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The effect of inflation targeting and money growth rate on banks' balance sheets during Covid-19

Azam Ahmadyan*

Department of banking studies, Monetary and banking research institute, Tehran, Iran.

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Abstract

This article explores the effects of inflation targeting and money growth rate targeting on the balance sheets of Iranian banks during the COVID-19 pandemic. To achieve this, the study focuses on three key objectives using annual macroeconomic and banking sector data from a developing oil-exporting country, employing the Bayesian method and a DSGE model. First, the macroeconomic and balance sheet impacts of the COVID-19 pandemic are examined without the use of inflation targeting or money growth rate targeting policies. Second, the effects of COVID-19 are analyzed in conjunction with inflation targeting, and third, the effects of COVID-19 are studied alongside money growth rate targeting. The primary shocks examined in this paper are the COVID-19 shock, the inflation targeting shock, and the money growth rate targeting shock. To assess the impact of these shocks on macroeconomic variables and the balance sheets of banks, reaction function analysis has been employed.The key findings reveal that the negative effects of COVID-19 are exacerbated by targeting policies. During the spread of the epidemic, the use of these targeting strategies further decreases production and investment compared to scenarios without such policies. Moreover, inflation targeting, in particular, has a more pronounced effect on reducing production and investment than money growth rate targeting. Based on these findings, it is recommended that the central bank considers implementing interest rate targeting alongside inflation and money growth rate targeting policies in order to better support the balance sheets of banks and mitigate the negative effects on the broader economy.

Highlights

- Contraction in Banks' Balance Sheets: Both deposits and loans experience a decline.
- Economic Recession: The spread of the pandemic has triggered a recession, leading to reduced employment and a rise in corporate bankruptcies. This, in turn, has negatively impacted banks' credit portfolios and liquidity.
- Inflation Targeting and Money Growth Rate Targeting during COVID-19: These policies result in lower deposit and loan interest rates .
- Amplification of Negative Effects: COVID-19 amplifies the adverse effects of both inflation targeting and money growth rate targeting.

* a.ahmadian@mbri.ac.ir

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1. Introduction

Banks play a crucial role in the financial system by collecting deposits, allocating credit, facilitating the flow of payments, and providing critical information for financial intermediation. Additionally, they serve as key instruments for implementing monetary policy. In a well-functioning banking system, central banks often prioritize inflation targeting as the primary goal of their monetary policy framework.

Central banks in different countries have adopted varying policies in response to the spread of the pandemic. These policies include lowering interest rates and injecting liquidity into the banking system (Holton etal. 2020), reducing capital buffers and liquidity requirements (Haas et al., 2020), and adopting different monetary policy targets. These targets include inflation targeting (Demertzis & Dominguez-Jimenez, 2020; Diwan, Leduc, & Mertens, 2020), interest rate targeting, exchange rate stabilization (Ratho et al., 2020), and money growth rate targeting (Erdogan et al,. 2020).

Iran, as a developing oil-exporting country, has recently faced several economic challenges, including a slowdown in economic growth, a sharp rise in inflation, a significant decline in stock prices, an increase in the outflow of bank deposits, and a growing number of non-performing loans. In response, the 2023 Central Bank of Iran Law identifies two key objectives: controlling inflation and fostering economic growth. To achieve these goals, the Central Bank of Iran employs discretionary monetary policies. Among the primary tools available for inflation control and economic growth are inflation targeting and money growth rate targeting, both of which the central bank can leverage to stabilize the economy.

With the global outbreak of COVID-19, Iran's economy and financial sector, as a developing oil-exporting nation, have also been significantly affected. As a result, choosing between two key monetary policies—inflation targeting and money growth rate targeting—becomes crucial for controlling inflation and promoting economic growth during this period. Each of these policies has its distinct implications and trade-offs, making it essential to carefully consider which would best help Iran navigate the economic challenges posed by the pandemic while fostering recovery and stability.

In this article, the effects of COVID-19 on the economy are analyzed through three different scenarios using the Calibration method and a DSGE model (Dynamic Stochastic General Equilibrium).

- Current Situation: This scenario examines the impact of COVID-19 on the macroeconomy and the balance sheets of banks without implementing either inflation targeting or money growth rate targeting policies.
- Expected Status (Money Growth Rate Targeting): In this scenario, the effect of COVID-19 is analyzed under a monetary policy framework that includes money growth rate targeting but excludes inflation targeting.

- Expected Status (Inflation Targeting): This scenario investigates the economic effects of COVID-19 with inflation targeting in place, while excluding the money growth rate targeting policy.

Additionally, three key shocks are analyzed in this study: the COVID-19 shock, the inflation targeting shock, and the money growth rate targeting shock. The Calibration method was employed to calibrate the parameters used in these scenarios, allowing for a more accurate analysis of policy impacts on the economy.

The contributions of this paper include the following:

- Impact of COVID-19 on the Utility Function: This study incorporates the effects of COVID-19 on the utility function, capturing how the pandemic influences overall economic welfare and consumer satisfaction.
- Assumption of Firm Cost Coverage: It is assumed that firms partially finance their current costs through external facilities, reflecting real-world adjustments companies make to manage financial strain during challenging periods.
- Asset and Liability Management in the Banking Sector: The paper outlines a framework for asset and liability management specific to banks, emphasizing how financial institutions navigate economic shifts and maintain stability.
- Monetary Policy: Since banks in Iran do not set the interest rate independently, this paper models a scenario where the central bank determines the money growth rate. Monetary policy is thus formulated with the objective of controlling the money supply, in line with the central bank's role in regulating economic stability.

This article is structured into five sections. Section 2 discusses the role of the central bank and its policies during the COVID-19 pandemic, providing insights into how monetary authorities responded to the crisis and its policies during the COVID-19 pandemic, providing insights into how monetary authorities responded to the crisis. Also this session presents a literature review on the impact of different monetary targeting policies during COVID-19, summarizing previous research and theoretical approaches. Section 3 explains the model used in the study, detailing its structure and underlying assumptions. Section 4 is dedicated to calibrating the model, outlining how the parameters were adjusted to fit the specific economic conditions. Also this session provides an analysis of the results and the associated reaction functions, offering a comprehensive evaluation of the model's outputs.Section 5, the final section, presents the conclusions, summarizing the findings and their broader implications.

2. A Review of the Related Literature

2.1 THEORY: Inflation Targeting, and Money growth targeting during COVID-19

A monetary targeting strategy includes three key components: 1) utilizing information from a monetary aggregate to guide monetary policy, 2) publicly

announcing targets for these monetary aggregates, and 3) implementing an accountability mechanism to prevent significant and consistent deviations from the set monetary targets (Mishkin, 2000).

In recent years, the long-term goal of monetary policy has been price stability. One of the most recent approaches to achieving this is inflation targeting. This policy, which dates back to the 1980s following oil shocks that caused high inflation, aims to control inflation more effectively. Due to the breakdown in the relationship between money supply and inflation, many countries have adopted the inflation targeting framework as their primary monetary policy system (Mousavi & Mostaani, 2012). Monetary authorities set a quantitative target for future inflation. If the forecasted inflation deviates from this target, they will implement new monetary policies to align it with the target (Khan & Knotek, 2012).

Since future inflation is not directly observable, inflation targeting can be seen as a two-step process. First, monetary authorities forecast inflation to determine if it aligns with the stated goal. If the forecasted inflation deviates from the target, the second step involves policymakers adjusting monetary policy tools to correct the deviation and steer inflation towards the target (Green, 1996).

The two fundamental prerequisites for inflation targeting are the absence of financial dominance and the non-conflict with other policy objectives, such as exchange rate or monetary targeting. While there is general consensus on the definition of inflation targeting, the primary differences lie in how the empirical targeting definition is applied across different countries (Corbo et al., 2002). To achieve this goal, central banks cannot directly use their instruments to ensure inflation stability and banking soundness. Therefore, they evaluate the channels through which monetary policy is transferred to the real sector via the banking system. The policy of targeting the money growth rate is discussed in the literature on monetary policy transmission, which is elaborated upon in this section.

The literature identifies several channels through which monetary policy is transmitted. These channels are primarily classified into four categories: the interest rate channel, the exchange rate channel, the durable asset price channel, and the credit channel. The latter, a non-neoclassical approach to monetary policy transmission, includes the bank lending and balance sheet channels.

Banks impact the economic system through the interest rate, durable assets, and credit channels. As this article focuses on exploring the transmission of monetary policy via the interest rate channel, we will provide a brief explanation of this specific channel.

