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Original Research Article

The Role of Bank Capital in the Propagation of Shocks in Iran: A Dynamic Stochastic General Equilibrium Approach

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Considering the intermediary role of banks in the economy and their critical function in the propagation of economic shocks to the real sector, this study aims to investigate the role of bank capital in analyzing the relationship between banks' balance sheet characteristics and economic fluctuations using a Dynamic Stochastic General Equilibrium (DSGE) model. The results demonstrate that, in the model with a bank capital channel, positive shocks lead to more robust economic growth. This is attributed to the banks' ability to invest, enhancing the positive effects of shocks. Taking bank capital into account, variables such as consumption, and inflation exhibit better performance, with reduced fluctuations or quicker adjustments, leading to economic stability. Conversely, in an economic scenario without a bank capital channel, positive shocks have a lesser impact on economic variables. Consequently, the results can effectively inform decision-making regarding the necessity of adhering to bank capital adequacy ratios.

Keywords: Dynamic Stochastic General Equilibrium model, Bank Capital, Oil, Capital Adequacy Shock
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1 Introduction

Banks wield a pivotal influence within the economy, driven by their role as financial intermediaries bridging the information gap between depositors and investors, and their central involvement in the money multiplier. The conduct of financial institutions, particularly banks, is markedly swayed by economic policies and the monetary transmission mechanism orchestrated by central banks. A preeminent challenge confronting any economy's banking sector revolves around its ability to navigate economic shocks. The magnitude of this challenge is underscored by the vulnerability of the banking industry in numerous advanced economies. Given their integral part in the monetary transmission mechanism, these vulnerabilities have propagated shocks across sectors, precipitating severe economic downturns.

The 2008 financial crisis in the United States and Europe starkly highlighted how the failure of a handful of major banks could plunge the global economy into a profound recession. Distinctive attributes of banks across different nations yielded divergent impacts of the financial crisis. These impacts hinged on the resilience of their balance sheets, encompassing factors like bank size, capitalization, and liquidity access. Empirical evidence underscores that bank endowed with enhanced liquidity access or bolstered capital levels tend to exhibit greater resilience in the face of economic shocks. Conversely, smaller, and weaker banks often curtail lending activities during such testing circumstances. Empirical evidence underscores that bank endowed with enhanced liquidity access or bolstered capital levels tend to exhibit greater resilience in the face of economic shocks. Conversely, smaller and weaker banks often curtail lending activities during such testing circumstances.

Guaranteeing the preservation of funds and credible capital resources reduces the risk for bank depositors. Banks rely on their capital to withstand losses from non-payment of loans, unfavorable market conditions, and operational constraints. Even in the best case scenario, a bank with a suitable capital position may still face unforeseen events that could lead to its downfall. However, researchers have found that the dimensions of a banking crisis are more limited for banks with a better capital position, as such banks have more time to identify and properly address problems.

Furthermore, considering the specific characteristics of oil-rich countries, especially Iran, which heavily rely on oil export revenues, incorporating the

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oil sector into models is necessary to account for fluctuations in this sector.[1] Given the high share of oil in Iran's economy, fluctuations in oil revenues can have an impact on the structure of Iran's economy and government budget. Therefore, the oil sector and the revenue it generates have been included in the model.

Iran's banking system has been scrutinized through various lenses within economic studies. However, this research embarks on an uncharted path by dissecting the role of bank balance sheets, with a specific focus on the capital channel, in transmitting oil, technology, capital adequacy, and banking-related shocks to the real economy. This pioneering endeavor employs the Dynamic Stochastic General Equilibrium (DSGE) methodology, hitherto unexplored in domestic Iranian research.

DSGE models offer a robust toolset for comprehending interactions among distinct economic agents and for dissecting policy ramifications. Anchored in microeconomic principles, these models seek to expound on macroeconomic phenomena such as growth trends, business cycles, and the repercussions of monetary and fiscal policies. Recent times have witnessed a heightened emphasis on financial components as contributors to macroeconomic fluctuations, as economists integrate intermediaries and financial markets into DSGE frameworks.

One of the main reasons macroeconomists have turned to building DSGE models is that these models are not subject to Lucas' critique like other macroeconomic forecasting models. Lucas (1976) argues that attempts to predict the effects of changes in economic policy based solely on observed relationships between past data are simplistic because estimated parameters are not structural; they are not constant under policy changes and are influenced by them.

Most results obtained from DSGE models in recent years are not only theoretically appealing but also provide a suitable tool for predicting and quantifying policy analysis in macroeconomics. These models can help identify sources of macroeconomic fluctuations and answer questions regarding structural changes while predicting the effects of policy changes.

It should be noted that one of the main challenges facing DSGE models raised by some economists is making them more realistic, which requires creating complex models with numerous relationships. This makes understanding, solving, estimating, and analyzing these models more difficult.

[1] Cooley and Hansen (1989)

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The primary objective of this study is to dissect the role of bank capital in untangling the nexus between bank balance sheet attributes and economic undulations. Thus, drawing inspiration from prior works by scholars like Agenor (2012), Christiano et al. (2005), Kuhl (2014), Meh and Moran (2010), Tabarraei et al. (2018), this research amalgamates conventional factors with the oil fund, oil sector, and banking domain. It engages two distinct economic scenarios: one incorporating the bank capital channel and the other omitting it, both perturbing shocks within the real sector.

The purpose of this article is not to argue that the current state of Iran's banking system is in crisis due to capital adequacy or other critical financial ratios. The purpose is to highlight that when banks' capital is included in modeling, positive shocks such as technological, oil-related, capital-related shocks have better effects on the economy. Therefore, attention to capital and adherence to capital adequacy requirements as recommended by Basel statements are advised. The research results bear potential significance in shaping critical decisions concerning the imperative of bank capital adequacy.

The paper's overarching structure comprises seven sections. Commencing with the introduction, the second section delves into the theoretical underpinnings and research methodology grounded in the DSGE model. The third section expounds upon the research's contextual backdrop, spanning domestic and international studies, along with the evolution of pertinent models. Section four designs the DSGE model tailored to Iran's economic landscape. The fifth section details the model's solution results. Section six delves into results analysis, encapsulating impulse response diagrams, a comparative assessment of scenarios with and without the bank capital channel, and the oscillations of economic variables triggered by technology, oil price, and banking shocks. Finally, the seventh section encapsulates the summary and concluding reflections.

2 Theoretical Background of Banks' Role in Financial Stability in DSGE Models

The reverberations of recent financial crises, along with their stark repercussions in transmitting crises from the monetary sector to the real economy, have cast a glaring spotlight on the imperative of honing our focus on the banking system. Within this contemporary context, New Keynesian models enriched with financial and banking components have assumed a pivotal role. These models have adeptly illuminated the mechanisms underpinning the propagation of shocks to the real economy and the intricate patterns forming business cycles.

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Banks, by virtue of their distinctive attributes in managing an array of risks and exposures inherent in their operations, and in shielding depositors from abrupt harm, are compelled to uphold a robust capital base. Maintaining adequate capital endows a bank with the temporal leeway to promptly identify and effectively address issues that arise. It furnishes the essential buffer for absorbing losses stemming from non-performing loans, adverse market circumstances, and specific operational limitations. While even well-capitalized banks may encounter distressing circumstances, scholarly investigations have corroborated that banks fortified with more substantial capital buffers experience comparatively tempered banking crises. Hence, a pivotal yardstick for assessing banks lies in the capital adequacy ratio. This ratio empowers banks to navigate unexpected losses and debt obligations amidst economic tumult. Bank capital adequacy stands as the linchpin of financial robustness, especially when confronted with adverse economic conditions and banking crises. Consequently, regulatory committees have formulated and disseminated agreements pertaining to bank capital in the aftermath of severe financial upheavals.

