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Original Research Article

Determining Banking economic Capital Using a Dynamic Stochastic General Equilibrium (DSGE) Model

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This study investigates the optimal determination of economic capital for Iranian banks by developing a Dynamic Stochastic General Equilibrium (DSGE) model that incorporates banking sector heterogeneity and macroeconomic shock transmission mechanisms. A comprehensive DSGE framework is constructed and calibrated using Iranian macroeconomic and banking data. The model implementation utilized Dynare software to analyze impulse response functions across technology, liquidity, and monetary policy shock scenarios, with particular emphasis on capital adequacy dynamics, the risk of bank bankruptcy and exit, and effects on economic welfare and financial stability.

Findings reveal that the optimal capital adequacy ratio for Iranian banks is approximately 17 percent, exceeding Basel III regulatory minimums to maintain adequate resilience against macroeconomic volatility and prevent bank bankruptcy and exit. Technology shocks generate expansionary effects on output, consumption, and investment variables while improving economic welfare, whereas liquidity shocks create contractionary pressures, reducing these key economic indicators and welfare levels. Interest rate shocks produce moderate and largely temporary effects across macroeconomic variables, with limited long-term impact on economic welfare and minimal influence on bank bankruptcy probability.

The shock analyses demonstrate the critical importance of macroeconomic conditions in bank capital management decisions, economic welfare preservation, and bank exit prevention, with liquidity shocks showing the most substantial explanatory power for optimal capital requirement variations. The study contributes to both theoretical understanding and practical application by extending DSGE modeling to incorporate banking sector capital dynamics, bankruptcy mechanisms, and welfare effects within

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an emerging market context, thereby offering a more comprehensive framework for economic capital determination.
Practical implications for Iranian financial institutions include the necessity of maintaining capital adequacy ratios around 17 percent, implementing dynamic capital management strategies responsive to macroeconomic conditions, and developing robust stress testing frameworks that account for country-specific shock transmission patterns, bankruptcy risks, and welfare effects. These insights provide valuable guidance for bank management, regulatory authorities, and policymakers in optimizing financial stability frameworks, preserving economic welfare, and preventing banking crises within developing economy contexts characterized by elevated macroeconomic uncertainty.

Keywords: Economic Capital, Dynamic Stochastic General Equilibrium (DSGE), Capital Adequacy Ratio (CAR), Liquidity Risk, Basel Regulations.
JEL Classification*:* E10, E47, E52, G28, G21, C61

1 Introduction

Banks are among the most important components of economic systems, playing a key role in resource mobilization and allocation. Any bank default can trigger a liquidity crisis and domino effects in the banking system. In recent decades, multiple financial crises including the 2008 US crisis and European crises have demonstrated that banking system instability can lead to economic collapse. Today, with increasing complexity of the economic environment and emergence of new risks, determining optimal banking capital levels has become one of the central issues in financial policy-making.

The necessity of this research can be considered from several aspects. First, previous studies show that the international Basel standards may not be suitable for all countries (Van den Heuvel, 2008; Begenau, 2022). Second, empirical evidence from different countries indicates significant differences in optimal capital levels (from 6% in studies by Elenev et al. (2021) to 25%). Third, criticisms of current regulations indicate misalignment of these standards with specific conditions of developing economies. In Iran, there is also a clear research gap in determining economic capital based on macroeconomic components. Fourth, no study has yet considered the possibility of bank bankruptcy with this research model and the intervention of protective institutions (such as deposit insurance funds).

The importance of this research can be examined from theoretical and practical dimensions. From a theoretical perspective, this study contributes to developing DSGE model literature in banking and provides a comprehensive framework for evaluating economic capital. From a practical perspective, findings of this research can provide a basis for central bank policymakers in formulating macroprudential regulations. It is also applicable for bank managers in making decisions related to capital composition and risk management. Finally, maintaining banking system stability will lead to strengthening public confidence and sustainable economic growth.

Given the importance of determining optimal banking capital levels and the absence of comprehensive studies in Iran, the main problem of this research is: The lack of precise knowledge of the appropriate amount of economic capital for Iran's banking system based on macroeconomic components and how it is affected by economic shocks. This problem leads to uncertainty in central bank policies and bank decision-making. The main objectives of this research are: 1) determining optimal economic capital amount for Iranian banks, 2) examining the impact of various economic shocks on this capital, 3) comparing results with international Basel standards.

To achieve the above objectives, this article is organized into four main sections. First, theoretical foundations and research background are presented to clarify the conceptual framework of the study. Then research methodology including DSGE model design and analysis methods is explained. Next, findings from model simulation and sensitivity analysis are presented. Finally, conclusions and policy recommendations are proposed. Each section is logically and sequentially connected to the next section, ultimately leading to answering the main question. In fact, the main research question is: considering welfare, what is the optimal economic capital amount for Iranian banks and how do economic shocks affect it?

2 Literature Review

The optimal level of required bank capital has been a key research topic at least since the introduction of the Basel regulations in the late 1980s. It is noted that the capital adequacy ratios in Basel were also calculated based on the Gaussian copula model[1].

This section reviews the literature, with a particular focus on recent findings from structural quantitative macroeconomic models. Dynamic Stochastic General Equilibrium (DSGE) models incorporate macroeconomic feedback effects through financial frictions.

A review of recent studies reveals a general tendency to determine a fixed optimal level of capital. In the following, both domestic and international studies are reviewed, with the international research literature further categorized into distinct groups.

[1] Tarahian, and Asadi (2018)

studies on optimal bank capital determination can be systematically categorized into three distinct methodological approaches, each offering unique insights into the complex relationship between capital requirements, banking stability, and economic welfare. This taxonomic framework provides a comprehensive understanding of how different analytical perspectives contribute to our knowledge of optimal banking regulation.

Methodological Categories:

1) Theoretical Static Models: These studies focus on identifying the fundamental roles and mechanisms of bank capital requirements through analytical frameworks. They typically examine specific market failures that justify regulatory intervention, such as moral hazard problems, deposit insurance subsidies, and systemic risk externalities. While these models provide crucial theoretical insights, they generally analyze fixed capital requirements and lack the dynamic complexity necessary for quantitative policy analysis.
2) Empirical Statistical Approaches: This category encompasses studies that employ econometric and statistical methods to estimate optimal capital levels using historical data and cross-sectional analysis. These studies excel at quantifying the key trade-offs in capital regulation, such as measuring the relationship between higher capital requirements and their associated costs and benefits. Their primary value lies in providing empirical validation of theoretical predictions and generating country-specific estimates.
3) Dynamic Stochastic General Equilibrium (DSGE) Models: The most sophisticated category involves macroeconomic structural models that capture both partial equilibrium (first-round) and general equilibrium (second-round) effects of macroprudential policies. These models demonstrate how real economic conditions influence financial stability and banking sector health, while simultaneously showing how financial sector dynamics feed back into the broader economy. As emphasized in the meta-analysis by Ma et al. (2019), these general equilibrium effects can be quantitatively substantial and policy-relevant. Van den Heuvel (2008) concludes that a 10% capital buffer in the United States is welfare-reducing, as its marginal cost exceeds its marginal benefit.

Repullo and Suarez (2013) analyze optimal bank capital and compare it to Basel I, II, and III. In their model, required capital should be higher in bad times than in good times. A key feature of their model is the linearity of capital in the production function. They also find that in a static setting;

capital requirements should decrease after a negative exogenous shock. Recent U.S.-calibrated studies indicate higher optimal capital levels.