The direct interest rate channel is the most traditional and long-established method for transmitting monetary policy to the real economy, as articulated in macroeconomic models. When monetary policy results in an increase in short-term interest rates, long-term interest rates also tend to rise, as they are influenced by expectations of future short-term rates. This rise in interest rates raises the cost of capital, which in turn reduces the demand for capital.

A decreased demand for capital assets leads to lower investment in these assets, which ultimately contributes to a reduction in overall costs and demand within the economy. This interest rate channel is central to the analysis of the classic Keynesian IS-LM model, originally developed by Hicks in 1937. In more recent developments, this channel has also been integrated into several new Keynesian models, including those proposed by McCallum and Nelson (1999) and Kerr and King (1996).

These modern adaptations acknowledge the complexities of the interest rate transmission mechanism, including factors such as expectations, the role of inflation, and the responsiveness of various economic agents to interest rate changes. By examining how the interest rate channel operates, we can gain insights into the broader implications of monetary policy decisions on investment behavior, consumption patterns, and overall economic activity.

According to the literature on the lending channel, banks typically prefer to engage with safe and low-risk borrowers, which helps mitigate issues related to asymmetric information in the credit market. Within the framework of the credit channel, the implementation of contractionary monetary policy—such as raising interest rates—makes access to bank resources more challenging and increases the cost of capital for small enterprises. In contrast, larger firms, with better access to alternative markets and financial instruments, are less affected by these monetary policy changes (Mishkin, 1995).

The credit channel of the monetary transmission mechanism affects not only the demand for loans through fluctuations in interest rates but also the supply of bank credit, investment, and consumption. In other words, it has implications for both borrowers and lenders (Güntner, 2011). Bernanke & Blinder (1988) examined the credit channel's impact on monetary policy transmission through changes in the statutory reserve ratio. They found that increasing this ratio constrains a bank's resources and restricts the supply of credit. This effect is transmitted through the level and composition of the bank's assets, which are affected by changes in interest rates and money supply.

Bernanke & Blinder (1988) argued that banks find it difficult to substitute deposits with other sources, such as certificates of deposit or securities issuance. This limitation underscores the vital role that bank credit plays in the broader monetary transmission process.

Monetary aggregates play a crucial role in the context of imperfect information, serving as important indicator variables that help address data uncertainty (Coenen et al., 2005). They assist in navigating model uncertainty and persistent misperceptions of key economic variables, such as the output gap (Beck & Wieland, 2008). These aggregates can provide valuable insights into the state of the economy, allowing policymakers and economists to make more informed decisions despite the challenges posed by incomplete or inaccurate data.

By tracking changes in monetary aggregates, analysts can gauge the effects of monetary policy on economic activity and inflation, offering a clearer view of the underlying economic dynamics. This is particularly significant in

environments where traditional metrics may be misleading or lagging, thereby reinforcing the importance of monetary aggregates as a tool for both analysis and policy formulation.

At the beginning of the COVID-19 crisis, the financial system was robust, with the world's largest banks holding high levels of capital and liquidity (Borio, 2020). Consequently, one of the central bank's primary goals during COVID-19 was to support the real economy and prevent financial and economic collapse (Fleming et al., 2020). However, the role of the central bank during COVID-19 was limited. Central bank policies could mitigate the economic impact of COVID-19 by providing loans, improving financial conditions, and paving the way for future economic recovery, thereby reducing future economic fragility. The scope and speed of central bank actions are closely tied to the scale and pace of the COVID-19 outbreak. In this context, economic crises during the pandemic typically occurred before financial crises, making it difficult to fully evaluate the impact of central banks' economic policies. Various sectors of the economy responded differently to the pandemic, but what remains clear is that overall economic activity declined, while unemployment rates and business bankruptcies surged. As a result, the unusual combination of both supply and demand shocks is expected to have long-lasting negative effects on the economy, raising challenges to the effectiveness of central banks' interventions (Guerrieri et al. 2020).

Countries implemented various programs to address these challenges (Fleming et al., 2020). The central bank's policy actions and initiatives can be categorized into three main areas: monetary policy, liquidity provision, and targeted credit programs (Mosser, 2020). A standard approach within monetary policy is the reduction of interest rates. In some countries, central banks not only lowered interest rates but also launched asset purchase programs to stimulate the economy. However, in countries where interest rates were already negative, further rate cuts were not implemented (Mosser, 2020). Liquidity provision, often referred to as the "lender of last resort" function, was another key program during the COVID-19 pandemic. Many central banks had already overhauled their lending frameworks in the aftermath of the 2007 financial crisis. During that period, liquidity facilities were typically accompanied by penalty rates, designed to help manage moral hazard risks and, as financial conditions improved, to gradually reduce reliance on such facilities. However, during the COVID-19 crisis, many central banks significantly lowered these penalty rates, as the risk of moral hazard associated with liquidity injections was deemed lower compared to the financial crisis (Mosser, 2020).

Credit programs represented the third major initiative during the COVID-19 pandemic. In countries with well-developed credit markets, central banks introduced or expanded corporate bond and securities purchase programs to ensure the flow of credit to the largest companies. Since central banks do not lend directly to the non-financial sector, they instead provided targeted facilities to banks, enabling banks to extend credit to the private sector (Mosser, 2020).

Monetary targeting was initially seen as a suitable replacement for currency pegs, as it offered a mechanism to control inflation by regulating money supply growth. However, the effectiveness of this strategy depended heavily on the stability of money demand, which was often disrupted by financial innovations and market changes. Financial innovations, such as new financial products and changing banking practices, often led to unstable money demand. This instability undermined the reliability of money supply as a control instrument for inflation, prompting many central banks to reconsider their approach. In response to the limitations of monetary targeting, many countries shifted towards direct inflation targeting. This strategy places emphasis on using policy instruments, primarily interest rates, to achieve explicit inflation targets. The focus is on the "transmission mechanism" — how changes in policy instruments like interest rates affect inflation and economic activity. Inflation targeting provides a clear nominal anchor while allowing central banks the flexibility to adjust policy instruments in response to economic conditions, thereby aligning short-term actions with long-term goals of price stability. The importance of incorporating forward-looking behavior in economic agents' expectations. This aligns with modern monetary policy frameworks that utilize models incorporating rational expectations to better predict the effects of policy decisions on inflation and economic output. Inflation targeting, with its blend of rule-like precision and flexible discretion, offers a robust framework for central banks to maintain price stability while also responding to economic variability. By focusing on medium-term targets, it enables policymakers to balance immediate economic needs with long-term inflation management objectives. This approach, as documented, underlines the evolution of monetary policy strategies and serves as guidance for contemporary central banking practices, ensuring adaptability in nurturing economic stability and growth (Gill, 2011, Scott, 2010). Dai (2011) discusses, Central banks use reliance on monetary aggregates as a basis for monetary policy decisions, assuming a stable relationship between the aggregates and target variables like inflation. By making targets public, central banks aim to increase transparency and accountability, influencing expectations and behavior in financial markets. Accountability mechanisms are essential to hold central banks responsible, preventing significant deviations from set monetary targets, thereby enhancing credibility. While monetarism provided a significant advancement over previous methodologies, its decline in modern monetary theory is attributed to its heavy reliance on the stability of money demand, which has become problematic with financial market innovations. The emphasis on monetary aggregates is debated, with arguments favoring inflation targeting due to its focus on price stability and economic output monitoring.The potential for interest rate volatility under inflation targeting and the challenges of financial market changes underscore the need for robust frameworks capable of handling economic shocks. For monetary or inflation targeting to succeed, the central bank must be credible, transparent, and flexible, managing public and market expectations effectively even in light of financial instability. Both monetary and inflation targeting face

challenges from unstable relationships between policy instruments (such as interest rates) and target variables. This instability necessitates an adaptive approach to policy formulation and communication.

2.2 Literature Review

Our paper contributes to two strands of literature. The first examines the effects of inflation targeting and money growth rate targeting on the balance sheets of banks before the COVID-19 pandemic. Regarding the first strand, numerous studies suggest that inflation targeting tends to result in better economic performance in countries that have adopted an independent domestic monetary policy, compared to those that have not. This approach is also associated with a reduction in macroeconomic instability. However, inflation expectations are influenced by the nature and types of shocks present in the economy (Mishkin, 2000, Barthélemy et al, 2017). In the context of the global financial crisis, García-Cicco and Kawamura (2014) provide empirical evidence on the role of central bank liquidity management within an inflation targeting framework. Their findings suggest that the use of foreign asset purchases as a liquidity management tool has a relatively mild impact on the economy of a developing country but is associated with significant inflationary effects.