Dynamic Stochastic General Equilibrium (DSGE) models emerge as potent instruments, providing a coherent framework for the discourse and analysis of policies. Essentially, these models serve as torchbearers in unraveling the origins of fluctuations, addressing queries about structural shifts, prognosticating the ramifications of policy modifications, and conducting empirical experiments. They establish a bridge between the economy's structural attributes and the reduced-form parameters—an accomplishment elusive within expansive macroeconomic models. Remarkable strides have been made over recent years in understanding the characteristics and estimating these models. Concurrently, central banks have exhibited growing enthusiasm for the pragmatic application of these models in policy analysis.

Presently, the landscape is characterized by the prevalence of DSGE models across the spectrum of developed and emerging economies' central banks. Many have crafted their unique models, while others have embarked on strategic trajectories to adopt them. Pioneering efforts in incorporating the banking sector within DSGE models have been pioneered by luminaries such as Goodfriend and Maccallum (2007), Christiano et al. (2010), and Gertler and Kiyotaki (2010).

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3 Research Background

Several domestic inquiries have harnessed DSGE models to dissect the dynamics of the banking sector, shedding light on the effects of monetary and financial shocks on macroeconomic variables. Dargahi and Hadian (2016) undertook an exploration into the period spanning 1990 to 2014, discerning the influence of monetary and financial shocks on macroeconomic oscillations. Their findings underscored the value of integrating the banking sector into macroeconomic models, endowing policymakers with richer insights to navigate economic undulations and frame effective policies.

Rafiei et al. (2019) delved into the realm of monetary policy's impact on bank performance, meticulously observing banks' responses to monetary shocks. Their model outlined that a positive monetary shock precipitates a decline in loan demand, a reduction in loan volume, subsequently curbing banks' profits. In parallel, a positive oil shock triggers augmented liquidity, lowered lending rates, amplified investment, and diminished household savings.

Sadeqpour et al. (2021) embarked on a nuanced examination of monetary and financial shocks through two distinct scenarios: one encompassing an Islamic banking system and the other assuming its absence. Their meticulously calibrated model unmasked that while the effects of shocks on the real sector remained consistent across both scenarios, nuances surfaced in terms of fluctuation intensity, the tempo of business cycle adjustments, and the equilibrium's economic stability. The former scenario emerged as the superior performer in these metrics.

Beyond domestic borders, following the seismic upheaval of the 2008 global financial crisis and its repercussions, researchers turned their focus toward empirical studies grounded in DSGE models equipped with financial components and a finely-tuned banking sector. Dib (2010) laid bare the ameliorative role of a banking system, positioned as a financial intermediary, in tempering the impact of financial shocks. This consequential effect translated into reduced macroeconomic uncertainty and an elevation in social welfare. Hafstead and Smith (2012) meticulously dissected the repercussions of credit and deposit withdrawal shocks on macroeconomic variables within a framework of monopolistic competition. Their model uncloaked that shocks originating within the banking realm manifest larger adverse effects upon macroeconomic variables.

Mirroring Agenor's (2012) work, Tabarraei et al. (2018) embarked on an inquiry into an oil-exporting economy within the precincts of a New Keynesian framework. Their model, intricately woven with a heterogeneous

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banking sector and an oil fund, showcased that bank capital requirements act as a mitigating force against technology, oil, and monetary policy shocks, ultimately fostering heightened economic stability. Notably, the government's role in shock propagation emerged as pivotal. Windfalls from amplified oil prices or favorable technological shocks propel the government to elevate transfers to households and augment public capital expenditures. Furthermore, banks, enmeshed with links to non-oil firms, the oil fund, and the central bank, wield the capacity to differentially maneuver market interest rates, with disparities emanating due to multifaceted frictions within the banking sector. The nuanced dynamics of lending banks, intricately interwoven with the government, non-oil entities, the oil fund, and the central bank, engender less monopoly power in deposit rates as compared to the dominance they exercise over lending rates.

4 Model

The DSGE model proposed in this study considers various economic agents, including households, banks, non-oil and oil producing firms, government, and the central bank. In the model, households deposit their savings in banks, and deposit-taking banks allocate these resources in the interbank market to lending banks. Lending banks then provide these funds to economic firms as bank loans. Therefore, the model consists of six sectors: households, economic firms (capital producers, intermediate, final, and retailers), the financial sector (deposit-taking and lending banks), oil, the central bank, and the government.

In this article, the DSGE model is tailored to the economic characteristics of an oil-exporting country based on the frameworks provided by Tabarraei et al. (2018), Agenor et al. (2012), and Meh and Moran (2009). The optimization process for each economic agent is examined, and the optimal equations are derived.

4.1 Households

Households are assumed to have an infinite lifetime and derive utility from consuming goods, services, and leisure. Households maximize their lifetime utility function given a consumption leisure trade-off. The household's utility function is as follows:

$$\text{Max}\, \mathbb{E}_t \sum_{s=t}^{\infty} \beta^{s-t} \left(\frac{C_t^{1-\sigma}}{1-\sigma} - \chi_N \frac{N_t^{1+\phi}}{1+\phi} \right)$$
$$C_t = \left[\int_0^1 C_t(j)^{\frac{\theta-1}{\theta}} d_j \right]^{\frac{\theta}{\theta-1}}$$

In the household utility function, $\mathbb{E}$ represents the expectations operator, τ_c and τ_w are the consumption and wage tax rates respectively, β is the intertemporal discount factor with $0 < \beta < 1$, $\sigma > 0$ is the inverse of intertemporal substitution of consumption (reflecting the intertemporal consumption smoothing), $\phi > 0$ is the coefficient of intertemporal labor supply elasticity (capturing the responsiveness of labor supply over time), and $\chi_N > 0$ is the coefficient of labor disutility.

Households supply labor N_t to firms for the production of goods and services and receive wages W_t in return. They also receive government transfers Γ_t in the form of subsidies and net payments in exchange for owning firms and banks $\mathbb{P}_t$ (assuming households own the firms and banks). On the other hand, they allocate part of their income to consumption C_t , part to tax payments T_t , and save the rest. Savings are held in the form of bank deposits D_t in the household's asset portfolio, and households receive an interest rate R_t^D from the bank on these deposits. Π_t represents the inflation rate $\frac{P_t}{P_{t-1}}$.

Thus, households in each period t will face the following budget constraint:

$$C_t + D_t + T_t \leq W_t N_t + \frac{R_{t-1}^D D_{t-1}}{\Pi_t} + \Gamma_t + \mathbb{P}_t$$
$$T_t = \tau_c C_t + \tau_w W_t N_t \tag{1}$$

The first-order conditions from maximizing household utility yield the following results for consumption, labor supply, and savings:

$$\lambda_t = \frac{C_t^{-\sigma}}{1+\tau_c} \tag{2}$$
$$\frac{N_t^{\phi}}{C_t^{-\sigma}} = \frac{W_t(1-\tau_w)}{\chi_N(1+\tau_c)} \tag{3}$$
$$C_t^{-\sigma} = \beta E_t \left(\frac{R_t^D C_{t+1}^{-\sigma}}{\Pi_{t+1}} \right) \tag{4}$$

4.2 Firm

In the New Keynesian general equilibrium models, the assumption is made about the existence of monopolistic competition. Therefore, to incorporate monopolistic competition into the model, two types of firms are considered.

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One group of firms is the producers of intermediate goods that operate in a monopolistically competitive market. The second group consists of producers of final goods. These firms act as aggregators and purchase the product of the first type of firms and sell it as final goods to consumers. These firms operate under perfect competition. Thus, in the context of firms, the maximization process of both types of firms should be taken into account.

4.2.1 Intermediate Goods Producers

The production function for intermediate goods is a Cobb-Douglas function of labor and capital, which is used by a set of intermediate goods producers to produce their output and sell it to final goods producers. The problem faced by the intermediate goods producers in determining the wage rate and the capital rent (W_t, R_t^k) is as follows:

$$\max \Pi_t^n = P_t^H Y_t^n + (1-\delta_k) P_t^k K_t - R_t^k P_{t-1}^k K_t - W_t N_t^n$$

The profit is maximized subject to the following Cobb-Douglas production technology

$$Y_t^n = A_t (K_t)^{\gamma_n} \left(K_{t-1}^G\right)^{\gamma_G} (N_t^n)^{1-\gamma_n} \tag{5}$$

where P_t^H represents the price of intermediate goods for final goods producers, A_t is the technology shock, and Y_t^n is the non-oil final production. K_t is private capital and K_t^G is public capital and γ_n and γ_G are the elasticities of private and public capital, respectively ($\gamma_n, \gamma_G > 0$), and δ_k is the capital depreciation rate.

