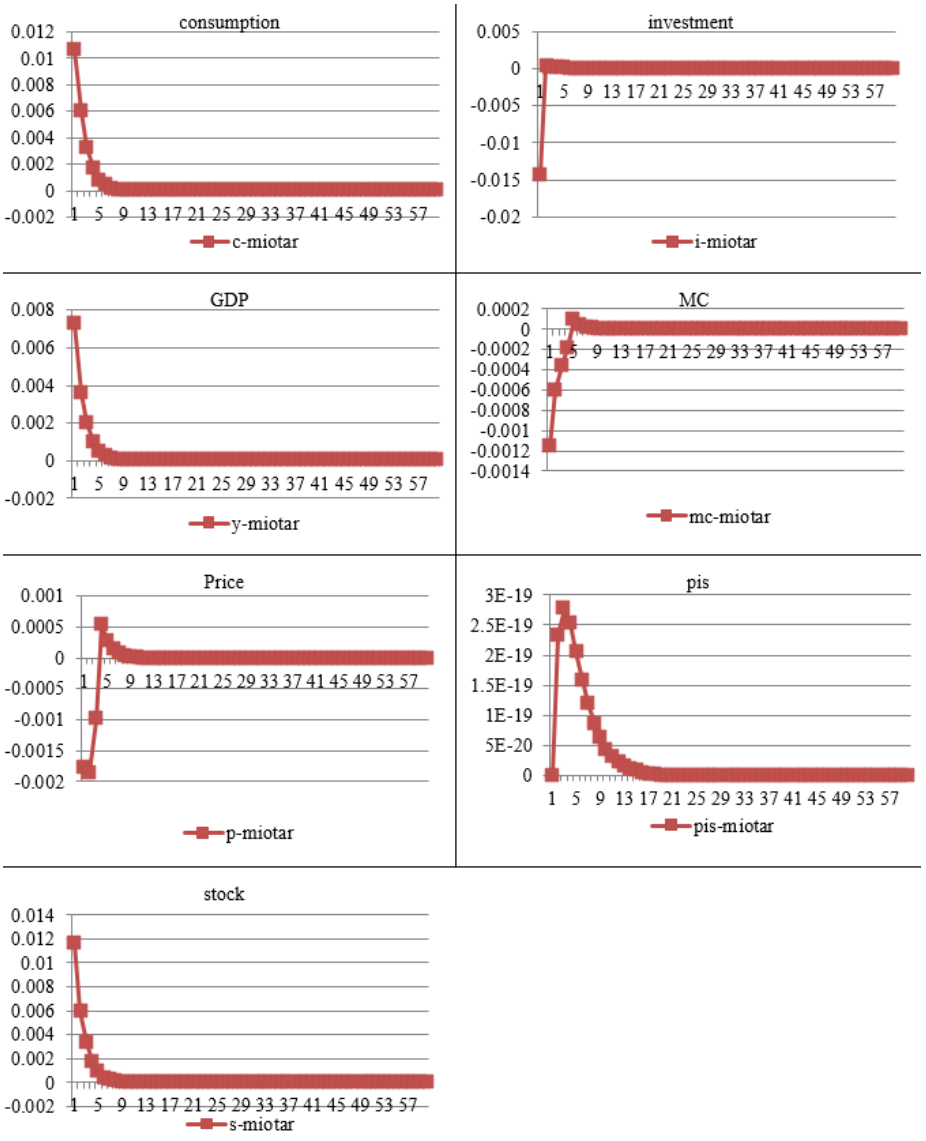

Figure 4: Macroeconomic and money growth targeting shock

market in recent years, stocks have been included in the utility function as an asset which the household acquires utility. Stock price and money growth rate are AR(1). Stocks enter the production function as financial capital. The cost of non-asset-liability management has been modeled. Stock enter in the production function as financial capital.

As stock prices rise and the stock market booms, bank deposits, the supply of facilities to households, and the banking network decline. The central bank will raise interest rates on deposits to prevent deposits from withdrawal. According to the hypothesis, an increase in stock prices increases the wealth effect of consumption, but an increase in interest rates on deposits reduces consumption, and the combination of these two effects indicates a decrease in total consumption. Rising stock prices lead to improved investment and production.

A negative shock to the money growth rate targeting reduces interest rates on deposits and loans, and consequently reduces the resources and lending power of banks. Although this reduces the cost of interest for the bank by reducing resources, but due to the reduction of loans and consequently the reduction of interest income, banks face a decrease in profitability and as a result their health is endangered. On the other hand, due to the reduction of banks' lending power, the access of the production sector to credit will decrease and investment and production will also decrease. It seems that if the policy of money growth targeting is accompanied by an increase in interest rates, in addition to worsening the balance sheet of banks and reducing their health, it will also reduce production.

According to the results of the article, it is suggested that the monetary authority to control inflation along with, also pay attention to the prosperity of the stock market. In addition to, it is also necessary to consider raising interest rates, so that over time it should increase the interest rate on bank deposits. In order to implement money growth rate targeting, basic preconditions such as the ability to accurately predict inflation and money growth, the ability to control monetary policy instruments for operational purposes, the effectiveness of the interest rate channel on prices, transparency, consistency and validity of monetary policy are essential and most be created.

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