Other related studies have explored the effects of inflation targeting, exchange rate targeting, interest rate targeting, liquidity targeting, and money growth rate targeting on both the broader economy and the balance sheets of banks in the post-COVID-19 period. Demertzis and Dominguez-Jimenez (2020) argue that scenario-building around COVID-19 and assessing the outcomes of disease control measures can aid monetary policymakers in selecting effective inflation control strategies and defining specific parameters for inflation targeting. Erdogan, Yildirim, and Gadiki (2020), as well as Niedźwiedzińska (2020), suggest that the effectiveness of monetary policy in targeting inflation—and the success of liquidity injections in stimulating economic growth—are enhanced in more developed financial markets. Wyplosz (2020) provides evidence from developed economies such as the United States and the European Union, suggesting that inflation targeting can help stimulate economic growth in the post-COVID-19 period and support the maintenance of interest rates within a positive range. Additionally, studies by Hetzel (2020), Budianto, Nakata, and Schmidt (2020), Diwan, Leduc, and Mertens (2020), as well as Amano, Gnocchi, and Leduc (2020), emphasize the importance of targeting interest rates below the inflation rate to further enhance economic growth.

Similarly, a number of studies have investigated the impact of exchange rate targeting on the economy and on banks' balance sheets during the COVID-19 pandemic. Raj et al. (2018) demonstrate that exchange rate instability negatively affects trade, investment, and overall macroeconomic stability, prompting many countries to prioritize exchange rate stabilization during the COVID-19 period. Ratho et al. (2020) provide evidence from India, where fluctuations in the exchange rate and foreign investment post-COVID-19 led policymakers to adjust

the allowable range of exchange rate fluctuations in response to the evolving pandemic conditions.

Regarding the effects of interest rate targeting on the economy and banks' balance sheets, Diwan, Leduc, and Mertens (2020), as well as Ilzetzki, Reinhart, & Rogoff (2020), provide evidence that developed countries aimed to keep interest rates at or near zero during the COVID-19 pandemic to support financial markets and control inflation. Marmefelt (2020) argues that liquidity injections were another key policy response from the European Central Bank (ECB) during this period. However, he warns that an excessive liquidity injection could lead to overly optimistic profit expectations, driving up household demand for credit. To address this challenge, the ECB has focused on green and digital transformation initiatives to manage inflation while fostering sustainable economic growth.

Another body of literature contends that monetary targeting is one of the most crucial tools for improving the economy and strengthening banks' balance sheets. Pinshi (2020) provides evidence that, during the COVID-19 pandemic, monetary targeting had long-term effects, though it showed little impact in the short term. As a result, Pinshi recommends focusing on exchange rate controls in the short term, while emphasizing money supply control as a long-term strategy. Additionally, the study suggests the purchase of long-term treasury bonds and liquidity injections as measures to bolster the economy.

Heidari & Molabahrami (2015) employed a Dynamic Stochastic General Equilibrium (DSGE) model to explore the household portfolio channel in the transmission of monetary and credit shocks within Iran. Their findings revealed that both current and expected prices of financial and physical assets significantly influenced the optimal composition of household portfolios. Additionally, the banking sector played a pivotal role in shaping household portfolio structures and impacting real economic variables. Specifically, a positive shock to deposit rates led to a reduction in the share of financial and physical assets within household portfolios, while simultaneously raising marginal costs and inflation. This, in turn, resulted in decreased levels of investment and output. Furthermore, a positive shock in stock prices negatively affected the demand for other assets in household portfolios, though this effect was quickly neutralized. Conversely, housing price shocks produced similar negative effects on asset demand, but these effects dissipated more gradually. The study underscores the critical role of credit markets, banking sectors, and asset markets in influencing financial fluctuations, business cycles, and the broader transmission of monetary policies in Iran.

Pirahmadi et al. (2019) developed a Dynamic Stochastic General Equilibrium (DSGE) model that incorporated the interbank market. Their results indicated that an increase in the interbank rate contributed to economic instability. However, the study concluded that raising liquidity and capital adequacy requirements—consistent with Basel III regulations—could mitigate the adverse effects of interbank shocks on macroeconomic variables. By implementing these regulatory measures, the economy would become more resilient and stable in the face of interbank rate fluctuations.

This session provided relates to two major topics in monetary policy strategy literature: the effectiveness of inflation targeting versus money growth rate targeting, and the impact of these strategies on bank balance sheets and economic stability, particularly before and after the COVID-19 pandemic. Pre-COVID-19 Strategic Insights indicate, inflation Targeting, generally leads to better economic performance and reduced macroeconomic instability in countries with independent monetary policies.Inflation expectations vary based on economic shocks, with liquidity management by central banks playing a critical role during inflation targeting, as seen during the global financial crisis.Monetary Targeting historically faced challenges due to financial innovation and instability in the relationship between monetary aggregates and economic targets.

Post-COVID-19 Adjustments, suggested, inflation targeting in developed economies, suggest that advanced financial markets enhance the success of inflation targeting policies. Policies involving setting positive interest rates and injecting liquidity have supported recovery and growth in post-COVID-19 scenarios. Interest Rate and Liquidity Targeting indicates, Interest rate targeting at zero levels, combined with liquidity injections, has been a tool to manage financial markets and control inflation amid the pandemic.Liquidity injections could lead to increased household demand for loans, with central banks like the ECB maintaining flexibility through focus on green and digital transitions.Exchange Rate Targeting during COVID-19 has been crucial for macroeconomic stability.The complexity of modern financial systems necessitates that monetary policy strategies consider developments in money and financial markets, especially under financial instability.

Contributions of this paper are:

First, the effect of COVID-19 on the utility function is considered.

Second, it is assumed that firms will cover part of their current costs through facilities.

Third, Asset and liability management is defined in the banking sector.

Forth while in Iran, the banks are not the determiners of the interest rate, so in this article, with the design of the appropriate model, it is assumed that the central bank determines the money growth rate and monetary policy is considered to control the money growth rate

3. The Study Model

The main framework of the model in this article is designed using the articles of Agnor et al. (2012), Gerali et al. (2011), Walque et al.(2010) It has been elaborated with the following points in mind:

- We introduce COVID-19 in utility function;
- We asuume part of loan to firms are outstanding;
- Banks have a liquidity deficit and borrow from the central bank and the interbank market;

- The borrowing shock from the central bank and the interbank market is modeled;
- Bank capital is modeled as the most important indicator of financial soundness and its shock is considered;
- In New Keynesian models, the interest rate tool is considered as a monetary policy, but according to the structure of the monetary policies of the Central Bank of Iran, the money has been used as a monetary policy tool;
- Due to the importance of foreign assets of Central Bank of Iran, this variable is also included in the model;
- Considering the relationship between the government and the central bank in Iran, this relationship is modeled through debt to the central bank.

3.1 Household

The household is modeled based on the New Keynesian framework, with the addition of a COVID-19 shock integrated into the model. The households are assumed to be homogeneous, live indefinitely, and make decisions about their consumption of goods and services,C_t, real money holdings m_t, labor$N_t = \int_0^1 Nj,t\, d_j$, and deposits $D_t = \int_0^1 D_{j,t} d_t$, in order to maximize their utility function, as described by Eq. (1). $R_t^d = 1 + r_t^d$ is the deposit interest rate and $R_t^d = 1 + r_t^d$is the return of bonds. The present value of the utility that the household acquires can be represented as follows. We have added the COVID-19 shock in a utility function

$$\sum_{s=0}^{\infty}(\beta^h)^s E_t\left[\frac{(c_t)^{1-\sigma_c}}{1-\sigma_c} - e_t^{covid}\frac{(N_t)^{1+\sigma_n}}{1+\sigma_n} + \frac{(m_t)^{1-\vartheta}}{1-\vartheta}\right] \quad (1)$$