The intermediate goods producers sell a portion of the undepreciated capital to the capital producers. For the future period's production, the intermediate goods producers purchase capital K_{t+1} at the price P_t^k from the capital producers. In each period, the intermediate goods producer raises loan (L_t) in order to finance its required capital

$$L_t = P_t^k K_{t+1}$$

The producer will sell the undepreciated part of capital to capital producers on the open market at the proper price. The firms choose labor and capital under perfect competition market conditions:

$$R_t^k = \frac{\gamma_n P_t^H Y_t^n + (1-\delta_k) P_t^k K_t}{L_{t-1}} \tag{6}$$

$$W_t = \frac{(1-\gamma_n)P_t^H Y_t^n}{N_t^n} \tag{7}$$

To find the marginal cost, the level of labor and capital for one unit of output is adjusted.

$$A_t (K_t^n)^{\gamma_n} \left(K_{t-1}^G\right)^{\gamma_G} (N_t^n)^{1-\gamma_n} = 1$$

This equation, by using factor prices 6 and 7, results in equations 8 and 9 implies:

$$N_t^n = \frac{1}{A_t}\left(\frac{\gamma_n}{1-\gamma_n}\frac{W_t}{R_t}\right)^{-\gamma_n} \tag{8}$$

$$mc_t = \left(\frac{1}{1-\gamma_n}\right)^{1-\gamma_n}\left(\frac{1}{\gamma_n}\right)^{\gamma_n}\frac{W_t^{1-\gamma_n} R_t^{\gamma_n}}{A_t\left(K_{t-1}^G\right)^{\gamma_G}} \tag{9}$$

The return on capital is given by the equation:

$$R_t = R_t^K P_{t-1}^K - (1-\delta_k)P_t^k$$

4.2.2 The Final Goods Producers

The final goods producer plays the role of an aggregator, purchasing differentiated goods from intermediate goods producers and combining them into a single final good. (Dixit-Stiglitz)

The profit maximization problem of the final goods producer is defined as follows:

$$\max_{Y_t(i)} P_t^H Y_t^H - \int_0^1 P_t^H(i) Y_t^n(i)\,di$$

$$Y_t^H = \left(\int_0^1 Y_t^n(i)^{\frac{\theta-1}{\theta}}\,di\right)^{\frac{\theta}{\theta-1}} \tag{10}$$

In equation (10), $P_t^H(i)$ is the price of the ith intermediate good, $P_t^H(i)$ is the price of the final good, and θ is the constant elasticity of substitution between intermediate goods. Y_t^H represents the aggregate demand.

The final goods producer tries to determine its purchases from intermediate goods according to the prices of differentiated intermediate goods to maximize its profit. As a result, the demand function for intermediate goods is as follows:

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$$Y_t^n(i) = \left(\frac{P_t^H(i)}{P_t^H}\right)^{-\theta} Y_t^H \ \forall \quad (11)$$

The price of the final good, which results in zero profit condition, is as follows:

$$P_t^H = \left(\int_0^1 P_t^H(i)^{1-\theta} di\right)^{\frac{1}{1-\theta}} \quad (12)$$

4.3 Capital Producers

Competitive capital producing firms build new capital by using undepreciated part of capital from intermediate goods producers and new investment denoted by I_t, where the new capital is sold at price P_t^k at time t.

The objective of capital-producing firms is to maximize their investment profit as follows:

$$\max_{\{I_s\}} \Pi_t^K = \mathbb{E}_t \sum_{s=t}^{\infty} M_{s,t} \left[P_s^k K_s - (1-\delta_k) P_s^k K_{s-1} - I_s\right]$$

$$K_t = (1-\delta_k) K_{t-1} + \Phi\left(\frac{I_t}{I_{t-1}}\right) I_t \quad (13)$$

$$\Phi\left(\frac{I_t}{I_{t-1}}\right) = 1 - \frac{\xi}{2} \frac{\left(\frac{I_t}{I_{t-1}} - 1\right)^2}{\frac{I_t}{I_{t-1}}} \quad (14)$$

In equation (13), the variable K_t represents the dynamic accumulation of capital, and $\Phi_t(.)$ isthe non-linear investment adjustment cost function. Following Cristiano et al. (2010), the parameter ξ measures the concavity of technological constraints. $M_{s,t}$ represents the stochastic discount factor, and λ_t is the Lagrange multiplier coefficient used in the household maximization problem, reflecting the final consumption utility. As household owns capital-producing firms, the stochastic discount factor (SDF) is defined as follows:

$$M_{s,t} = \beta^{s-t} \frac{\lambda_s}{\lambda_t} \frac{1}{\pi_{s,t}} = \begin{cases} 1 & s = t \\ \Pi_{t-1}^{s-1} \frac{1}{R_i^D} & s > t \end{cases} \quad (15)$$

$$\pi_{s,t} = \frac{P_s}{P_t}$$

It is assumed that the price of depreciated and new capital is the same.

In a competitive market and at a steady state, the profit of capital producers is zero, although, during transition periods, the adjustment cost may differ and not be zero. By solving the maximization problem yields equation 16:

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$$P_t^k\left[\frac{I_t}{I_{t-1}}\Phi'\left(\frac{I_t}{I_{t-1}}\right)+\Phi\left(\frac{I_t}{I_{t-1}}\right)\right]+\mathbb{E}_t\left[M_{t+1,t}\left(P_{t+1}^k\left(\frac{I_{t+1}}{I_t}\right)^2\Phi'\left(\frac{I_{t+1}}{I_t}\right)\right)\right]=1 \quad (16)$$

4.4 Retailers

Retailers face price adjustments cost and=mark-up prices through monopolistic competition with nominal stickiness. They determine prices using the Calvo (1983) price rigidity setting, following Fernández-Villaverde and Rubio-Ramírez (2009). In each period, a fraction $1-\alpha_p$ of retailers may change their prices relative to the last time they adjusted their prices P_t^*. Thus, they have the power of price setting and choose the optimal price such that the discounted flow of their profit remains maximized in the infinite horizon. On the other hand, other retailers, as they do not have the opportunity to adjust prices, determine their prices solely based on past inflation. The parameters α_p and $\chi \in [0,1]$ represent the degree of backward-looking indexation to past inflation. When $\chi = 0$, there is no price adjustment relative to the past period's inflation, and when $\chi = 1$, it indicates complete indexation.