Shah Hosseini and Bahrami (2012), developed a New Keynesian Dynamic Stochastic General Equilibrium (DSGE) model that incorporates the banking sector as a financial intermediary for the Iranian economy, achieved important results. The model solutions indicate a relatively successful simulation of Iran's macroeconomic dynamics. Furthermore, their examination of the impacts of oil and monetary shocks on real, nominal, and banking variables confirms that the constructed model is compatible with both theoretical expectations and the realities of the Iranian economy.

Martinez-Miera and Suarez (2014) consider banks investing in both systemically safe and unsafe projects. Banks trade off the risk of systemic shock against the capital they hold. In good times, they accumulate capital, leading to increased investment in riskier firms (which yield lower average returns but potentially high conditional payoffs). Static requirements may reduce lending and welfare by making capital scarce before and after shocks, but they also limit systemic losses.

Nguyen (2015) builds a general equilibrium model in which banks endogenously enter and exit the market. The model embeds an endogenous growth channel and focuses on the impact of capital requirements on economic growth and welfare. Banks compete in this setup.

Mirbagherijam et al. (2015), taking into account the risks in the insurance industry, calculated the capital required for this sector. By using hierarchical Archimedean copula functions, they arrived at an estimate of economic capital that was significantly lower than the requirements stipulated in the Central Insurance Organization’s regulatory guidelines.

Ahmadian (2015), in a Dynamic Stochastic General Equilibrium (DSGE) model with the inclusion of a banking sector, examined the issue of bank runs. By analyzing data, he concluded that bank runs weaken lending capacity, which ultimately leads to reduced investment and production.

Dargahi and Hadian (2016) used a DSGE model to examine the effects of monetary and financial shocks on economic variables. Their findings indicated that including the banking sector in the modeling process provides policymakers with richer information for analyzing variables, due to the transmission of shocks to the real economy.

Khoshnoud and Esfandiari (2017) calculated the banking capital buffer based on the Central Bank’s capital adequacy directive. They found that, on average, the capital buffer of the banking network behaves countercyclically, whereas private banks show procyclical behavior.

Heidari and Molabahrami (2017) examined the impact of credit shocks—including deposit and loan interest rates—on real sector variables within a New Keynesian DSGE framework. The results from the calibration and simulation showed that a positive shock to deposit interest rates reduces the demand for investment in physical and financial assets, and through the channel of increased financing costs, raises marginal costs.

Akinci and Queralto (2022) identify the optimal capital ratio as 17 percent. Their model, featuring a small open economy and solved under binding constraints, shows that banks endogenously issue equity for precautionary reasons.

Nourahmadi (2017), discussed the application of stress testing as a tool for risk management. In this study, she explained various stress test models and their implementation methods for assessing market, liquidity, and credit risks under different shock scenarios, and also outlined their advantages, disadvantages, and potential issues.

Tarahian and Asadi (2018) developed the Basel regulatory capital model. They demonstrated that the Basel model is applicable under normal economic conditions and relies on a single-factor Gaussian copula and the Vasicek process. In their own model, Tarahian and Asadi employed the Student-t copula and estimated economic capital to be nearly twice the Basel regulatory requirement.

Birn et al. (2020) assess the opportunity cost of capital requirements. Their findings suggest that Basel regulations often provide net economic benefits. However, in systems lacking proper resolution regimes or liquidity rules, capital may fail to act as an effective buffer.

Begenau (2020) develops a model where limited liability and government subsidies incentivize excessive risk-taking. Households earn explicit returns from holding deposits. Higher capital requirements lower bank profitability and lending capacity, and in general equilibrium, reduce deposit supply and rates. Nevertheless, lower funding costs may allow banks to expand credit. The study estimates an optimal capital ratio of 12.4%.

Marzban et al. (2010) estimated the capital required by banks to withstand market and credit risks, chosen due to the availability of financial data. Instead of simple arithmetic summation, they used copula functions for modeling. The estimations were performed using financial data from four Iranian banks over the period 2009 to 2017.

Goodarzi Farahani et al. (2021) investigated the impact of banking system risks on bank performance and macroeconomic variables. Using a DSGE model that incorporated the structure of the banking system, they found that most macroeconomic and banking variables respond most strongly to market and credit risks, while showing the least sensitivity to operational and liquidity risks.

Elenev et al. (2021) propose a lower optimal capital ratio (6% of risk-weighted assets). Their model includes frictions for both banks and firms and considers taxation on equity, adjustment costs, deposit insurance, and sovereign debt acting as a liquidity substitute. The framework results in fewer trade-offs and justifies a lower capital threshold.

Begenau and Landvoigt (2022) integrate concepts of traditional bank bailouts, deposit insurance, household benefits from liquidity (deposits), and the existence of shadow banks. They find that the optimal capital ratio can reach up to 16%, partly because shadow banks alleviate pressure from stricter requirements on.

Sabeti et al. (2023) demonstrate that relying solely on regulatory capital for banking risk assessment is insufficient, highlighting the necessity for more sophisticated modeling approaches to calculate economic capital. Their findings support the argument for country-specific methodologies that go beyond Basel requirements.

Khalili et al. (2024) examined the impact of macroeconomic shocks on banks' asset and liability management using Dynamic Stochastic General Equilibrium (DSGE) models. The designed model demonstrates the behavior of key variables in banks' asset and liability management in response to four types of shocks.

Ogawa (2022) studied capital requirements and their welfare implications in a dynamic general equilibrium model with endogenous bank entry and exit. He finds that the optimal capital requirement would be lower than previous literature suggests because of expanded negative effects through the extensive margin. His study demonstrates that increasing capital requirements contributes to reducing the number of banks and deposits supplied to the economy significantly, despite the fact that deposits provide important liquidity services to households. This finding aligns with our research approach of incorporating bank entry/exit mechanisms and occasionally binding capital requirements.

Hecker et al. (2024) examined the robust design of countercyclical capital buffer rules, identifying these buffers as key macroprudential policy tools that increase during economic booms and decrease during recessions. This cyclical adjustment mechanism aligns with our research's focus on dynamic capital management under varying economic conditions.

Aliman (2025) investigated macroprudential policy in the Romanian economy using DSGE modeling, concluding that banking market structure plays a crucial role in determining the magnitude and speed of macroprudential policy transmission to the real economy. This finding reinforces the importance of incorporating banking sector dynamics in DSGE models, as implemented in our study.

Table 1

Objectives and Findings of Studies Related to the Research Literature

Study Title	**Year**	**Authors**	**Main Objective and Key Findings**
The Welfare Cost of Bank Capital Requirements	2008	Van den Heuvel	A 10% capital buffer in the U.S. is harmful to public welfare as its marginal cost exceeds its marginal benefit.
Cyclical Effects of Bank Capital Requirements	2013	Repullo & Suarez	Required capital should be higher in bad times than in good times. In a static model, capital requirements should decrease after a negative exogenous shock.
Endogenous Systemic Risk-Taking by Banks	2014	Martinez-Miera & Suarez	Banks manage risk based on how much capital they will have in bad times. In good times, they build up capital, leading to more investment in systemically risky firms. Static requirements make capital scarce, reduce lending, and cause welfare losses.
Bank Capital Requirements: A Quantitative Analysis	2015	Nguyen	Develops a general equilibrium banking model where banks endogenously enter and exit. Focuses on how capital requirements affect economic growth through an endogenous growth channel and emphasizes welfare impacts under bank competition.
Credit Spreads, Financial Crises, and Macroprudential Policy	2022	Akinci & Queralto	The optimal capital ratio is found to be 17%. The model, featuring a small open economy and nonlinear constraints, shows that banks endogenously issue equity for precautionary reasons.
The Opportunity Cost of Bank Capital Requirements	2020	Birn et al.	Basel capital requirements often yield net economic benefits. However, if key frameworks like bank resolution regimes and liquidity rules are not well-designed, capital requirements may fail to act as effective buffers.
Capital Requirements, Risk Choices, and Liquidity Provision in a Business Cycle Model	2020	Begenau	Develops a model where limited liability and government subsidies induce excessive risk-taking. Higher capital requirements reduce deposit issuance and deposit rates but also reduce funding costs. The optimal capital level is estimated at 12.4%.
A Macroeconomic Model with Producers and Financially Constrained Intermediaries	2021	Elenev et al.	Proposes a model with fewer trade-offs. Both firms and banks face frictions. Recommends a lower optimal capital level (6% of risk-weighted assets).