$E_t$is the expectation factor, $\boldsymbol{\beta}$ is the discount factor,σ_c is the inverse of the inter-time substitution elasticity, and σ_j is the inverse of the inter-temporal substitution elasticity. $\boldsymbol{\vartheta}$ is the elasticity of money demand. Covid-19 has a negative effect on employment, and this negative effect can reduce the utility of labor supply. For this reason, in this article, the shock of Covid-19 is included in the utility function. $\boldsymbol{e_t^{covid}}$ is the shock of the labor force to modeling the impact of COVID on the supply labor force. We model this shock as autoregressive processes:

$$e_t^{covid} = \rho_{covid} e_{t-1}^{covid} + \varepsilon_{tcovid} \qquad \rho_{covid}\epsilon(0,-1),\ \varepsilon_{tcovid}\sim(0,\sigma_{\varepsilon_{covid}}) \quad (2)$$

The household maximizes its preferences subject to budget constraints (Eq. 3) and capital stock (Eq. 4).

$$m_t + c_t + d_t = w_t N_t + r_t^k k_t + \frac{m_{t-1}}{\pi_t} + (1 + r_{t-1}^d)\frac{d_{t-1}}{\pi_t} + \frac{\pi_t^f}{p_t} + \frac{\pi_t^b}{p_t} \quad (3)$$

$m_{t-1}$is the actual amount of money in the previous period. T_t is the tax, i_t is the actual investment, k_t is the capital balance, and $d_t = \frac{D_t}{P_t}$ is the actual deposit,.

$$k_{t+1} = (1-\delta)k_t + i_t - \frac{\varphi_k}{2}(\frac{k_{t+1}}{k_t} - 1)^2 k_t \quad (4)$$

$\frac{\varphi_k}{2}(\frac{k_{t+1}}{k_t} - 1)^2 k_t$ is the cost of capital adjustment.

The household maximizes its utility function subject to the budget constraint to obtain first-order conditions concerningc_t, n_t, k_t, m_t.

3.2 Firms

A representative firm purchases j intermediate goods and uses them to produce final goods through the Dixit-Stiglitz production function.

$$Y_t = \left(\int_0^1 Y_{jt}^{\left(\frac{\theta-1}{\theta}\right)}\right)^{\frac{\theta}{\theta-1}} \quad (5)$$

$Y_{j,t}$ represents the intermediate commodity j and $\theta$is the constant elasticity of substitution between the intermediate commodities and $\theta > 1$. The final goods producer decides on the purchase of intermediate goods based on their prices to maximize profit. The demand function for these distinct goods is:

$$Y_{jt} = \left(\frac{P_{jt}}{P_t}\right)^{-\theta} Y_t \quad (6)$$

The demand for good j, $\frac{P_{j,t}}{P_t}$ is a function of its relative price (the ratio of its price to the price of the final goods) and the quantity of the final commodity produced. The price of the final product will be::

$$P_t = (\int_0^1 P_{jt}^{1-\theta} d_j)^{\frac{1}{1-\theta}} \quad (7)$$

$$P_t = \left(\int_0^1 P_{jt}^{1-\theta}\, d_j\right)^{\frac{1}{1-\theta}}$$

Each producer creates intermediate goods using a mix of physical capital and labor, operating under conditions of imperfect competition. The share of capital in production is denoted by $\alpha \in (0,1)$. Y_{jt} is:

$$Y_{jt} = A_t N_{jt}^{1-\alpha} K_{jt}^{\alpha} \quad (8)$$

and A_t is the technological shock:

$$A_t = \rho_a A_{t-1} + \varepsilon_{t,a} \qquad \rho_a \epsilon (0,1),\ \varepsilon_{t,a} \sim N(0, \sigma_{a_t}) \quad (9)$$

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

$$PAC_t^j = \frac{\varphi_f}{2}\left(\frac{P_{jt}}{\bar{\pi}P_{jt-1}} - 1\right)^2 Y_2 \quad (10)$$

$\varphi_f \geq 0$ The parameter representing the adjustment cost or the degree of price stickiness $\bar{\pi}$ is the inflation rate in a steady state.

This article, similar to Atta-Mensah & Dib (2008), and the developing economy condition assume that each intermediate-good-producing firm j borrows cash from banks to pay a portion of the cost of intermediate-good inputs as working capital. In Iran firms need to receive loans to provide part of working capital, it is assumed that each firm receives L_{jt} a loan from the bank at the beginning of each period and finances part of the cost of capital and labor γ. Loan is:

$$L_{jt} = \gamma(P_{jt}r_t^k K_{jt} + P_{jt}W_t N_{jt}) \quad (11)$$

r_{jt}^l is the loan interest rate at the end of the period.

The firm seeks to maximize the total current and future real profits:

$$E_t \sum_{s=0}^{\infty} \beta^s \frac{\pi_{t+s}^f}{P_{t+s}} \quad (12)$$

The nominal profit function according to the model by Agnor et al. (2012) is:

$$\pi_{jt}^f = P_{jt}Y_{jt} - P_t mc_t Y_{jt} - PAC_t^j \quad (13)$$

The firm maximizes the expected profit based on (5) to (14) to obtain first-order conditions concerningK_{jt}, N_{jt}, P_{jt}.

3.3 Banks

A representative bank is assumed to conduct intermediation operations under conditions of monopolistic competition by allocating deposits to loans. Despite the monopolistic competition in the banking system, the bank does not set the deposit interest rate; instead, the central bank, as the monetary authority, determines it. The bank's balance sheet 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 loan interest rates r_t^l and due from banks and credit institutions (interbank market)L_t^i with interbank interest rates r_t^i. In this article, such as those by Hafstead & Smith (2012) and Brzoza-Brzezina & Kolasa (2013), it is assumed that firms are unable to repay a portion of their loans. Consequently, the bank may encounter default rates α^bdue to non-performing loans, which affects its revenue $(1-\alpha_b)(1+r_t^l)L_t$ if the bank is repaid in full On the debt side, the interest rate on deposits r_t^d is specified. The bank borrows from the interbank market D_t^i at an interbank interest rate $r_t^i$and due to the central bank isD_t^c and due to the central bank interest rate is r_t^c. In the Iranian banking network, the following relationship is between the existing interest rates.

$$r_t^d < r_t^i < r_t^l < r_t^c \quad (14)$$

In this article, the costs associated with non-asset-liability management include those from the interbank market obligations and central bank liabilities. Therefore, a second-degree cost is considered for adjusting the interbank market obligations: due to the interbank market (D_t^i), due from interbank marker (L_t^i) and due to the central bank (D_t^c).

$$\frac{1}{2}\left[\varphi_{di}\left(D_t^i\right)^2+\varphi_{dc}(D_t^c)^2-\varphi_{li}(L_t^i)^2\right] \quad (15)$$

Banks keep capital (K_t^b) to cover the cost of unexpected events. According to the principles of the Basel Committee, banks should maintain amount of capital that can provide capital adequacy. According to Iranian regulations, minimum capital adequacy (θ_k) is 8%. In this article we suppose:

$$k_t^b=(k_{t-1}^b)^{\Phi kb}*(y_t)^{\Phi y} \quad (16)$$

and the adjested cost of banks' capital is $\frac{kb}{2}\left(K_t^b-\theta_k\right)^2$.

Therefore, the bank's profit is:

$$\pi_t^b=(1-\alpha^b)\left(1+r_t^l\right)L_t-\left(1+r_t^d\right)D_t-\left(1+r_t^i\right)D_t^i-(1+r_t^c)D_t^c-\frac{1}{2}\left[\varphi_{di}\left(D_t^i\right)^2+\varphi_{dc}(D_t^c)^2-\varphi_{li}(L_t^i)^2\right]-\frac{kb}{2}\left(K_t^b-\theta_k\right)^2+(1+r_t^i)L_t^i \quad (17)$$

Which is maximized according to:

$$l_t+l_t^i=d_t^i+d_t^c+(1-\eta)d_t+k_t^b \quad (18)$$

η is legal reserve in steady state.

According to the realities of Iran's economy and Iranian banking network, due to banks and credit institutions(interbank market), and due to the central bank are Eq.(18), and Eq. 19.

Debt to the interbank market is a function of d_{t-1}^i and ε_t.

$$d_t^i=(d_{t-1}^i)^{\Phi di}\varepsilon_{di} \quad (19)$$

If the bank's resources are insufficient, it will borrow from the central bank to compensate for the shortfall. In light of the recession in the Iranian economy, Iranian banks have increasingly turned to the interbank market. Rather than lending within the interbank market, they are extending credit to the non-banking sector. Should their resources remain inadequate, they resort to borrowing from the central bank to meet their liquidity needs. due to the central bank in the Iranian banking network is:

$$d_t^c=(d_{t-1}^c)^{\Phi dc}\varepsilon_{dc} \quad (20)$$

Banks maximize profits to obtain first-order conditions to consider, d_t^c, d_t^i, l_t^i, k_t^b, d_t l_t.