When these prices are aggregated using the Dixit-Stiglitz form, the general price level (price index) based on the Calvo price setting model can be expressed as follows:

$$P_t^H=\left[\alpha_p\left(\Pi_{t-1}^{\chi}P_{t-1}^H\right)^{1-\theta}+\left(1-\alpha_p\right)\left(P_t^*\right)^{1-\theta}\right]^{\frac{1}{1-\theta}} \quad (17)$$

The dynamic pricing problem for retailers aims to maximize the sum discounted real profits, given their supply curve. The objective is formulated as follows:

$$\max_{P_t^H}\mathbb{E}_t\sum_{\tau=0}^{\infty}\left(\beta\alpha_p\right)^{\tau}\frac{\lambda_{t+\tau}}{\lambda_t}\left[\left(\prod_{s=1}^{\tau}\left(\Pi^{\chi}{}_{t+s-1}\right)\frac{P_t^H(i)}{P_{t+\tau}^H}-mc_{t+\tau}\right)Y_{t+\tau}^n(i)\right]$$

$$Y_{t+\tau}^n(i)=\left(\prod_{s=1}^{\tau}\Pi_{t+s-1}^{\chi}\frac{P_t^H(i)}{P_{t+\tau}^H}\right)^{-\theta}Y_{t+\tau}^H \quad (18)$$

It should be noted that $\Pi_t=\frac{P_t^H}{P_{t-1}^H}$ represents inflation, and Π is the inflation rate in a steady state. As we consider households' stochastic discount factor for segmentation, the optimal solution conditions for each good are as follows:

$$X_t^1 = \lambda_t mc_t Y_t^H + \beta\alpha_p E_t \left(\frac{\Pi_t^{\chi}}{\Pi_{t+1}}\right)^{-\theta} X_{t+1}^1 \tag{19}$$

$$X_t^2 = \lambda_t \Pi_t^* Y_t^H + \beta\alpha_p E_t \left(\frac{\Pi_t^{\chi}}{\Pi_{t+1}}\right)^{1-\theta} \left(\frac{\Pi_t^*}{\Pi_{t+1}^*}\right) X_{t+1}^2 \tag{20}$$

In equation (20), $\Pi_t^* = \frac{P_t^*}{P_t^H}$, represents the relative prices of firms obtained from optimization and the general level of retail prices, which includes both optimal and non-optimal prices. The recursive auxiliary equations for X_t^1 and X_t^2 are given by $\theta X_t^1 = (\theta - 1) X_t^2$.

4.5 Oil Sector

The oil production denoted as Y_t^0 , is sold in the international open market at the price P_t^0 . The government owns the oil sector, and it engages in oil extraction using the Cobb-Douglas production function, utilizing both capital and labor.

The maximization problem for oil revenue Θ_t is as follows:

$$\max \Theta_t = (1 - \alpha_0) P_t^0 Y_t^0 - W_t^0 N_t^0$$
$$Y_t^0 = A_t^0 (K_{t-1}^0)^{\gamma_0} (N_t^0)^{1-\gamma_0}$$
$$K_t^0 = (1 - \delta_0) K_{t-1}^0 + \alpha_0 P_t^0 Y_t^0 \tag{21}$$

In each period, the government spends a fixed fraction of the oil revenue (α_0) for replace depreciated capital.

These assumptions are abstract and can vary based on the economic conditions of each country.

The oil sector maximizes its profit by optimizing the choice of labor, subject to the first-order condition:

$$N_t^0 = (1 - \alpha_0)(1 - \gamma_0) \frac{P_t^0 Y_t^0}{W_t} \tag{22}$$

Oil sector profits are returned to the government. We assume that the oil price is exogenous and follows an AR(1) process:

$$P_t^0 = \rho_0 P_{t-1}^0 + (1 - \rho_0)\bar{P}^0 + \epsilon_t^0, \qquad \epsilon_t^0 \sim \text{i.i.d}\ N(0, \sigma_0^2) \tag{23}$$

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4.6 Financial Section

4.6.1 Deposit Banks

In the financial sector, we have deposit banks operating in a monopolistic competitive market. Each deposit bank holds household deposits at zero risk and pays interest on these deposits in the next period, denoted as $R_t^D(i)$. These banks transfer the collected deposits to lending banks in the interbank market at the interbank interest rate R_t^{IB} .

Given the monopolistic competition among banks, each deposit bank, indexed by i, faces a Dixit-Stiglitz demand:

$$D_t(i) = \left(\frac{R_t^D(i)}{R_t^D}\right)^{\varepsilon} D_t \tag{24}$$

$D_{t(i)}$ represents the deposits supplied to the bank i at the interest rate $R_t^D(i)$. The increase in demand for deposits depends on the deposit interest rate. The parameter $1 < \varepsilon$ denotes the substitution elasticity between different banks. D_t and R_t refer to the total deposits and deposit interest rates, respectively. Deposit banks employ second-degree price adjustments based on the Rotemberg (1982) model to determine the deposit interest rate. By maximizing profits, we obtain the following expression:

$$\Pi_t^D = \underset{R_t^D(i)}{maxE_t} \sum_{s=t}^{\infty} M_{s,t} \left\{ \left(R_t^{IB} - R_t^D(i) \right) D_t(i) - \frac{KD}{2} \left(\frac{R_t^D(i)}{R_{t-1}^D(i)} - 1 \right)^2 D_t \right\} \tag{25}$$

It is important to note that in equation (25), K_D is the parameter of adjustment costs. The first-order conditions are as follows:

$$-1 + \varepsilon - \varepsilon \frac{R_t^{IB}}{R_t^D} - \kappa D \left(\frac{R_t^D}{R_{t-1}^D} - 1 \right) \frac{R_t^D}{R_{t-1}^D} + \beta_p E_t M_{t+1,t} \kappa D \left(\frac{R_{t+1}^D}{R_t^D} - 1 \right) \left(\frac{R_{t+1}^D}{R_t^D}\right)^2 \frac{D_{t+1}}{D_t} = 0 \tag{26}$$

These conditions indicate a symmetric equilibrium, where $R_t^D(i) - R_t^D$ for all i € (0,1). Equation (26) shows that the interbank interest rate includes risk-free deposit rates plus deposit bank's markup and adjustment costs.

4.6.2 Lending Banks

Purely all financial intermediaries indebted in the interbank market are recognized as Lending banks (providers of loans).

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These banks maximize their profit between periods, which is obtained from the difference between the income from their assets (loans) and their costs (interest paid to depositors and the cost of deviating from the capital adequacy ratio).

$$\max \Pi_t^L = E_t\left[\sum_{s=t+1}^{\infty} M_{s,t}\varpi_s\right]$$
$$B_t + L_t = D_t + L_t^F + \varpi_t$$
$$\varpi_t = R_t^k L_t + R_t^B B_t - R_t^{IB} D_t - R_t^{CB} L_t^F - \frac{\eta_D}{2}\left(D_t - \overline{D}\right)^2 - \frac{\eta_B}{2}\left(B_t - \overline{B}\right)^2 - \frac{\eta_L}{2}\left(L_t - \overline{L}\right)^2 - \Omega_t^B \quad (27)$$
$$K_t^B = (1\text{-}\delta_L)K_{t-1}^B + \varepsilon_{K_t^B}\Pi_t^{l_t}$$
$$log\varepsilon_{K_t^B} = \left(1 - \rho_{K^B}\right)log\bar{\varepsilon}_{K^B} + \rho_{K^B}log\varepsilon_{K_{t-1}^B} + e_t^{KL}$$

It is assumed that banks' capital K_t^B is determined by the level of banks' capital in the previous period and its profits. Banks can only increase their capital through their retained earnings. δ_L represents the cost of capital management for the bank, and it seems logical that one reason for homogeneity is that part of the bank's net wealth disappears altogether, such as due to defaults on some loan recipients. The value of parameter δ_L is determined so that the capital adequacy ratio remains stable at 8% (Angelini et al. (2014)). Additionally, $\varepsilon_{K_t^B}$ refers to bank profit shock and follows an AR(1) process and e_{KL} is also a random and exogenous shock.

In the Iran's banking system, banks are required to comply with the minimum capital adequacy ratio set by the central bank. The central bank may not necessarily incur adjustment costs when banks do not comply with capital adequacy requirements. Instead, it is the individual banks themselves that face the related costs of not adhering to Basel capital adequacy criteria. These costs can appear in various ways, including:

– **Higher Borrowing Costs:** Banks with low capital adequacy ratios may find it more expensive to borrow funds from the market or other financial institutions, as investors and lenders may perceive them as riskier borrowers.
– **Reduced Lending Capacity:** Banks with insufficient capital may have to limit their lending activities, which can hamper economic growth by reducing access to credit for businesses and individuals.
– **Regulatory Penalties:** Regulatory authorities may impose fines or penalties on banks that consistently fail to meet capital adequacy requirements.