Financial Regulation in a Quantitative Model of the Modern Banking System	2022	Begenau & Landvoigt	Identifies an optimal capital ratio of up to 16%. Shadow banks can partially offset the tightening effects of stricter capital regulations on traditional banks.
Calculating Economic Capital of Bank Loan Portfolio and Comparison with Basel Regulatory Capital	2023	Sabeti et al.	Relying solely on regulatory capital for banking risk assessment is insufficient. Therefore, using more accurate modeling for calculating economic capital is essential.
Welfare Implications of Bank Capital Requirements under Dynamic Default Decisions	2022	Ogawa	Incorporates endogenous bank entry/exit and costly equity issuance. Finds optimal capital requirements would be lower due to expanded negative effects through extensive margin.
Robust Design of Countercyclical Capital Buffer Rules	2024	Hecker et al.	Countercyclical capital buffer is one of the key macroprudential policy tools that increases during economic booms and decreases during recessions.
Macroprudential Policy in Romanian Economy with DSGE	2025	Aliman	Banking market structure plays a crucial role in determining the magnitude and speed of macroprudential policy transmission to the real economy.

Source:

Furthermore, the following presents a summary of studies that have calculated optimal bank capital levels based on various models.

Table 2

Optimal Bank Capital Levels Based on Various Models

Part 1: Empirical Studies

Year	**Authors**	**Study Location**	**Optimal Capital (Tier1/RWA)**
2013	Miles et al.	UK	16–20%
2015	Brooke et al.	UK	10–14%
2016	Fender & Lewrick	BCBS Members	10–11%
2017	Firestone et al.	USA	13–25%
2017	Cline	USA, Japan, Western EU	12–14%
2017	Fed Reserve Minneapolis	USA	25%
2018	Barth & Miller	USA	23.5%
2017	Almenberg et al.	Sweden	10–24%

Part 2: DSGE Macroeconomic Models

Year	Authors	Study Location	Optimal Capital
2014	Martinez-Miera & Suarez	N/A	~14%
2015	Nguyen	USA	8%
2015	Clerc et al.	EU	10.2% (Commercial Loans)
2015	Clerc et al.	Finland	9.2% (Corporate Loans)
2022	Akinci & Queralto	Multiple Countries	~17%
2018	Mendicino et al.	EU	Basel II +1% (Corporate)
2019	Davydiuk	USA	~6%
2020	Begenau	USA	12%
2020	Mendicino et al.	EU	9.38%
2000	Allen & Gale	USA	6%
2022	Begenau & Landvoigt	USA	~18%

Source: Research Findings

A review of existing literature reveals that varying levels of economic capital have been calculated across different countries based on diverse scenarios and models. Most studies recommend an additional buffer beyond Basel requirements to cover risks. The estimated economic capital ranges from 6% to 25%, depending on country-specific conditions, research methodologies, and other factors.

Based on the comprehensive literature review, the following gaps and shortcomings were identified in the field of banking economic capital determination: Firstly, most domestic studies have focused on individual risks (credit, operational, market) and have overlooked the comprehensive macroeconomic approach. Secondly, limited research exists in Iran examining economic capital determination through DSGE frameworks while simultaneously incorporating macroeconomic shocks and banking sector heterogeneity, creating a significant gap that this study addresses. Thirdly, the impact of liquidity shocks on the optimal level of banking capital has received less attention in the domestic literature. Fourthly, in general, consideration of banking bankruptcy mechanisms, bank entry and exit, and the role of deposit insurance are absent in the studies. Moreover, the use of social welfare criteria for determining optimal capital levels has been neglected in domestic studies. This research addresses these gaps by providing the first comprehensive DSGE-based analysis of optimal economic capital for Iranian banks, incorporating macroeconomic shocks, bank entry/exit dynamics, and welfare optimization criteria.

3 Model/Methodology

A review of the literature reveals multiple approaches for calculating bank economic capital. This study employs a macroeconomic approach through a

Dynamic Stochastic General Equilibrium (DSGE) model to determine appropriate bank capital levels. Two key features are incorporated into the DSGE model: Firstly, banks can choose to enter or exit the market. Secondly, given the costliness of equity issuance, banks maintain precautionary capital buffers to mitigate liquidity shocks.

1. Model Structure and Assumptions

Variables must first be defined according to the study's objectives, while considering Iran's specific conditions. Since the research focuses on determining optimal banking system capital, the banking sector must be separately defined alongside other economic sectors. Thus, the banking sector is added to households and firms. The economy consists of two population groups: households and entrepreneurs.

2. Model Specification

In the macroeconomic approach, model components must first be defined:

- **Households**: They supply labor to firms and deposit their savings in banks.
- **Entrepreneurs**: Hold ownership, maintain productive capital, and lease it to firms. They act as household representatives, seeking to maximize dividend payments.
- **Banks** (owned by households): Extend loans to entrepreneurs using deposits and capital. Banks can fully diversify individual borrower risk but may default on deposit contracts with households.
- **Entrepreneurs**: May default on loan repayments to banks.
- **Deposit Insurance**: Repays deposits when banks default.
- **Firms**: Produce final consumer goods using capital goods and household-supplied labor.
- **Capital Producers**: Manufacture final goods using capital goods.

The model assumes no general uncertainty in the economy. The following diagram illustrates the overall model structure

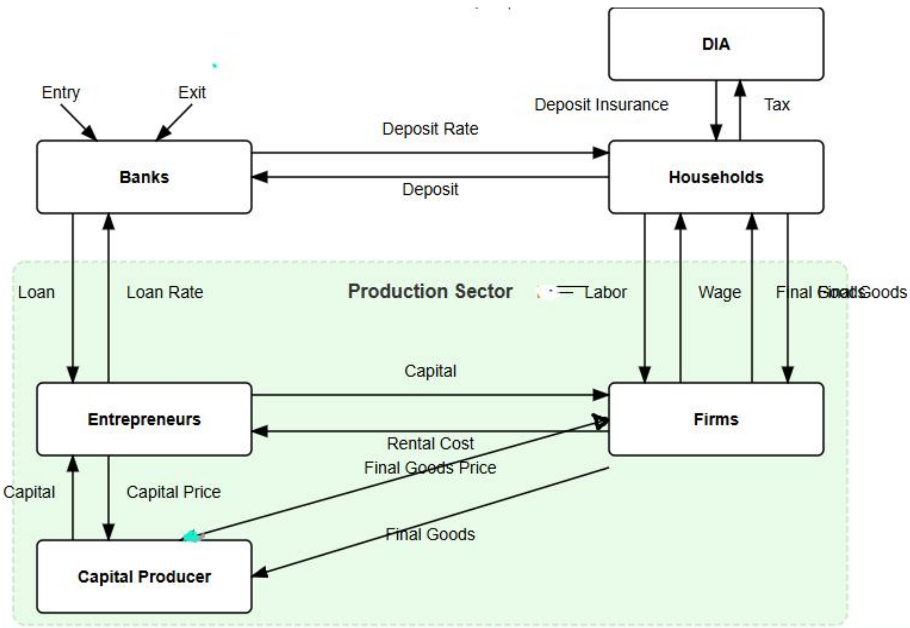

Figure 1. Research Model Flowchart
Source: Research Findings

Households:

Households are modeled as identical, risk-averse agents with infinite lifespans. They deposit their savings in banks at a rate dt. These deposits are insured by the Deposit Insurance Agency. Regardless of whether the banks default or not, households receive a return of $R_t^D d_{t-1}$. They consume an amount ct and withdraw liquidity from their deposits in the amount of dt. In addition, households receive dividends from capital producers, entrepreneurs (c_t^e), and banks (DIV). Accordingly, the household budget constraint is given by:

$$c_t + d_t \leq w_t l_t + R_t^D d_{t-1} - T_t + \Pi_t^c + c_t^e + DIV_t$$

The household's objective function is defined as follows :

$$E_t\left[\sum_{i=0}^{\infty} (\beta)^{t+i} u(c_{t+i}, l_{t+i}, d_{t+i})\right] = E_t\left[\sum_{i=0}^{\infty} (\beta)^{t+i}\left[\log(c_{t+i}) + \log\left(1 + \theta\frac{d_{t+i}}{c_{t+i}}\right) - \frac{\varphi}{1+\eta}(l_{t+i})^{1+\eta}\right]\right]$$

Entrepreneurs:

Entrepreneurs are agents who maximize dividend payouts for households. They are the sole entities permitted to hold equity shares. Entrepreneurs retain a portion of profits as retained wealth, while also having the capacity to secure financing through loans from banks and the government to augment their capital. The entrepreneur's objective function in period t is defined as follows:

$$\max_{c_{t+1}^e, n_{t+1}^e} (c_{t+1}^e)^{\chi^e} (n_{t+1}^e)^{1-\chi^e}$$

Banks:

The Iranian banking sector consists of heterogeneous banks with varying sizes, ownership structures, and risk profiles. This study employs a representative bank framework that captures the essential dynamics of the banking sector while maintaining analytical tractability. The representative bank approach allows us to focus on the core mechanisms of capital adequacy, liquidity management, and macroeconomic shock transmission without the computational complexity of multiple bank types. This modeling choice is consistent with the DSGE banking literature (Gertler and Karadi, 2011; Clerc et al., 2015) and provides robust insights into optimal capital requirements applicable across the Iranian banking sector. The representative bank framework effectively captures the average behavior and responses of Iranian banks to macroeconomic shocks while ensuring model stability and clear policy implications.

At the end of period t-1, a bank with capital (equity[1]) e_t determines:

The dividend amount to be paid to households (i.e., shareholders)

The bank's capital level

[1] In this study, equity refers to the comprehensive bank capital structure including Tier 1 capital (paid-up capital and /retained earnings) and Tier 2 capital (statutory reserves and general provisions) as defined in Basel framework and recognized in Iranian banking practice.

$$[n_t = e_t - div_t]$$

At the beginning of period t, deposits experience a specific liquidity shock D_t (liquidity shock). Banks affected by the liquidity shock face a binary choice: either exit the market or continue operations by meeting repayment obligations. If a bank defaults, its value becomes zero due to limited liability.

$$L_t = n_t + D_t$$

When making these decisions, banks face several constraints. To continue operations, banks must maintain positive capital at the beginning of the period.

$$n_l = e_l - div_l \geq 0$$

In addition, banks are subject to maintaining a minimum required capital.

$$\Phi_l \equiv \frac{n_l}{L_l} \geq \emptyset$$

Where Φ_t is the capital-to-loans ratio and Φ is the statutory required capital. The bank's equity (e_{t+1}) at the end of the period can be expressed as follows:

$$e_{t+1} = E(L_t, D_t) = \widetilde{R^F_{t+1}} L_t - R^D_{t+1} D_t - k$$

Where R^F_{t+1} is the gross return on diversified loans, and k is the fixed operating cost. It should be noted that $R^F_{t+1} \neq R^F_t$ (the contractual rate), as some borrowers default on their loans. Consequently, loan defaults erode the bank's equity. Liquidity shocks D_{t+1} are independently and identically distributed (i.i.d.) across banks and follow an AR(1) process.

$$\log D_{t+1} = (1 - \rho)\overline{\log D} + \rho \log D_t + \epsilon_{t+1}$$

Banks maximize expected discounted profits subject to regulatory capital constraints:

$$MaxE_t \sum_{i=0}^{\infty} \beta^s \Lambda_{t,t+i} \Theta(div_{t+i})$$

where Λ_t is the household's stochastic discount factor, and also.

$$\Theta(d) = \begin{cases} d \ if\ d \geq 0 \\ d(1+a) if d < 0 \end{cases}$$

It should be noted that a negative d does not imply negative dividends, but rather equity issuance (capital increase), which is assumed to be a costly action. The parameter a represents the equity issuance cost. This cost arises due to problems stemming from information asymmetry between equity issuers and investors.

Firms and Capital producers:

Firms produce consumption goods using leased capital from entrepreneurs (k_{t-1}), labor, and a standard Cobb-Douglas production function.

$$y_t = A_t k_{t-1}^{\alpha} l_t^{1-\alpha}$$

Households own the capital. Capital producers use capital goods to produce consumption goods and sell them to entrepreneurs. The capital producers' objective function is as follows:

$$E_{t\sum_{i=0}^{\infty}\Lambda_{t,t+i}}\Pi_{t+i}^{c} = E_{t\sum_{i=0}^{\infty}\Lambda_{t,t+i}}\{q_{t+i}^{K} I_{t+i} - \left[1 + g\left(\frac{I_{t+i}}{I_{t+i-1}}\right)\right] I_{t+i}\}$$

4 Equilibrium and Model Solution

Household Decision-Making:

As mentioned earlier, households make decisions based on their utility function and budget constraint. This generates the following equations. The equation shows that total household expenditures (current consumption plus changes in assets) cannot exceed the sum of current income (wages, asset returns, firm profits, and dividend payments).

$$c_t + d_t \leq w_t l_t + R_t^D d_{t-1} - T_t + \Pi_t^c + c_t^e + DIV_t$$

The following equation represents the household's intertemporal consumption-labor optimality condition

$$\varphi l_l^{\eta} = \frac{\omega_l}{c_l + \theta d_l}$$

The following equation represents the household's intertemporal consumption optimality condition. It characterizes the trade-off between current and future consumption.

$$\frac{1-\theta}{c_t + \theta d_t} = \beta E_t \left[\frac{R_{t+1}^D}{c_{t+1} + \theta d_{t+1}}\right]$$

Entrepreneurial Decision-Making:
The entrepreneurs' decision equation when facing default choices is as follows:

$$W_{t+1}^{e} = \max\{\, \omega_{t+1}^{e}\left[r_{t+1}^{K} + (1-\delta)q_{t+1}^{K}\right]k_t - R_t^{F} b_t, 0\}$$

When the following relation represents the gross return per unit of efficient capital in period t+1, derived from capital owned in period t:

$$R_{t+1}^{K} = \frac{r_{t+1}^{K} + (1-\delta)q_{t+1}^{K}}{q_t^{K}}$$

Entrepreneur's Repayment Decision:
The entrepreneur will only repay the debt if the project's net value (future revenues minus debt obligations) is positive. Otherwise, default occurs."