3.4 Central Bank, Government, Oil Sector

The central bank, as the monetary authority, determines the money growth rate (μ_t). In this article, it is assumed that the monetary authority in Iran can adjust the money growth rate. In Equation 20, the money growth rate (μ_t) d is influenced by the difference between the money growth rate of the previous period (μ_{t-1})), the current period's inflation (π_t) and the steady-state inflation ($\bar{\pi}$), the gap between actual GDP (y_t) and targeted GDP (y_t^*).

$$\mu_t = \left(\frac{\mu_{t-1}}{\bar{\mu}}\right)^{\omega\mu} \left(\frac{1+\pi_t}{1+\bar{\pi}}\right)^{\omega\pi} \left(\frac{y_t}{y^*}\right)^{\omega y} \varepsilon_{t,\mu} \quad (21)$$

$$\mu_t = \frac{M_t}{M_{t-1}} \pi_t \quad (22)$$

$\omega\mu$, , and ωy are the weights of lag of money growth rate(μ_{t-1}), inflation in the current period (π_t), and GDP targeting (y_t^*)in monetary policy. $\varepsilon_{t,\mu}$is the monetary policy shock, that:

$$\varepsilon_{t,\mu} = \rho_{epsimio}\varepsilon_{t-1,\mu} + \left(1 - \rho_{epsimio}\right)\bar{\varepsilon}_{\mu}\varepsilon_{t,\mu\mu} \quad (23)$$

And

$$y_t^* = \rho_{y*} * y_{t-1}^* + \varepsilon_{t,y*} \quad (24)$$

In Iran, the central bank does not publicly announce explicit targets; however, policymakers implicitly pursue targets due to goal-setting in development plans. Consequently, the reaction function presented in this article assumes that the money growth rate target (μ_t^*) is an unobservable variable, recognized by policymakers but unknown to other economic agents. It is posited that the monetary authority, as indicated by Kandrac (2012) and Khan and Kenatek (2012), determines both the money growth rate target (μ_t^*) and the inflation rate target (π_t^*).

It has been hypothesized, as in the studies of Kandrac (2012) and Khan and Kenatek (2012) that the implicit targets are:

$$\mu_t^* = \rho_{\mu^*}\mu_{t-1}^* + \left(1 - \rho_{\mu^*}\right)\bar{\mu}^* + \varepsilon_{\mu^*} \qquad \rho_{\mu^*} \in (0,1) \quad \varepsilon_{\mu^*} \sim N(0, \sigma_{\mu^*}^2) \quad (25)$$

Where μ_t^* is money growth rate target and $\bar{\mu}_t^*$ is money growth rate in steady state. So, money growth rate policy is:

$$\mu_t = \left(\frac{\mu_{t-1}}{\mu_t^*}\right)^{\omega\mu*} \left(\frac{1+\pi_t}{1+\bar{\pi}}\right)^{\omega\pi} \left(\frac{y_t}{y^*}\right)^{\omega y} \varepsilon_{t,\mu} \quad (26)$$

and

$$\pi_t^* = \rho_{\pi^*}\pi_{t-1}^* + (1-\rho_{\pi^*})\bar{\pi}^* + \varepsilon_{\pi_t^*} \qquad \rho_{\pi^*} \in (0,1) \qquad \varepsilon_{\pi^*} \sim N(0,\sigma_{\pi^*}^2) \tag{27}$$

Where π_t^* is money growth rate target and $\bar{\pi}_t^*$ is money growth rate in steady state. So, money growth rate policy is:

$$\mu_t = \left(\frac{\mu_{t-1}}{\bar{\mu}}\right)^{\omega\mu}\left(\frac{1+\pi_t}{1+\pi_t^*}\right)^{\omega\pi^*}\left(\frac{y_t}{y^*}\right)^{\omega y}\varepsilon_{t,\mu} \tag{28}$$

Where $\varepsilon_{t,\mu}$ is:

$$\varepsilon_{t,\mu} = \rho_{epsimio}\varepsilon_{t-1,\mu} + \epsilon_{t,\mu} \tag{29}$$

The balance sheet of the Central Bank is:

$$dg_t + fr_t = m_t \tag{30}$$

m_t is money supply, fr_t is Net foreign assets of Central Bank, $dg_t$is government debt to the central bank. fr_t is:

$$fr_t = {fr_{t-1}}^{\omega fr}\,{or_t}^{wor} \tag{31}$$

or_t is revenue from oil exports that it is:

$$or_t = \rho_{or}or_{t-1} + (1-\rho_{or})\bar{or} + \varepsilon_{or,t} \qquad \varepsilon_{t,or} \approx N\left(0,\sigma_{\varepsilon_{t,or}}\right) \tag{32}$$

or_t is, the actual oil revenue in period t and $\bar{or}$ is a steady state of oil revenue. The government budget is:

$$g_t = or_t^{vor}t_t^{vt}(dg_t - dg_{t-1})^{vdg}x_t^{vx} \tag{33}$$

Where t_t is tax revenue and x_t is other revenue.

Tax revenue is:

$$t_t = \Phi_t^y y_t \tag{34}$$

And x_t is:

$$x_t = \Phi_x^y y_t \tag{35}$$

3.5 Market settlement condition

The settlement condition of the final commodity market is:

$$y_t = c_t + i_t + g_t + ac_t \tag{36}$$

4. Methodology and Stylized Facts

The central bank and Statistical center of Iran data were used during 1981-2021, and the Calibration method is used to calibrate parameters.

4.1 Calibration

This article focuses on parameter calibration. The priors were calibrated either based on existing literature or through the researchers' own calculations. The sample data spans from 1981 to 2022, sourced from the Central Bank of Iran's databases, including national accounts and bank balance sheets. The model development process followed these steps:

First Order Condition: The first-order conditions of the model were derived and subsequently linearized.

Model Solution: The linearized model was then solved.

Parameter Initialization: The parameters were initialized by using both findings from prior studies and actual data. The parameters were first expressed in terms of the model's intrinsic variables. Using annual time series data, steady-state values for these parameters were then determined.

Parameter Calculation: Finally, the parameter values were computed based on the steady-state results. In doing so, we followed a similar approach to Tavakkolian & Sarem (2017), employing detrended variables to calculate the steady-state values. (Eq. (37)).

$$\log(x_t) = \acute{c} + \acute{r}.trend \tag{37}$$

The intercept c' represents the base level, and the trend component r' has an associated coefficient. Taking the antilog of the estimated intercept provides the steady state of x_t. To estimate the coefficient for the trend component, the detrended time series is calculated using Equation (38):

$$x_t^s = \frac{x_t}{(1+\acute{r})^t} \tag{38}$$

After redefining the parameters in terms of the endogenous variables, the steady states of these variables are incorporated, allowing the numerical values of the parameters to be calculated using actual data. Some parameters, such as the discount rate and the depreciation rate, are determined by solving the model. Other parameters, including the weights for money growth, inflation, deviation from production targets, and their respective target weights in Equations (21), (26), and (28), are estimated. This estimation also applies to the share of bank capital and production in Equation (16), the contributions from the interbank market in Equation (19), and from the central bank in Equation (20). Additionally, the weights of lagged foreign assets and oil income in Equation (31), the money growth rate shock coefficient in Equation (29), and the oil income shock coefficient in Equation (32) are calculated using their respective equations with EVIEWS 12.

Parameters of shocks are estimated using Eviews (12) and Eq. (39):

$$\log(x_t) = c + \rho \log(x_{t-1}) + \epsilon_{x_t} \tag{39}$$

Where ρ is Autoregressive Coefficient and its standard deviation ofϵ_{x_t} is the standard deviation of variable. The productivity shock cofficent in Eq. (9), the Covid-19 shock cofficent in Eq. (2), the money growth rate target shock coefficient in Eq. (23), the inflation target shock cofficient in Eq. (27), and the output target shock coefficient in Eq. (25) are selected appropriately the structure

of the model. Distribution of parameters are selected based on the characteristics of parameters and features of the distribution.