- **Loss of Investor Confidence:** Low capital adequacy can erode investor and depositor confidence in a bank, leading to withdrawals and a loss of business.
- **Credit Rating Downgrades:** A bank's credit rating may be downgraded, further increasing its borrowing costs and negatively impacting its reputation. Accordingly, in case of non-compliance, banks will incur adjustment costs, as described by the equation:

$$\Omega_t^B = \frac{\iota_k^B}{2}\left(\frac{K_t^B}{L_t} - \mu_t\right)^2 K_t^B$$

$$\mu_t = \exp(\varepsilon_t^{\mu})\left(\bar{\mu}\frac{\frac{L_t}{D_t}}{\frac{\bar{L}}{\bar{D}}}\right)^{\chi_{\mu}}$$

In this part of the modeling, the approach of Gerali et al. (2010) is considered, where if the ratio of bank capital to risk-weighted assets is less than the capital adequacy ratio determined by the risk committee, the bank will incur costs. The parameter ι_k^B measures the intensity of deviation costs from the capital adequacy ratio. And $\bar{\mu}$ represents the capital adequacy ratio under baseline one[1] and is the ratio of basic capital to the sum of risk-weighted assets, and banks must maintain an 8% ratio of capital to risk-weighted assets. χ_{μ} is an adjustment coefficient, and $\chi_{\mu} \in [0,1]$. ε_t^{μ} is a random and exogenous shock to the capital adequacy ratio.

Furthermore, currently, many banks worldwide resort to increasing their capital or altering their asset and liability composition to achieve this ratio.

The Loan to Deposit Ratio is defined as a profitability index, and studies show that it has a positive and significant impact on the capital adequacy ratio. Increasing bank profitability improves the bank's capital base, leading to an increase in the capital adequacy ratio. With reduced bank profitability, the financial power of banks diminishes. In studies by Abdolkarim et al. (2014), the loans ratio had a direct impact on the capital adequacy ratio. Similarly, Samaei et al. (2019) and Asarkaya and Özkan (2007) have shown that the structure of deposits negatively affects the capital adequacy ratio. (Bahrami Zanouz et al., 2021)

[1] In 1988, in the aftermath of the South American debt crisis, the Basel Committee introduced a special risk coefficient for various assets, aiming to provide a straightforward and meaningful approach to asset risk assessment. This approach is quite similar to the model used today to calculate capital adequacy for banks in Iran. (Capital Adequacy Regulation approved in the 1٠14th meeting of the esteemed Money and Credit Council on 25/11/1382 AH.)

The first constraint is the balance sheet, and the second constraint is the dynamic of net worth. lending banks have access to resources from deposit banks and the National Development Fund (L_t^F) at the central bank's policy rate (R_t^{CB}). Each bank utilizes these resources and its previous period's profits (ϖ_t) to finance lending to firms (L_t) and purchase government bonds (B_t).

According to Basle I regulations, lending banks are subject to risk-based capital requirements and must have a certain amount of equity (capital) that covers at least a percentage of their loans, which is determined exogenously by the central bank. Government bonds have no risk and weight zero in calculating the required capital. The risk weight related to lending to enterprises (businesses) is set as a constant $1 \leq \sigma_t^F$ in Basel I regulations, and in Basel II regulations, it is linked to credit rating agencies and related documents.

In other words, banks need to hold a sufficient amount of capital to ensure their financial stability and protection against unexpected losses. Capital regulations require that banks maintain a minimum required capital in their loan portfolio, which plays a stabilizing role in coping with the crisis of rising delinquent claims. The bank's capital must be at least equal to the capital adequacy ratio. In other words, banks and credit institutions must always maintain an appropriate ratio between their capital and assets, and their primary function is to protect the bank against unexpected losses.

$\eta_B, \eta_D, \eta_L \; 0 < \Omega_t^B$ are the adjustment cost parameters. The first-order conditions will be as follows:

$$R_t^{IB} = R_t^{CB} - \eta_D(D_t - \bar{D}) \quad (28)$$

$$R_t^{B} = R_t^{CB} + \eta_B(B_t - \bar{B}) \quad (29)$$

$$R_t^{k} = R_t^{CB} + \eta_L(L_t - \bar{L}) \quad (30)$$

All interest rates are related to the policy rate in equations (28) to (30), except for the deposit interest rate obtained in equation (26). Each of these rates can markup or markdown depending on the policy rate. For example, if there is excess liquidity in the banking system due to high deposit levels, the interbank interest rate will temporarily decrease below the policy rate. Conversely, in times of liquidity shortages, the interbank interest rate will be higher than the central bank rate.

4.7 Government

The government collects taxes (T_t) and issues government bonds (B_t). It also receives a portion of oil revenue (Θ_t) and fraction from the oil fund (F_t)

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represented by (ρ_g). Additionally, it earns international investment return through the oil fund at an interest rate of R_t^*. On the other hand, the government incurs expenditures (G_t) and makes payments to bondholders at an interest rate of (R_t^B) . It also provides transfers to households (Γ_t).

The budget constraint of the government is as follows:

$$T_t + B_{t+1} + \nu\Phi_t + \left(\rho_g + R^*\right)F_{t-1} = G_t + R_t^B B_t + \Gamma_t \tag{31}$$

The rules for transfer payments and current expenditures are as follows:

$$\Gamma_t = \rho\Gamma\nu\Theta_t \tag{32}$$
$$G_t = G_t^c + G_t^p \tag{33}$$
$$G_t^c = \bar{G}^c \tag{34}$$
$$G_t^p = K_t^G - (1 - \sigma_G)K_{t-1}^G \tag{35}$$

The government adjusts transfer payments based on oil revenue with the parameter ρ_Γ. G_t^c represents the current expenditures of the government, which is assumed to be constant, and G_t^p represents government infrastructure investment in public capital.

4.8 Central Bank and Oil Fund

The central bank is the monetary authority and economic policymaker. Given that the country's interest rate is under the control of the central bank and the Money and Credit Council, it responds to economic fluctuations by choosing the nominal interest rate (for interbank rates and bonds) as a monetary tool. The interest rate rule, based on the Taylor rule, is as follows:

$$1 + r_t^{CB} = \left(\frac{1+r_{t-1}^{CB}}{1+r_t^{CB}}\right)^{\rho_{cb}} \left[\left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\rho_\pi} \left(\frac{Y_t}{\bar{Y}_t}\right)^{\rho_y} \left(\frac{\Omega_t^B}{\bar{\Omega}_t^B}\right)^{\rho_\Omega}\right]^{(1-\rho_{cb})} e^{\varepsilon_{r,t}} \tag{36}$$

The target of the central bank is to stabilize the output gap and inflation. ρ_π represents the adjustment coefficient of the inflation gap from long-run equilibrium values, and ρ_y represents the adjustment coefficient of the output gap from long-run values. Y_t denotes the output, r_t^{CB} is the interest rate $(1 + r_t^{CB} = R_t^{CB})$, ρ_{cb} represents the weight of the interest rate in the previous period Ω_t^B also represents the cost of not meeting the minimum capital adequacy requirement and $e^{\varepsilon_{r,t}}$ represents the shock arising from errors in the central bank's monetary policy in determining the interest rate. It directly affects the monetary policy rule and acts as an exogenous and random

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variable, influencing the policy interest rate. It is also assumed that the central bank will supply any amount of money demanded from households.

The dynamics of the oil fund are as follows:

$$F_t = \left(1-\rho_g^0\right)F_{t-1} + (1-\nu)\Theta_t + R_{t-1}^{CB}L_{t-1}^F - L_t^F \tag{37}$$

The oil fund's resources result from the combination of three factors: the previous reserves $\left(1-\rho_g^0\right)F_{t-1}$, a portion of oil revenue $(1-\nu)\Theta_t$, and the return of granted loans $R_{t-1}^{CB}L_{t-1}^F$. Therefore, the value of the oil fund at time t, L_t^F , is the sum of these three factors minus the loans.