Bank's decision making:
At the end of period t-1, a bank with equity e_t and idiosyncratic shock D_i solves the following problem, given the loan rate R_t^f and deposit rate R_t^D:

$$V(e_t, D_i) = \max_{div_t, L_t, n_t} \Theta\,(div_t) + \beta \sum_{j} P\left(D_i \middle| D_j\right) \max\{V\left(e_{t+1}, D_j\right), \text{Repay}_{(x=0)}\text{Default}_{(x=1)}\}$$

The above relation shows that in each period, the bank faces three key decisions:
1) Profit allocation (between dividend distribution and reinvestment)
2) Loan portfolio management
3) Debt policy (default vs. deposit repayment)

Equilibrium Solution:
Through solving the described functions, we arrive at an economic equilibrium model where markets clear. In this equilibrium state, markets behave optimally.

Calibration Methodology:
This section examines whether the obtained results can be generalized to Iran's economy. Accordingly, parameters are carefully matched and assigned values. While the abundance of international studies facilitates parameter value identification, the scarcity of domestic studies makes this challenging. We have endeavored to utilize available domestic research findings where

possible, while supplementing with international studies when necessary. The following table presents key parameter values used for model calibration:

Table 3
Parameter Table for a DSGE Model

Parameter	**Symbol**	**Value**	**Source**
Discount factor (time preference)	β	0.98	Shah Hosseini & Bahrami (2012)
Capital share in production (Cobb-Douglas)	α	0.42	Tavakolian (2012)
Depreciation rate of physical capital	δ	0.042	Amini & Neshat Haji (2005)
Minimum capital adequacy ratio (Basel III)	θ	0.105	Banking Regulations (Basel III)
Inverse of intertemporal elasticity of substitution	σ	2.5	(Woodford, 2003)
Elasticity of substitution between goods	η	6.0	(Calvo, 1983)
Price adjustment cost	κ_p	2.5	(Rotemberg, 1982)
Investment adjustment cost	κ_i	1.5	(Christiano et al., 2014)
Depreciation rate of banking capital	δ_b	0.20	Gertler & Karadi (2011)
Speed of adjustment in bank lending	ψ_L	0.30	(Bernanke et al., 1999)
Bank exit threshold (critical capital ratio)	exit_CR	0.04	(Diamond & Dybvig, 1983)
Entry rate of new banks	entry	0.08	Basel Regulations
Interest rate response to inflation (Taylor rule)	φ_π	1.8	Taylor (1993)
Interest rate response to output	φ_y	0.1	Clarida et al. (2000)
Degree of interest rate smoothing	ρ_r	0.8	(Woodford, 2003)
Autocorrelation of productivity shock	ρ_z	0.83	Smets & Wouters (2007)
Standard deviation of productivity shock	σ_z	0.01	Backus et al. (1992)
Autocorrelation of liquidity shock	ρ_liq	0.6	(Brunnermeier, 2009)

Source: Research Findings

Model Fit Evaluation

This section assesses how well the model replicates economic reality. In this study, the designed DSGE model is calibrated and simulated using Dynare software. To evaluate the model's fit, the first-order moments (means) of key model variables are compared with their corresponding values in real-world data from Iran's economy. The examined variables include output, consumption, investment, bank capital, and loans.

Table 4
Comparison of the model’s average variables with real values

Real Data	Model	Variable
5.75	5.73	Production (Y)
1.22	1.21	Consumption (C)
1.95	1.93	Investment (I)
0.32	0.30	Bank Capital (K^b)
1.55	1.54	Loans (L)

Source: Research Findings

The comparison results in the Table 4 indicate that the model has successfully replicated the behavior of economic variables with high accuracy. This demonstrates that the model possesses adequate explanatory power and can be used to analyze economic and policy shocks. Ultimately, given the close alignment between the simulated values and the actual data, it can be concluded that the model exhibits a satisfactory fit and can serve as a reliable tool for policy analysis in the context of Iran's macroeconomy and banking system.

In the following section, we examine the model's sensitivity to the parameters calibrated for Iran's economy. One of the key findings of this research is determining the optimal level of banking capital by considering the effects of various economic shocks.

4 Results and Discussion

This section presents the comprehensive analysis of our DSGE model simulations, examining how various macroeconomic shocks affect key variables in the Iranian banking sector and broader economy. The results provide crucial insights into optimal capital requirements and the transmission mechanisms of financial and real shocks. Our analysis determines the optimal capital adequacy ratio for Iranian banks at approximately 17 percent, representing a significant buffer above the Basel III and current Iranian requirement. This elevated level reflects Iran's higher macroeconomic volatility, sanctions-related liquidity constraints, and specific domestic financial system risks. The 17 percent optimal ratio ensures banks maintain adequate resilience against various shocks while preserving lending capacity and avoiding bankruptcy during stress periods. Our simulations demonstrate that well-capitalized banks at this level exhibit superior stability across all scenarios: effectively channeling credit during productivity shocks, preventing sharp capital deterioration under liquidity stress, and maintaining lending capacity during interest rate shocks without severe credit contraction.

Before presenting the comprehensive simulation results and impulse response functions, it is essential to clearly define the key variables that will be analyzed throughout our shock scenarios. Understanding these variables and their economic significance is crucial for interpreting the dynamic responses and transmission mechanisms examined in this study. The following table provides detailed definitions of all primary variables investigated in the impulse response analysis, encompassing both real economic indicators and banking sector measures that collectively capture the multifaceted effects of macroeconomic shocks on Iran's economy and financial system.

Table 5

Key Variables in Macroeconomic Shock Analysis Variable Symbol

Symbol	**Variable Name**	**Definition**
Y	Output (GDP)	Total economic production representing aggregate economic activity
C	Consumption	Household consumption expenditure reflecting consumer welfare
I	Investment	Private sector investment in physical capital assets
L	Loans	Total bank lending to private sector entities
Kb	Banking Capital	Total bank equity representing financial institution stability
rloans	Loan Interest Rate	Average interest rate charged on bank loans
rd	Deposit Interest Rate	Interest rate paid to depositors
CAR	Capital Adequacy Ratio	Ratio of bank capital to risk-weighted assets
Welfare	Economic Welfare	Social welfare index calculated from household utility
N	Number of Banks	Count of active banking institutions in the market

Source: Research Findings

This comprehensive variable framework enables systematic analysis of how different types of macroeconomic shocks transmit through the banking sector and affect broader economic outcomes, providing insights into the complex interactions between financial stability and real economic performance in the Iranian context.

Impulse Response Functions

Productivity Shock

The productivity shock is one of the most significant real shocks in DSGE models, exerting broad effects on economic and banking variables. In this analysis, we assess the impact of a positive productivity shock (ez) on key model variables, including output, banking capital, bank loans, and interest rates. The results show that this shock leads to an increase in output and an improvement in financial indicators in the short run. However, due to adjustment mechanisms, its effects gradually diminish in the long run. This shock follows a first-order autoregressive process AR(1) with moderate persistence, ensuring that productivity changes are temporary and gradually return to their long-run average rather than being permanent random walk effects.

The transmission mechanism of productivity shocks in the economy operates through four main channels that interact in a reinforcing and amplifying manner. The direct production channel works when positive productivity improvements enhance production efficiency, reducing per-unit costs and increasing firm profitability, which directly translates into higher output levels and improved economic performance across all sectors. The investment channel also operates, whereby enhanced profitability creates stronger investment incentives as firms anticipate higher returns on capital projects, leading to increased investment demand and greater loan demand from the banking sector, which further stimulates economic activity. The banking channel comes into play, as improved economic conditions enhance the quality of bank loan portfolios by reducing default probabilities and improving borrower creditworthiness, which strengthens bank capital positions and enhances their lending capacity, creating positive feedback effects through the financial system. The welfare channel operates through the direct improvement in household living standards, as higher production and income levels improve consumption possibilities and economic well-being, creating sustained positive effects on aggregate demand that reinforce the initial productivity gains throughout the economy.