Table 1. Prior

Parameter	Value	Calibrated from	Description
		Households	
σ_c	0.93	Khoshnevis & Ahmadyan (2017)	Elasticity of intertemporal substitution
σ_n	0.63	Khoshnevis & Ahmadyan (2017)	Relative preference for leisure
ϑ	1.072	Taghipour and manzoor (2016)	Relative preference for money holding
δ	0.24	Author calculations	Depration rate of physical capital
φ_k	8.6	Agneor et al. (2012)	Adjustment cost parameter, capital
β	0.97	Author calculations	Discount factor
		Firms	
θ	4.33	Mark-up 30%	Elasticity of demand, intermediate goods
α	0.78	Khoshnevis and Ahmadyan (2017)	Share of labor in output, intermediate good
φ_f	4.26	Atta-Mensa and Dib (2008)	Adjustment cost parameter, Prices
γ	0.65	Solving Model	Part of the cost of capital and labor
		Banks	
α_b	0.58	Author calculations	Default rate
φ_{di}	0.1	Ahmadyan (2016)	Adjustment cost parameter, due to interbank market
φ_{dc}	0.1	Ahmadyan (2016)	Adjustment cost parameter, due to central bank
φ_{li}	0.1	Author assumption	Adjustment cost parameter, due from interbank market
Φkb	0.65	Author calculations	Share of Bank capital
Φy	0.35	Author calculations	Share of production
kb	0.1	Khoshnevis and Ahmadyan (2017)	Adjustment cost of Bank capital
θ_k	0.08	Basell(I)	Capital adequacy ratio
η	0.2	Average legal reserve rate in Iran	Legal Resrve ratio
Φdi	0.46	Author calculations	Share of due to interbank market

Φdc	0.57	Author calculations	Share of due to central bank
Central Bank			
$\omega\mu$	0.25	Author calculations	Weight of money growth
$\omega\pi$	0.56	Author calculations	Weight of inflation
ωy	-0.36	Author calculations	Weight of difference production from production target
$\omega\mu*$	-0.25	Author calculations	Weight of money growth target
$\omega\pi*$	-1.56	Author calculations	Weight of inflation target
ωfr	0.6	Author calculations	Weight of lag of foreighn asset
wor	0.4	Author calculations	Weight of oil income
Government			
vor	0.55	Ahmadyan (2016)	Weight of oil revenue in government expenditure
vt	0.25	Ahmadyan (2016)	Weight of tax in government expenditure
vdg	0.1	Ahmadyan (2016)	Weight of government debt in government expenditure
vx	0.1	Ahmadyan (2016)	Weight of other revenue in government expenditure
Φ_t^y	2.08	Ahmadyan (2016)	Weight of output in tax
Φ_x^y	1.54	Ahmadyan (2016)	Weight of output in other revenue
Shocks			
$\boldsymbol{\rho_{covid}}$	0.60	Appropriate structural of model	Covid-19 shock cofficent
ρ_a	0.64	Appropriate structural of model	Productivity shock cofficient
$\boldsymbol{\rho_{epsimio}}$	0.56	Author calculations	Money growth rate shock cofficient
ρ_{y*}	0.30	Appropriate structural of model	Output target shock cofficient
$\rho_{\mu*}$	0.85	Appropriate structural of model	Money growth rate target shock cofficient
$\rho_{\pi*}$	0.80	Appropriate structural of model	inflation target shock cofficient

ρ_{or}	0.60	Author calculations	Oil income shock cofficient

Source: *Research Finding*

To evaluate the goodness of fit of the calibrated model in this study, the moments generated by the model are compared with their real-world counterparts. Another indicator of the model's goodness of fit is the comparison between the autocorrelation coefficients of the lagged simulated variables and those of the actual data for the same variables. To achieve this, the ratio of the model's moments and autocorrelation coefficients to those of the actual data has been calculated. The closer this ratio is to one, the better the model fits the real data. Specifically, the ratios of the mean, standard deviation, and the first and second lag autocorrelation coefficients for four variables—non-oil production, inflation, bank loans, and bank deposits,—are presented in Table 2. As shown, these ratios highlight the relative success of the model in simulating the dynamics of the Iranian economy.

Table 2. The ratio of the first and second order moments and the autocorrelation coefficient of the first and second interval between simulated and real values

	average	standard deviation	Autocorrelation coefficients	
	model	model	First lag	Second lag
GDP	1.0003	0.97	0.91	0.77
inflation	0.99	0.98	0.87	0.88
loan	0.99	1.05	0.89	1
deposit	0.99	0.98	0.87	0.97

Source: *Research Finding*

Additionally, comparing the correlation coefficients between the model's simulated variables and the actual variables is another important criterion for evaluating the model's fit. In this analysis, key variables such as non-oil production, inflation, bank loans, and bank deposits were selected. To calculate these values, the real variables were detrended, and their autocorrelation coefficients were computed using Eviews software at the level of the variables. Furthermore, cross-correlation coefficients with non-oil production were calculated. The results indicate that the correlation coefficients between the simulated and actual values of the studied variables are quite close, demonstrating a good fit of the calibrated model.

Table 3. Comparison of correlation coefficients of variables, real and simulated values

Correlation	Real				Simulation			
	GDP	inflation	loan	deposit	GDP	inflation	loan	deposit
GDP	1	-	-	-	1	-	-	-
inflation	-0.31	1	-	-	-0.36	1	-	-
loan	0.56	-0.19	1	-	0.33	-0.19	1	-
deposit	0.59	-0.21	0.82	1	0.99	-0.17	0.29	1

Source: *Research Finding*

4.2 Impulse Response Function

Figure 1 illustrates the impact of COVID-19 on interest rates under two scenarios: with and without inflation targeting and money growth rate targeting. In the case without inflation targeting and money growth rate targeting, the results show that during the COVID-19 period, the central bank lowered loan interest rates to enhance firms' access to credit facilities. At the same time, the central bank raised deposit interest rates to help banks attract more resources. Additionally, the central bank reduced the interest rate applied to loans extended to banks, allowing banks to access funds more affordably. Reducing interest rates can lead to a decline in banks' interest income. Our findings, consistent with the theoretical insights of McCallum and Nelson (1999) and Kerr and King (1996), suggest that interest rate reductions are amplified by inflation targeting and money growth rate targeting policies. Specifically, the central bank decreases interest rates by lowering both the targeted inflation rate and the targeted money growth rate. Additionally, in line with Hicks (1937), we find that the cost of capital increased during the COVID-19 period, reflecting the heightened challenges for firms in accessing capital despite lower interest rates.

If the central bank follows an inflation targeting policy, interest rates will decline more sharply compared to a money growth rate targeting policy. This is because the banking sector plays a crucial role in financing the production sector, and banks' funding is typically more affordable than non-banking sources. As a result, bank interest rates directly contribute to firms' costs. Since firms' costs influence the prices of goods, lowering interest rates becomes a tool to reduce production costs. Consequently, to lower firms' costs and achieve the inflation reduction target, the central bank reduces interest rates. In the case of money growth rate targeting, even though the central bank aims to reduce the money growth rate, the money supply continues to expand, resulting in a smaller reduction in interest rates compared to inflation targeting. These findings align with the results of Ilzetzki, Reinhart, and Rogoff (2020), and Benmelech & Tzur-Ilan (2020). Lowering deposit interest rates can lead to a withdrawal of deposits from banks, which in turn diminishes the lending capacity of the banking sector. Although a reduction in lending capacity may decrease the risk of non-performing loans, it also negatively impacts the bank's income and profitability. Since profitability is a key indicator of a bank's overall health, both inflation targeting and money growth rate targeting can lead to a deterioration in bank health and increase the risk of damage to banks' balance sheets.