4.9 Market Clearing

By adding all budget constraints, market clearing conditions can be described as follows:

$$Y_t + R_t^* F_{t-1} = C_t + \Phi\left(\frac{I_t}{I_{t-1}}\right) I_t + \alpha^0 P_t^0 Y_t^0 + G_t + (F_t - F_{t-1}) \tag{38}$$

$$N_t = N_t^0 + N_t^n \tag{39}$$

$$\mathbb{P}_t = \Pi_t^K + \Pi_t^R + \Pi_t^D + \Pi_t^L \tag{40}$$

In equation (38), GDP (Gross Domestic Product) ($Y_t = Y_t^H + P_t^0 Y_t^0$) and the external return on the Oil Fund investments will be equal to the sum of consumption, capital investments, government expenditures, and net deposits in the Sovereign Wealth Fund.

5 Model Parameters Calibration

Calibration is one of the most crucial steps in the empirical evaluation of dynamic stochastic general equilibrium. Table (1) shows the calibrated parameter values. All parameters are calibrated so that the model can best describe data. The model goodness of fit is based on comparing actual data and the steady state. To do so, the ratio of selected variables to gross domestic product steady state is presented in Table (2). This model is suitable for any other country with similar characteristics.

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Table 1
Calibrated parameters

Parameter	Symbol	Value	Source
Discount factors	β	٠/96	The data outputs of the model have been explained.
Consumption elasticity	σ	1/5	The data outputs of the model have been explained.
Elasticity of private capital	γ_n	0/3	(Ghiaie et al., 2020)
Inverse Frisch elasticity of labour supply	ϕ	2/17	(Ghiaie et al., 2020)
Elasticity of public capital	γ_G	0/1	(Ghiaie et al., 2020)
Coef. of intermediate producer	θ, χ, α_p	9, 0/241, 0/5	(Ghiaie et al., 2020)
Depreciation rates	δ_k	0/05	The status of capital accumulation is about equation (13) and the data of capital volume and investment.
Capital pro. adj. cost)	ξ	2	(Ghiaie et al., 2020)
Coef. of deposit bank	ε, κ_D	237, 1/5	(Ghiaie et al., 2020)
Taxes	τ_c, τ_w	0/09, 0/04	The average tax rate
Central Bank	$\rho_{cb}, \rho_\pi, \rho_y, \rho_\Omega$	0/7, 3, 0/3, 0/1	They have been determined to be consistent with the economic data of Iran.
Oil AR processes	ρ	0/8	(Ghiaie et al., 2020)
Other AR processes	$\rho_A, \rho_{A^o}, \rho_\xi, \rho_{KB}$	0/9, 0/9, 0/8, 0/8	The data outputs of the model have been explained.
Bank capital depreciation rate	δ_L	0/042	The data outputs of the model have been explained.
Capital adequacy ratio	µ	0/08	Capital Adequacy Regulations, Basel Committee 1
Government share of oil revenue	ν	0.7	Legal obligation
Government usage of oil fund	ρ_g	0/05	Central Bank
Share of investment in oil revenue	α	0/01	Central Bank
Adj. costs of lending bank	η_D, η_B, η_L	2, 0/2, 2	(Ghiaie et al., 2020)

Source: Research findings

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Table 2
Ratios of Selected Variables to Gross Domestic Product (GDP) in Steady State

Variable	Symbol	The ratio of Variable to Gross Domestic Product (GDP) in Steady State
Consumption	C	0/63
Transfer Payments	Γ	0/06
Private Capital	K	2/14
Oil Capital	K^{oil}	0/37
Public Capital	K^{G}	0/48
Non-Oil Sector output	$P^{H}Y^{H}$	0/76
Oil Revenue	$P^{oil}Y^{oil}$	0/24
Government Expenditure	G_c, G_p, G	0/026, 0/234, 0/26
Investment	X	0/11
Government Bonds	B	0/03
Tax	T	0/10
Bank Capital	KB	0/06
Current Expenditures / Investment Expenditures	G_c/G_p	5/2

Source: Research findings

6 Impulse Response Functions (IRFs) Analysis

After calibrating the model, the dynamic behavior of the model variables is examined by impulse response functions. The question of this study is whether considering bank capital channel in the model improves the evaluation of macroeconomic fluctuations? For this purpose, two scenarios, one with the existence and one without the existence of the bank capital channel, are compared to assess the behavior of the model's variables in response to shocks. The effectiveness of shocks on the variables of interest is then investigated.

Following Pieschacon (2012), it is assumed that the shocks to oil prices, technology, and monetary policy are constant and follow an AR(1) process:

$$P_t^0 = \rho_0 P_{t-1}^0 + (1-\rho_0)\bar{P}^0 + \epsilon_t^0, \qquad \epsilon_t^0 \sim \text{i.i.d}\ N(0, \sigma_0^2)$$

$$\text{Log}(A_t) = \rho_0 \log(A_{t-1}) + \epsilon_t^0$$

6.1 Non-Oil Sector Technology Shock

A positive technology shock in the non-oil sector instigates a ripple effect. Output escalates, yielding better wages and heightened employment. Owing to seamless labor mobility bridging different economic sectors, the augmented wages in the non-oil domain culminate in a reduced labor supply within the oil sector. This phenomenon orchestrates an eventual wage increase and,

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subsequently, an upswing in oil production following a single period of contraction. Consequently, both oil revenue and government transfers experience an uptick. Demand-side pressure ushers in a wave of inflation escalation. In response, the monetary policymaker intervenes by elevating the policy rate, triggering an across-the-board augmentation in market rates and the overall value of the banking system. Concurrently, an influx of deposits and expanded loan volumes, orchestrated by banks to offset the burgeoning operational costs of firms, ensue. The accruing profits stemming from lending outstrip those offered to deposit holders, amplifying the banks' profitability and bolstering their capital reserves.

In the scenario encompassing bank capital considerations, Due to more access to non-deposit resources, banks have more resources to grant facilities, so more facilities are paid, as a result, the financing of enterprises for investment is more, and this leads to an increase in output and productive activity. Inflation follows the path of demand and in the bank capital scenario, inflation increases less and , nominal fluctuations within this scenario remain notably constrained, depicting a landscape of heightened stability.

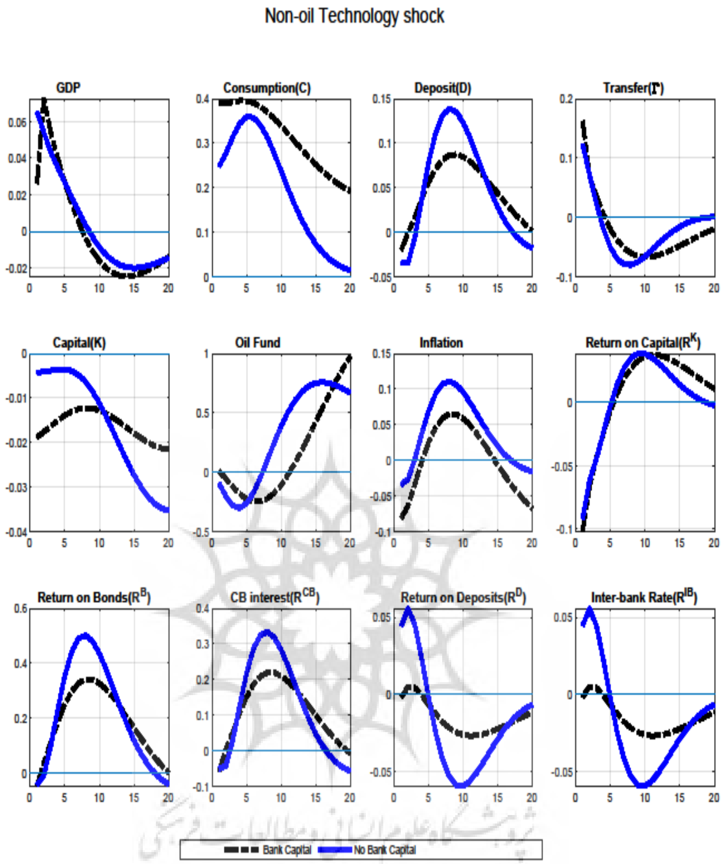

Figure 1. Impulse Response Functions to Technology Shock in the Non-Oil Sector
Source: Research findings

6.2 Oil Sector Technology Shock

The Technology Shock depicted in Figure 2 manifests itself within the Oil Sector, generating a surge in both oil revenues and wages confined to this sector. While non-oil output experiences an initial dip, the augmentation in non-oil sector wages triggers a symbiotic rise in labor supply and output for both oil and non-oil realms.