Effect on Production (Y)

In the short run, a positive productivity shock enhances production efficiency, leading to an immediate increase in output. According to the simulation results, production rises by approximately 0.5 percent in response to this shock. This finding aligns with economic theory, which identifies productivity improvements as a key driver of growth. In the long run, the shock’s effect gradually fades, and output returns to its steady-state level. This adjustment stems from the reversion of investment and consumption to equilibrium levels.

Effect on Consumption (C)

In the short run, a positive productivity shock increases households' disposable income, directly stimulating consumption demand. The simulation results indicate that consumption rises by about 0.4 percent in response to the productivity shock. This increase is driven by two main mechanisms: the income effect where higher productivity boosts wages and dividend earnings, and the wealth effect where the appreciation of assets due to economic growth enhances perceived wealth.

In the long run, consumption gradually adjusts to a new equilibrium path. With household preferences remaining stable and interest rates reverting to equilibrium levels, the growth rate of consumption declines. In the current model, consumption remains approximately 0.2 percent above its initial level in the long run.

Effect on Investment (I)

In the short run, the productivity shock sharply boosts investment incentives by reducing marginal production costs. According to the results, investment increases by approximately 1.2 percent in response to the shock. This strong reaction stems from improved profit expectations for firms, lower financing costs due to stronger balance sheets, and higher demand for goods that collectively create an attractive investment environment.

In the long run, the shock's impact on investment adjusts nonlinearly. After an initial surge, investment gradually declines due to production capacity saturation, rising adjustment costs, and the return of interest rates to natural levels, resulting in a more balanced investment trajectory.

Effect on Banking Capital (Kb)

In the short run, the productivity-driven output growth enhances bank profitability through increased loan demand from firms and reduced credit risk amid improved economic conditions. Consequently, banking capital (Kb) rises by approximately 0.3% initially. In the long run, as bank profitability adjusts and economic growth moderates, banking capital converges toward its steady-state level.

Effect on Bank Loans

The productivity shock strengthens firms' incentives to invest and expand operations, leading to a 0.4 percent rise in loan demand in the short term. Over time, however, loan growth decelerate due to lower credit risk and stabilizing economic conditions. This aligns with empirical evidence on the nonlinear effects of productivity shocks on credit markets.

Effect on Interest Rates (rloans and rd)

In the short term, higher loan demand could push up bank lending rates (rloans); however, improved economic conditions may offset this by reducing risk premiums. In the model, lending rates increase only 0.1 percent. In the long-term adjustment phase, interest rates revert to equilibrium levels, influenced by monetary policy responses and market-driven adjustments.

Effect on Economic Welfare

The productivity shock generates substantial and sustained improvements in economic welfare, with initial gains of 1-1.5% expanding to 1.2-2% in the long term. This welfare enhancement occurs through multiple reinforcing channels that create lasting benefits for society. Higher productivity directly translates into increased real incomes as wages rise and employment opportunities expand throughout the economy. The improved production efficiency enables firms to generate higher profits while simultaneously offering better compensation to workers, creating a win-win scenario that boosts overall living standards. The welfare gains extend beyond immediate income effects to encompass broader quality-of-life improvements. Enhanced productivity reduces the relative prices of goods and services, effectively increasing households' purchasing power and enabling access to higher-quality consumption baskets. Additionally, the productivity improvements generate positive spillover effects across sectors, leading to innovation diffusion and knowledge transfer that create sustained competitive advantages and long-term growth prospects. These welfare improvements prove remarkably persistent, with benefits continuing well after other macroeconomic variables return to their steady-state levels, demonstrating the fundamental importance of productivity growth for societal well-being.

Table 6

Effects of Productivity Shock

Variable	Short-Term Effect (%Δ)	Long-Term Effect	Explanation
Output (Y)	+6.0%	Adjustment to steady state	Productivity growth as a driver of output
Consumption (C)	+0.2%	Stabilization at +0.1%	Higher household income and wealth
Investment (I)	+4.0%	Adjustment to new level	Improved profitability & lower investment costs
Banking Capital	+5%	New higher steady state	Enhanced bank profitability

(Kb)			
Bank Loans	+0.4%	Gradual decline	Initial demand surge followed by adjustment
Loan Rate (rloans)	+0.02%	Return to steady state	Interplay of demand and risk factors
Capital Adequacy Ratio (CAR)	_0.8%	Return to steady state	Improved loan quality, higher retained earnings, lower credit risk
Economic Welfare	0.6% - initially, then +0.1%	Sustained improvement (0.1%)	Higher real income, employment growth, wage gains

Source: Research Findings

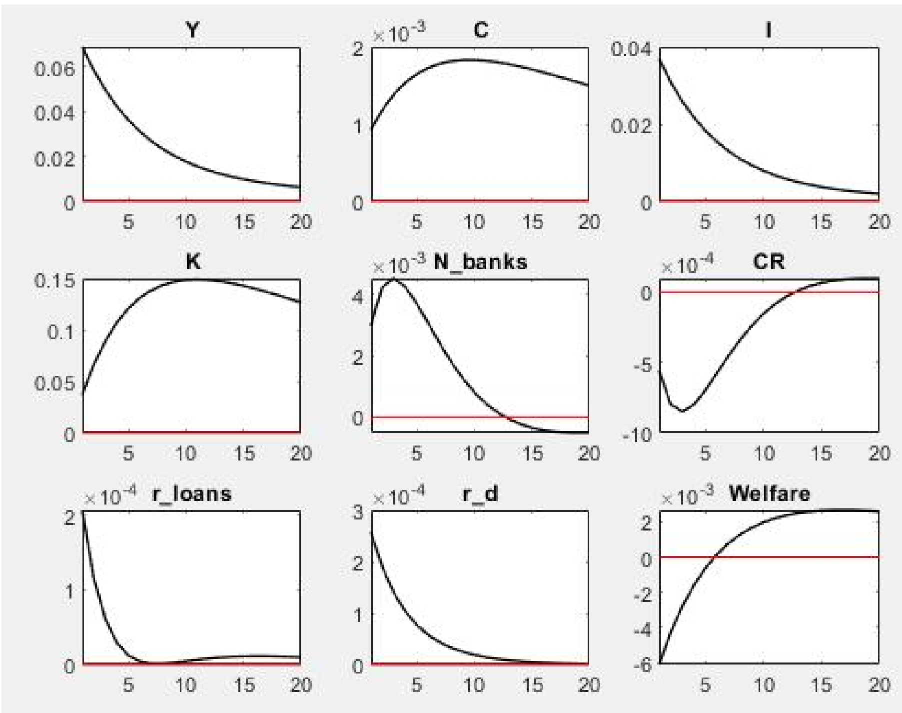

Figure 2. Impulse Response Functions (IRFs) of Productivity Shock
Source: Research Findings

Liquidity Shocks

A bank liquidity shock or bank run refers to a situation where a large number of customers of a bank simultaneously attempt to withdraw their deposits. This event can arise from concerns and fears about bank bankruptcy, and if this rush continues, the bank may face liquidity shortages and even lead to bankruptcy. In our model, this shock follows an autoregressive process of order one. Liquidity shocks are modeled as a stationary autoregressive process of order one AR(1), capturing the persistent but mean-reverting nature of funding disruptions in banking markets.