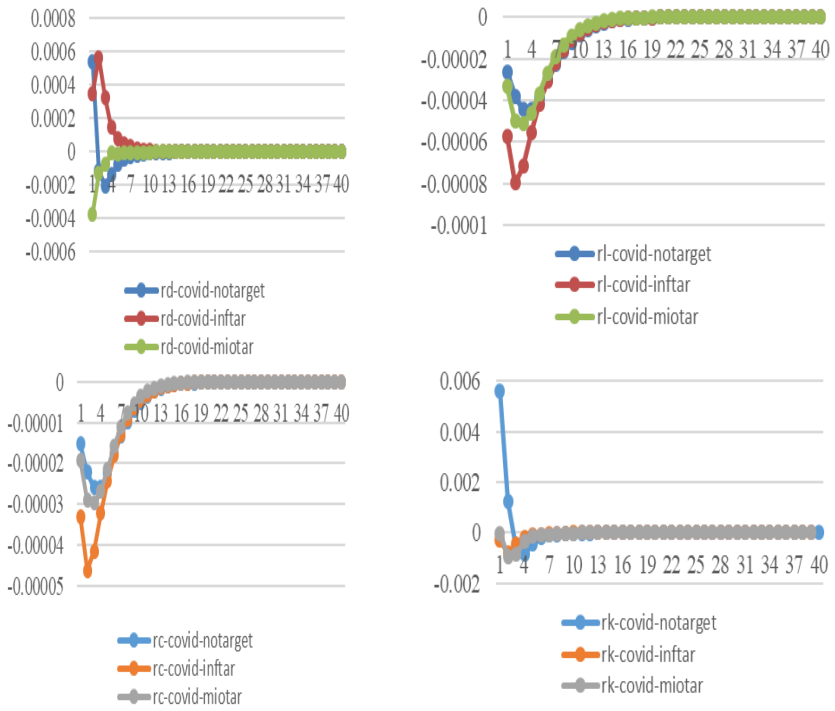


Figure 1.COVID 19, Targeting Policies and Interest Rate

Source: *Research Finding*

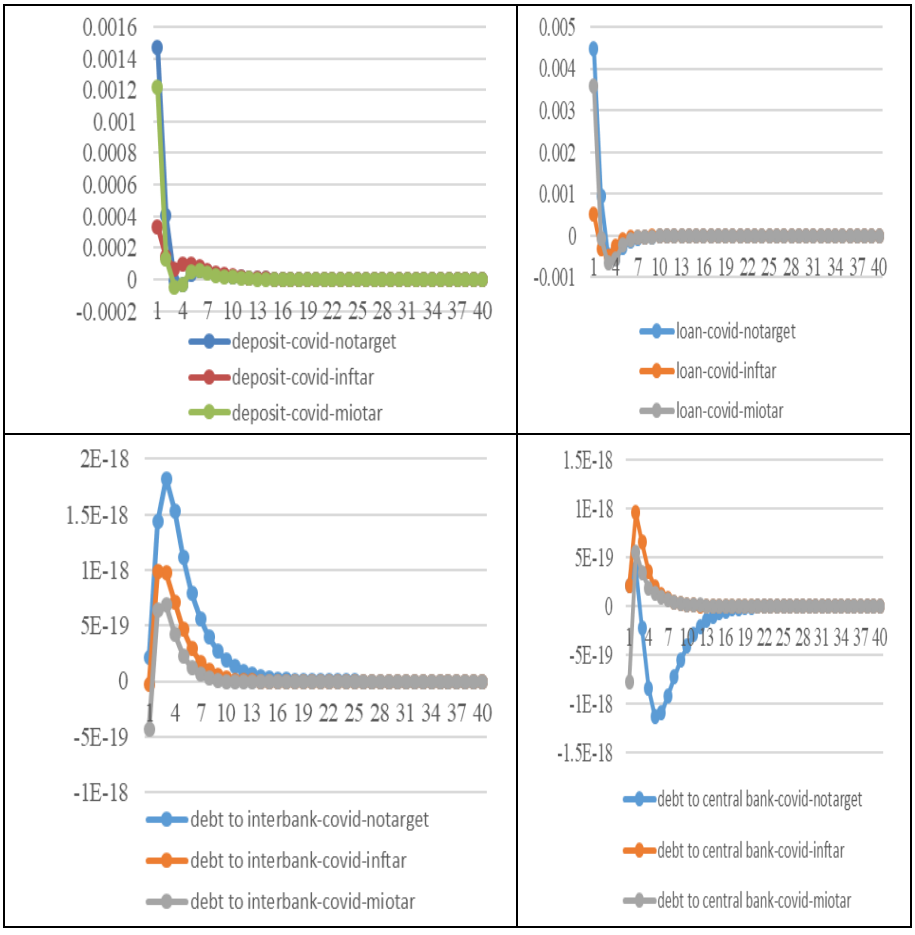
Note: rd is deposit interest rate, rl is loan interest rate, rc is due from central bank interest rate, rk is capital payment

Figure 2 illustrates the impact of COVID-19 on banks' balance sheets under two scenarios: with and without inflation targeting and money growth rate targeting. In line with theoretical contributions from Mishkin (1995), Guentner (2011), and Bernanke & Gertler (1998), as well as empirical findings from Barthelemy et al. (2011) and Niedzwidzinska (2020), our results demonstrate that in the model without targeting during the COVID-19 shock, an increase in deposit interest rates leads to higher deposits, which in turn allows banks to extend more loans. As a result, banks have less reliance on borrowing from the central bank or the interbank market, reducing the need for external funding during the COVID-19 period.However, when the COVID-19 shock coincides with inflation targeting and money growth rate targeting, both deposits and loans decline. In this case, the demand for borrowing from the central bank and the interbank market increases, as banks struggle with reduced liquidity. This scenario also leads to a decrease in bank capital during the COVID-19 shock, highlighting the detrimental effects of simultaneous shocks on the banking sector's health.

Money growth rate targeting leads to a greater increase in deposits and loans compared to inflation targeting, but it results in a larger decline during the COVID-19 period. In contrast, inflation targeting causes a larger rise in borrowing

from the interbank market and the central bank than money growth rate targeting. These results are consistent with the findings of Pinshi (2020) and Marmefelt (2020).

During the COVID-19 pandemic, it is recommended that the central bank avoid implementing inflation targeting or money growth rate targeting policies. Without these policies, the declines in deposits, loans, and borrowing from the interbank market would be less severe compared to the scenario where these targeting policies are in place during the pandemic. As a result, the need for borrowing from the central bank would also decrease. Both inflation targeting and money growth rate targeting policies can harm the health of banks' balance sheets during COVID-19, primarily due to the instability and weakened condition of the Iranian banking system. This conclusion aligns with the findings of Ahmadyan & Heydari (2016).



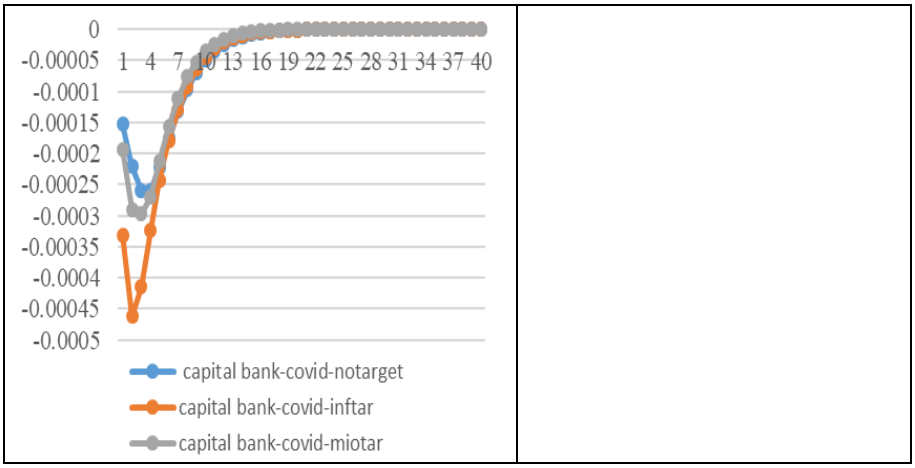


Figure 2.COVID 19, Targeting Policies and Balance Sheet
Source: *Research Finding*