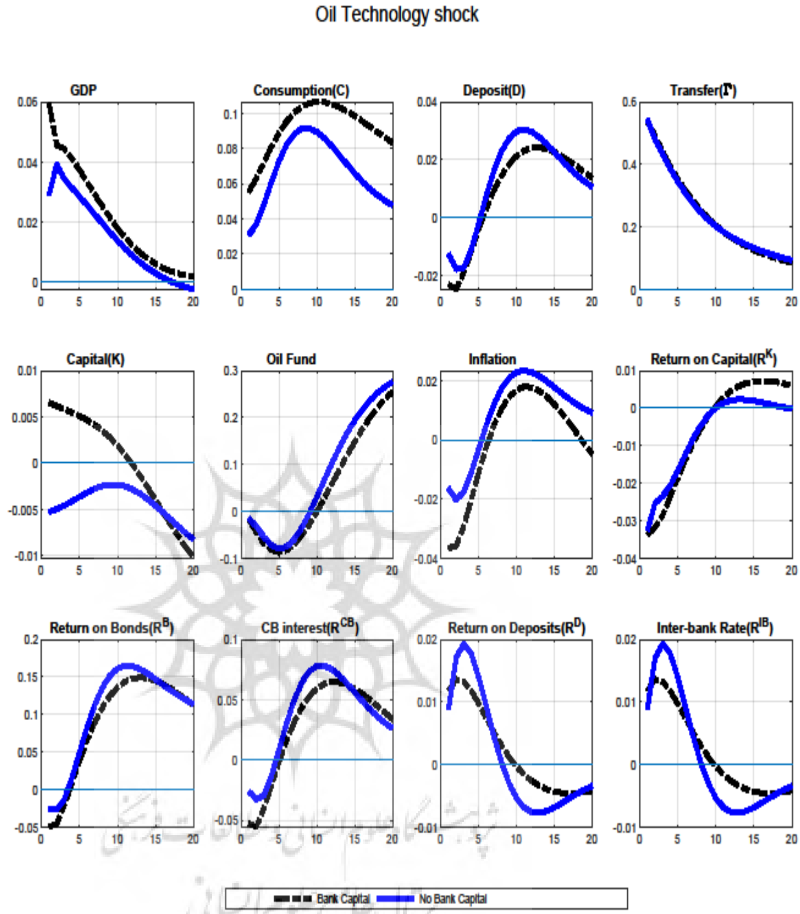

Figure 2. Impulse Response Functions to Technology Shock on the Oil Sector
Source: Research findings

6.3 Oil Price Shock

Figure 3 clearly shows the impulse response functions following an oil price shock. When confronted with a positive oil price shock, a cascade of effects unfolds. Firstly, this shock triggers a surge in oil revenues, thereby invigorating investments in the oil industry. Simultaneously, it elevates labor demand within this sector, resulting in a subsequent augmentation of future

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oil production and overall output, thereby bolstering the accrual of capital within this sector.

For the non-oil sector, the same shock manifests as a labor supply disruption. Consequently, non-oil production undergoes a decline, with the magnitude of this contraction outstripping the surge in oil production. This discrepancy culminates in an initial dip in overall output.

Concurrently, the interplay of lower wages and heightened government transfers induces households to opt for reduced work hours, subsequently escalating both consumption and deposits. The government's dependence on oil revenues for fiscal purposes through the money market recedes, engendering a parallel decrease in the allure of bank deposits.

However, when we pivot to the context of the scenario informed by bank capital constraints, the decline in deposits exhibits a tempered trajectory due to the compulsion to maintain capital adequacy and in this scenario, the drop in inflation will be more

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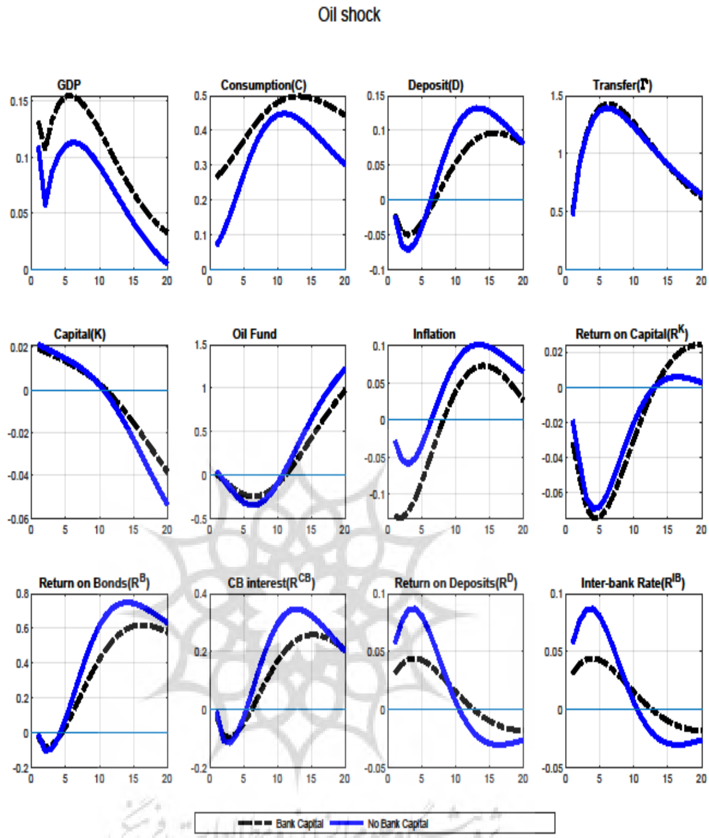

Figure 3. Impulse Response Functions to an Oil Shock
Source: Research findings

6.4 Bank Capital Shock

Figure 4 gives a visual representation of the Impulse Response functions triggered by a positive bank capital shock. Within the context of a scenario bolstered by ample bank capital, the ramifications unfold as follows: the positive capital shock cascades into the accumulation of bank capital and the subsequent distribution of profits among shareholders. This injects an augmentation into household income, consequently fanning the flames of heightened consumption patterns. The surge in bank capital orchestrates a reduction in deposit demands, which in turn translates to a contraction in

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money creation, culminating in a deflationary effect that ushers in a decrease in inflation. Furthermore, a notable consequence emerges within the interbank market: the demand for loans slackens, contributing to a decline in the interbank rate.

The ascension of household income sets in motion a parallel increase in their savings, thus galvanizing the overarching capital pool. This amplified capital reservoir, in a cyclical sequence, serves as the catalyst igniting investment endeavors, ultimately begetting augmented savings for households. The tangible manifestation of this augmented savings comes to fruition through elevated deposit levels in subsequent stages. As the narrative unfolds, various market rates, including the central bank's policy rate and bond yields, follow the trajectories dictated by monetary policy. In this case, they undergo an initial descent before reorienting towards an upward trajectory, emblematic of a deflationary phase.

In Parallel, as banks' capital positions find themselves on an upward trajectory, the cost associated with conforming to capital adequacy stipulations becomes more pronounced.