The transmission mechanism of liquidity shocks in the economy operates through three main channels that interact in a chain-like and reciprocal manner. The direct credit channel works when banks face liquidity stress, their funding costs increase, leading to higher lending rates, which subsequently reduces firms' investment demand as the net present value of projects declines with higher discount rates, ultimately causing a reduction in total economic output. The bank capital channel also operates, whereby liquidity shocks erode bank capital through increased funding costs and potential losses, and lower capital ratios force banks to reduce lending to maintain regulatory compliance, creating a credit crunch that amplifies the initial shock. General equilibrium effects also come into play, as reduced investment and credit access decrease aggregate demand, leading to lower output and employment, which creates feedback effects since reduced income leads to lower consumption, further dampening economic activity while also affecting bank loan demand and repayment capacity.

Effect on Production (Y):

A liquidity shock initially leads to a decline in output. While the injection of liquidity may temporarily stimulate demand, the simultaneous reduction in bank capital ratios (CR) restricts credit availability, ultimately dampening economic activity. In the long run, as interest rates adjust and banks gradually restore their capital buffers, output returns to its equilibrium level.

Effect on Consumption (C):

In the short term, the shock boosts household consumption due to improved access to liquidity and purchasing power. However, over time, inflationary pressures and the erosion of real wages cause consumption to revert to pre-shock level.

Effect on Investment (I):

Investment contracts in the short run as higher lending rates (rloans↑) raise financing costs for firms. This downturn intensifies in the long term due to the shock’s persistent effects on capital accumulation and productive capacity.

Effect on Bank Capital Ratios (CR):
The liquidity shock triggers an immediate deterioration in CR as banks' risk-weighted assets expand. Recovery is slow, as rebuilding capital reserves is a protracted process under regulatory constraints (e.g., Basel III).

Effect on Lending Rates (r_loans):
Banks respond to heightened risk by raising loan rates in the short term. Even after stabilization, rates settle at a higher equilibrium due to lasting shifts in risk perception.

Effect on Economic Welfare:
Welfare improves temporarily through consumption gains but neutralizes over time as inflationary effects and investment declines offset initial benefits.

Table 7
The Effects of Liquidity Shocks

Variable	**Short-Term Effect (%Δ)**	**Long-Term Effect**	**Economic Explanation**
Production (Y)	-0.3%	Adjustment to steady state	Initial decline due to credit market disruption, then return to equilibrium
Consumption (C)	+0.09%	Adjustment to steady state	Temporary increase in purchasing power, then stabilization at new level
Investment (I)	-0.3%	New equilibrium level	Initial decline due to higher financing costs, then adjustment to new investment level
Capital Adequacy Ratio (CR)	-1.5%	Slow improvement	Sharp initial decline due to increased risk, then gradual recovery
Loan Rate (rloans)	+1.5%	+0.5% (persistent)	Significant initial rate hike, then stabilization at higher level
Bank Loans	-2.0%	Adjustment to steady state	Severe initial credit contraction, then gradual recovery
Welfare	+0.02%	Adjustment to steady state	Temporary welfare improvement from consumption boost, then return to equilibrium

Source: Research Findings

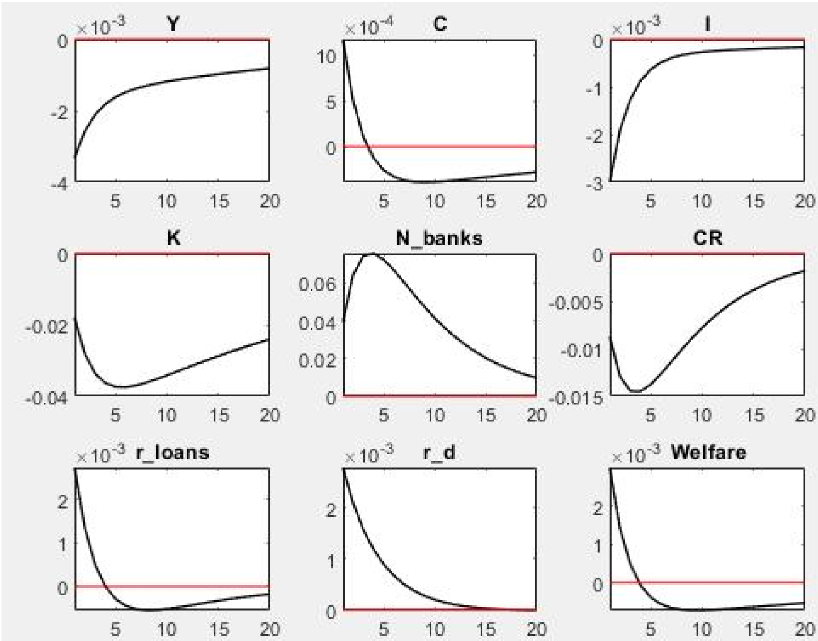

Figure 3. Impulse Response Functions (IRFs) of Liquidity Shock
Source: Research Findings

Interest Rate Shock

Interest rate (monetary policy) shocks represent one of the most direct channels through which central bank policy affects the broader economy. These shocks capture unexpected changes in the monetary authority's policy stance that deviate from predictable responses to macroeconomic conditions. When the central bank adjusts interest rates beyond what economic fundamentals would suggest, it creates ripple effects throughout the financial system and real economy. Such policy surprises can occur due to shifts in monetary strategy, external economic pressures, or preemptive actions to address emerging economic risks. The interest rate shocks are modeled via an autoregressive Taylor rule where the policy rate follows an AR (1) process with systematic responses to inflation and output, plus temporary shock innovations that represent unexpected policy deviations.

The transmission mechanism of interest rate shocks in the economy operates through four main channels that interact in a coordinated and systematic manner. The price channel works when changes in the central bank's policy rate directly influence market interest rates, altering the cost of capital across the economy and affecting borrowing costs for firms and individuals, which influences their investment and consumption decisions through standard cost-benefit calculations. The credit channel also operates, whereby interest rate changes affect loan demand through altered borrowing costs while simultaneously influencing banks' lending capacity through changes in funding costs and profit margins, creating dual effects on credit market equilibrium. The bank balance sheet channel comes into play, as interest rate fluctuations affect bank profitability through changes in net interest margins between lending and deposit rates, which influences banks' capital accumulation capacity and their ability to maintain adequate lending while preserving regulatory compliance. The expectations channel operates through the signaling effects of monetary policy changes, as these policy shifts communicate central bank intentions regarding inflation control and economic growth objectives, influencing forward-looking economic decisions by firms and households and potentially amplifying or dampening the direct price effects of interest rate changes throughout the economic system.

Effect on Production (Y):

In the short term, an increase in the interest rate leads to a slight decline in output, as borrowing costs for firms rise and investment decreases. In the long run, production gradually recovers and returns toward its equilibrium level over approximately 15-20 periods, as shown in the impulse response function.

Effect on Consumption (C):

In the short term, consumption experiences a minimal decline as households face higher borrowing costs. In the long run, consumption fully recovers and returns to its steady-state level, demonstrating the temporary nature of the interest rate shock's impact on household spending patterns.

Effect on Investment (I)

In the short term, investment experiences a sharp decline, as the discount rate for projects increases, reducing their profitability. Investment shows the strongest response among real variables due to its high sensitivity to financing costs and future profitability expectations. In the long run, investment gradually adjusts and returns toward equilibrium over approximately 10-15 periods, reflecting the temporary nature of tighter financing conditions.

Effect on Loan Rate (rloans):
Loan rates increase substantially in the short term, as banks pass on the higher policy rate to customers through direct transmission mechanisms. In the long run, loan rates gradually decline but remain moderately elevated compared to pre-shock levels, reflecting banks' reassessment of systemic risks and persistent risk premiums.