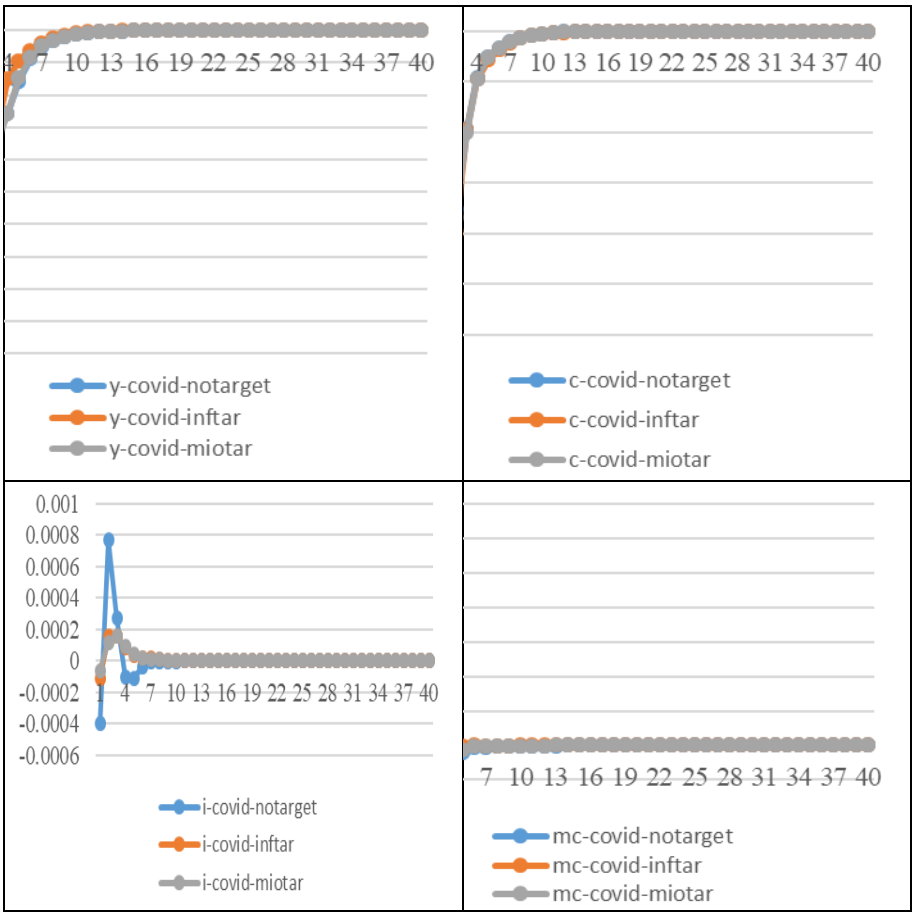
Figure 3 illustrates that during the COVID-19 pandemic, policymakers implemented various measures such as closing educational institutions, shutting down certain businesses, and enforcing stricter social distancing measures. These findings, consistent with those of Diwan, Leduc, and Mertens (2020) and Erdoğan Yıldırım & Gadiki (2020), indicate that the adoption of these policies led to a significant reduction in investment across various sectors of the economy, as well as a decline in production. Furthermore, consumption levels fell due to the contraction in both production and employment.

As Holton, Phelan, & Stuart (2020) suggest, our results similarly indicate that as the crisis deepens, consumer confidence in the economic environment will diminish. This decline in consumer confidence may result in delays in making long-term purchases, such as homes or cars, which in turn exacerbates the recession by further reducing economic activity.

In line with Beck and Wieland (2008) and Flemig et al. (2020), our theoretical findings suggest that both inflation targeting and money growth rate targeting can negatively affect consumption. During the COVID-19 pandemic, implementing these targeted policies may reduce firms' marginal costs. While a decrease in loan interest rates can increase the demand for loans, the limited availability of resources and the diminished lending capacity of banks restrict firms' access to credit. As a result, investment opportunities shrink, leading to a reduction in production. Consequently, this decline in production negatively impacts government tax revenues.

During inflation targeting amid COVID-19, both production and investment decline, while consumption increases more compared to money growth rate targeting. This is because, under inflation targeting, loans and deposits decrease more significantly. As a result, during the COVID-19 period, the overall negative and positive effects of inflation targeting are more pronounced than those of

money growth rate targeting. These findings are consistent with the theoretical work of Beck and Wieland (2008) and Borio (2020).



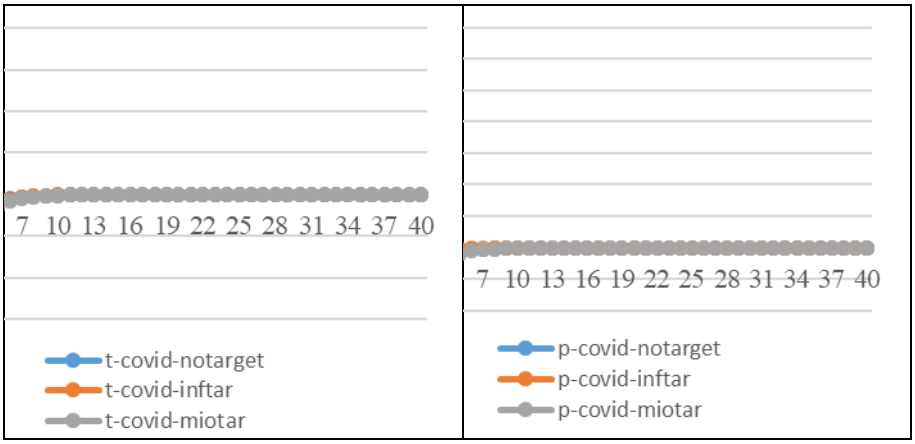


Figure 3.COVID-19, Targeting policies and Macroeconomic

Source: *Research Finding*

Note: Y is GDP, C is consumption, I is investment, mc is marginal cost, t is tax, p is price.

5. Concluding Remarks

The spread of COVID-19 and the uncertainty regarding its magnitude and duration have generated significant volatility in the financial markets, leading to a recession in these sectors. In response, central banks across various countries have adopted a range of policies, including inflation targeting, money growth rate targeting, exchange rate stabilization, interest rate targeting, and injecting liquidity into banks, as well as reducing capital buffers and liquidity requirements. These measures aim to mitigate the adverse effects of the pandemic on both the economy and the banking sector. The primary objective of policymakers has been to reduce inflation, foster economic growth, and enhance financial stability. Achieving these goals necessitates the establishment of a precise and purposeful mechanism for the monetary policy-making process. In its standard form, this process encompasses forecasting economic conditions, setting targets, and ultimately formulating and implementing appropriate policies.

In Iran, two main approaches—inflation targeting and money growth rate targeting—are frequently employed to stabilize prices, promote economic growth, and enhance financial stability. When the COVID-19 pandemic emerged, selecting the most appropriate policy became even more crucial. In determining whether to adopt inflation targeting or money growth rate targeting in response to the pandemic's economic effects, it is essential to take into account its unprecedented and unpredictable nature.

In this paper, we simultaneously model the impact of inflation targeting and money growth rate targeting alongside the COVID-19 shock using a Dynamic Stochastic General Equilibrium (DSGE) model. To capture the effects of COVID-19, we incorporate a COVID-19 shock into the utility function. Additionally, we employ the money growth rate policy rule to represent central bank behavior, and this rule is adjusted to include both inflation targeting and money growth rate

targeting mechanisms. The Vector Autoregressive (VAR) method was also applied to analyze both inflation targeting and money growth rate targeting. The study specifically examined the effects of shocks to money growth rate targeting and inflation targeting during the COVID-19 pandemic on the balance sheets of financial institutions.

The results of the COVID-19 shock indicate a contraction in banks' balance sheets, with decreases in both deposits and loans. The economic recession triggered by the pandemic has led to lower employment rates and an increase in corporate bankruptcies, ultimately weakening the credit portfolios and liquidity positions of banks.

Furthermore, the shocks from both inflation targeting and money growth rate targeting during the pandemic contribute to an increase in deposits but a decline in loan interest rates. This, in turn, reduces banks' available resources and their lending capacity. As a result, banks experience diminished interest income, profitability, and overall financial health.

Moreover, as banks' lending capacity shrinks, the production sector faces reduced access to credit, leading to lower investment and production levels. If inflation targeting and money growth rate targeting policies are accompanied by an increase in interest rates, this will likely exacerbate the deterioration of banks' balance sheets, further weakening their financial health and also curtailing production activities.

During the COVID-19 pandemic, inflation targeting has a more detrimental impact on banks' balance sheets compared to money growth rate targeting. Under inflation targeting, interest rates fall more significantly than with money growth rate targeting, leading to reductions in both deposits and interest expenses. Consequently, investment and production also decline. Additionally, COVID-19 amplifies the negative effects of both inflation targeting and money growth rate targeting.

Given Iran's current economic situation, it appears that during the pandemic, policymakers may not be able to stimulate production through inflation targeting or money growth rate targeting. However, they can still control inflation using these tools. It is important to note that the application of these policies during COVID-19 further weakens banks' balance sheets. Therefore, it is recommended that the central bank simultaneously implement interest rate targeting alongside inflation targeting and money growth rate targeting to help mitigate the adverse effects on banks' financial stability.

Author Contributions

Conceptualization, methodology, validation, formal analysis, resources, writing— original draft preparation, writing—review and editing, supervision by A. Ahmadyan.

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Conflicts of Interest
The authors declare no conflict of interest.

Data Availability Statement
The data used in the study were taken from https://www.cbi.ir/page/4275.aspx.

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