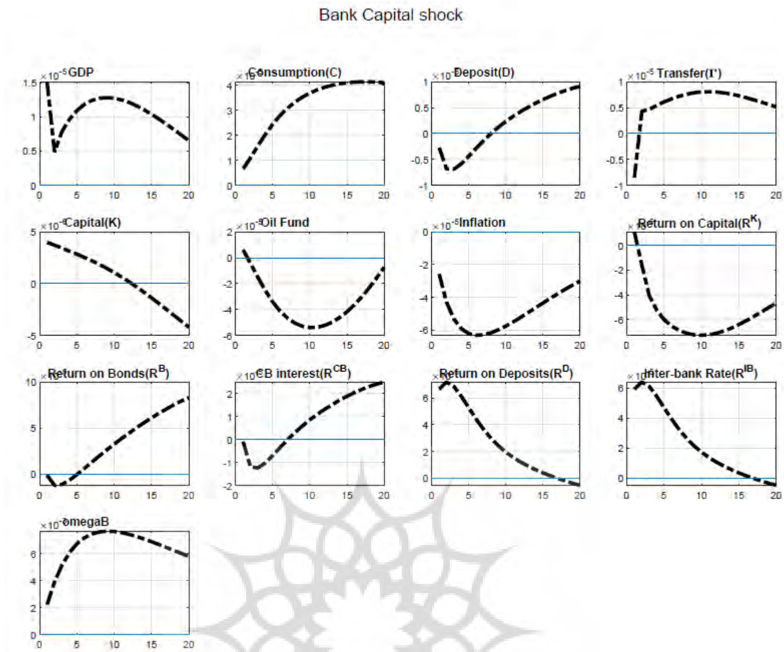

Figure 4. Impulse Response Functions to Banking Capital Shock
Source: Research findings

6.5 Bank Capital Adequacy Shock

Figure 5 elucidates the impulse response functions generated by a bank capital adequacy shock. Within the context of a pre-existing bank capital framework, the ramifications unfurl as follows: A positive capital adequacy shock propels an elevation in banks' capital, resulting in harmoniously balanced assets with reduced risk exposure. The capital adequacy ratio emerges as a cornerstone metric for scrutinizing the financial robustness and stability of banks and financial institutions. It stands as a gauge measuring the extent to which banks can underwrite existing risks and preempt potential threats like bankruptcy or inability to honor obligations. Its core purpose lies in fortifying banks against unanticipated losses while bolstering support for creditors and depositors. At its essence, this ratio quantifies the level of risk undertaken by each bank.

Augmenting capital adequacy reinforces the bedrock of banks' capital, encompassing retained earnings, while simultaneously enhancing the risk-adjusted value of assets. This dynamic augments the repository of high-quality assets within banks. The ripple effect extends to heightened lending activities,

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elevated capital fortifies banks' capacity to assume risks, translating into amplified lending (risk absorption). Consequently, when a capital adequacy shock transpires, the mandate for banks to augment their capital gains traction, instigating an increase in household income owing to shareholders' equity and consequent intensified consumption. Nonetheless, the curtailment of banks' lending activities ushers in a decline in both capital and production, generating an initial uptick in inflation.

However, in tandem with the progression of augmented bank capital, the economy's financial landscape blossoms. This trajectory translates into heightened capital, augmented production, and curbed inflation. In the interbank market, diminished demand for loans orchestrates a reduction in interbank rates, precipitating a broader surge in production, physical capital, oil revenue, and, as an inevitable consequence of demand pressure. As the capital adequacy ratio surges, securing the stability and durability of banks' operations, a harmonious equilibrium between capital and asset risks takes shape. This development translates into reduced costs linked to non-compliance with capital adequacy prerequisites, thereby fostering a more stable financial ecosystem for banks.

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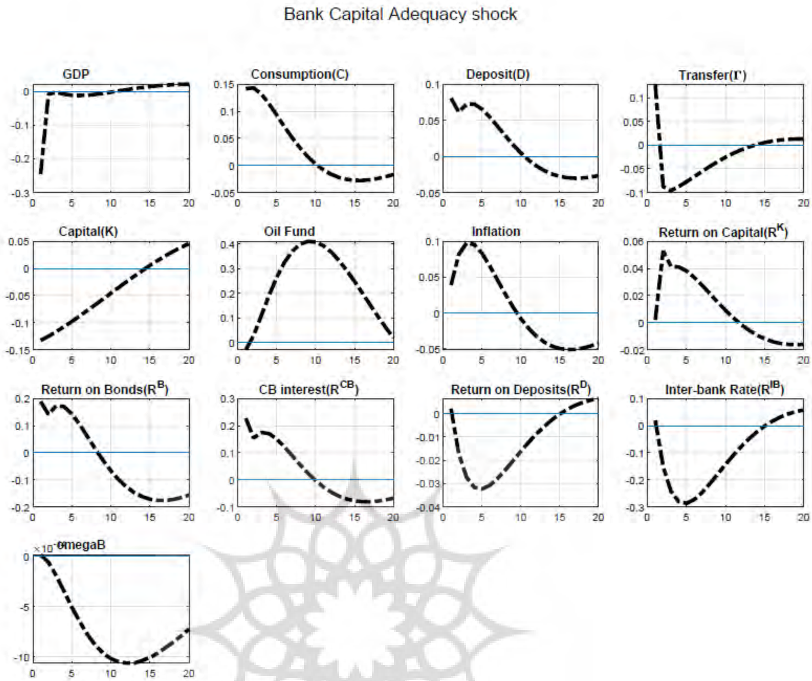

Figure 5. impulse Response Functions to Bank Capital Adequacy Shock
Source: Research findings

7 Summary and Conclusion

The empirical assessment of the model presented in this study, juxtaposed with tangible economic data from Iran and aligned with theoretical expectations, underscores the model's aptitude in elucidating the undulations in real variables. Within this framework, the pivotal role of banks in amplifying economic shocks becomes apparent. Research findings signify that when banks possess ample capital, as observed in the scenario underpinning an economy with a banking capital channel, they exhibit more pronounced economic buoyancy when subjected to positive shocks. In such a milieu, the banks' investment capacity bolsters the favorable repercussions of these shocks. The presence of banking capital engenders a landscape wherein real variables like consumption, deposits, and inflation manifest improved conditions, with diminished fluctuations or expedited adjustments, all culminating in heightened economic stability. Notably, the dynamics of these variables within this scenario offer a more illuminating portrayal of Iran's economic landscape.

In stark contrast, within an economy devoid of the banking capital channel's consideration (depicting a scenario bereft of such capital influence), the same positive shocks yield relatively less substantial economic enhancements. Ergo, the significance of research findings crystallizes as they shed light on pivotal decisions concerning the imperative adherence to bank capital adequacy. Fostering credible capital and resources substantially curbs the risk borne by depositors within banks, rendering bank capital adequacy a paramount yardstick for banks' evaluation. Owing to their distinctive ability to navigate a spectrum of risks intrinsic to their activities and to forestall the swift propagation of harm to depositors, banks necessitate a reservoir of adequate capital. Notably, a bank fortified with sufficient capital affords itself ample time to skillfully confront and resolve challenges. Conversely, banks teetering on lower capital adequacy, when confronted with negative shocks, curtail lending practices and resort to asset sales tactics to ensure liquidity, all in an effort to address depositors' demands and the potential for deposit withdrawals. This, in turn, intensifies the transmission of shocks to the real sector.

The role of the government in propagating shocks assumes paramount significance. Following an upswing in oil prices, elevated oil revenues catalyze augmented government transfers to households and heightened public capital expenditures. The resulting magnification in transfer payments not only bolsters consumption but also exerts influence on households' labor allocation decisions. Concurrently, surging oil revenues engender an accumulation of public capital within the government's coffers. This capital, in its role as a production factor in the non-oil sector, imparts proportional momentum to total production growth.

Leveraging insights gleaned from the model's results and recognizing the pivotal role of bank capital adequacy in economic stability and the mitigation of potential shocks, it is recommended that Iran's bank capital adequacy regulations (as of 2003) be subjected to review and enhancement, aimed at bolstering banks' risk tolerance. In alignment with the precepts of Basel III regulations, banks' capital adequacy requirements have been elevated, mandating a minimum of 10.5% capital adequacy during normal conditions, augmented by an additional 2.5% during periods of economic expansion, thereby culminating in an effective 13% capital adequacy ratio. Disclosing information regarding banks' adherence to this ratio could augur better performance and foster increased customer confidence in banks endowed with robust capital positions. For prospective research, an inclusion of risk weight based on the probability of repayment and non-performing risk, aligning with Basel II regulations, could be explored in the calculation of banks' capital adequacy ratios.

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