Effect on Deposit Rate (rd):
In the short term, deposit rates show a significant upward adjustment, as banks seek to attract new funds in response to monetary tightening. In the long run, deposit rates gradually moderate but remain somewhat elevated, reflecting the new equilibrium in the money market.

Effect on Loans:
The volume of loans experiences a notable contraction in the short term, due to both reduced demand and tighter supply from banks. In the long run, loan volumes gradually recover toward their equilibrium level, demonstrating the temporary nature of credit market disruptions.

Effect on Capital Adequacy Ratio (CAR):
In the short term, the interest rate shock places moderate pressure on on banks' capital adequacy ratios, as the market value of their assets (particularly bonds) declines with rising interest rates. This decrease in asset value affects the ratio of capital to risk-weighted assets.

In the long run, as banks gradually adjust their asset portfolios and benefit from higher interest income, the capital adequacy ratio steadily improves and returns to its equilibrium level. The recovery occurs over approximately 12-18 periods, as banks adapt their strategies to the new interest rate environment.

Effect on Economic Welfare:
The interest rate shock imposes moderate welfare costs on the economy through multiple transmission channels. Higher interest rates directly reduce household welfare by increasing borrowing costs for mortgages, consumer loans, and credit cards, while making saving more attractive relative to consumption. As investment and output experience temporary contractions, employment opportunities diminish and wage growth slows, creating short-term income effects. Small businesses and credit-dependent sectors face particular hardship as financing becomes more expensive and less accessible. However, these welfare effects are largely temporary, with gradual recovery occurring as the economy adjusts to new equilibrium conditions over approximately 15-20 periods, demonstrating the transient nature of monetary

policy impacts on societal well-being. The relatively quick recovery reflects the resilience of the Iranian economy and the temporary nature of monetary policy transmission effects.

Table 8
Effects of an Interest Rate Shock

Variable	**Short-Term Effect (%Δ)**	**Long-Term Effect**	**Transmission Mechanism**
Production (Y)	-0.2%	Gradual recovery	Reduced investment and consumption demand
Consumption (C)	-0.06%	Full recovery	Decreased purchasing power due to higher borrowing costs
Investment (I)	3.9%	Gradual adjustment	Lower project profitability with higher discount rates
Capital (K)	-1.0%	Gradual recovery	Reduced capital formation
Capital Adequacy Ratio (CAR)	-1.1%	Steady improvement	Portfolio adjustments
Economic Welfare	+0.02%	Gradual recovery	Multiple transmission channels

Source: Research Findings

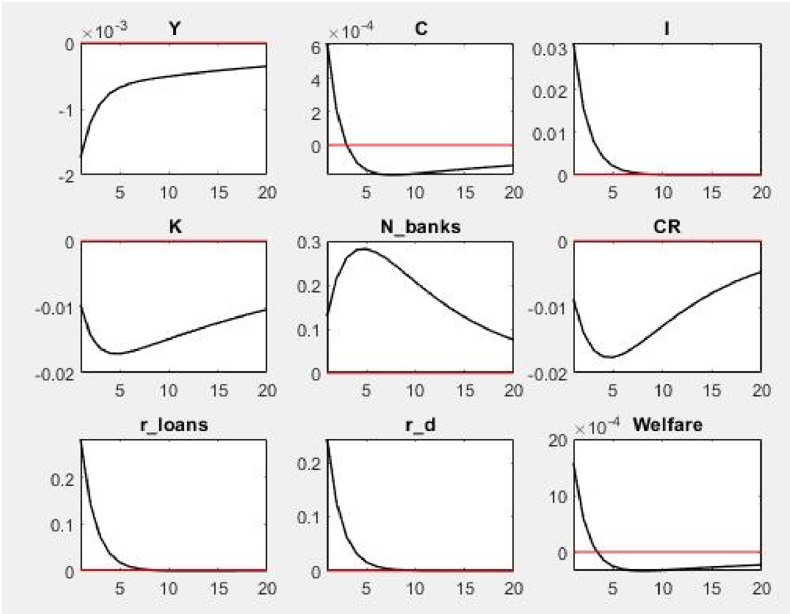

Figure 4. Impulse Response Functions (IRFs) Interest Rate Shock
Source: Research Findings

5 Conclusion

This study contributes to the existing literature by providing the first comprehensive DSGE-based estimation of optimal economic capital for Iranian banks. Through a four-sector dynamic model incorporating banking sector dynamics, macroeconomic shocks, and welfare optimization, we address a critical gap in domestic research on banking capital adequacy.

Key Findings

Our analysis reveals that the optimal capital adequacy ratio for Iranian banks is approximately 17 percent, significantly exceeding Basel III minimum requirements of 10.5 percent. This finding indicates the necessity for substantial capital buffers beyond international regulatory standards to ensure financial stability in Iran's economic environment. The higher optimal capital level reflects the specific risk profile and macroeconomic volatility characteristics of the Iranian banking system.

The impulse response analysis demonstrates that liquidity shocks exert the most severe impact on required capital levels, with substantial short-term effects on the capital adequacy ratio. Productivity shocks generate the largest welfare impacts, emphasizing the interconnection between real economic performance and banking sector stability. Interest rate shocks primarily affect financial variables with temporary but notable effects that gradually dissipate over time, demonstrating the resilience of the Iranian banking system to monetary policy adjustments.

Scientific Contribution

This research makes several important theoretical and methodological contributions. First, it introduces bank entry and exit mechanisms within a DSGE framework, allowing for endogenous banking sector evolution under stress conditions. Second, the incorporation of deposit insurance and welfare-based optimization criteria provides a more comprehensive approach to capital determination than previous studies. Third, the calibration to Iranian economic conditions offers country-specific insights that challenge the universal applicability of international capital standards.

Policy Implications

The findings have significant implications for monetary and macroprudential policy in Iran. The Central Bank should consider implementing a gradual transition toward the 17 percent capital adequacy target through phased regulatory adjustments over several periods. This approach would minimize disruption to credit supply while strengthening systemic stability. Additionally, enhanced liquidity supervision and stress testing protocols should be prioritized given the substantial impact of liquidity shocks on capital adequacy.

Policymakers should also recognize that while higher capital requirements enhance financial stability, they may impose short-term adjustment costs through temporarily reduced credit availability and potential changes in bank profitability. The welfare-based optimization framework suggests these costs are outweighed by long-term stability benefits, supporting the case for stricter capital standards. The temporary nature of most shock effects, as demonstrated by the impulse response analysis, indicates that the banking system possesses inherent resilience mechanisms.

Limitations and Future Research

Several limitations should be acknowledged. The model relies on linearization assumptions that may not fully capture extreme tail risks or nonlinear dynamics during severe crises. Data availability constraints required some parameters to be calibrated from international studies rather than Iranian-specific estimates. The four-sector framework, while comprehensive, simplifies certain aspects of the financial system such as interbank markets and shadow banking activities.

Future research should extend this framework to incorporate additional risk factors such as operational and cyber risks, which are increasingly relevant in modern banking. Cross-country comparative studies using similar DSGE methodologies would enhance understanding of optimal capital variation across different economic structures. Finally, dynamic capital requirements that adjust with business cycles warrant investigation as an extension of this static optimization approach.

Final Remarks

This study demonstrates that optimal banking capital determination requires country-specific analysis that accounts for unique economic conditions and risk profiles. The 17 percent optimal capital ratio for Iranian banks, while substantially higher than international norms, reflects an appropriate balance between financial stability and economic efficiency given domestic macroeconomic characteristics. The temporary and recoverable nature of most macroeconomic shock effects, as evidenced by the impulse response functions, supports the resilience of the proposed capital framework. These findings provide a solid foundation for evidence-based regulatory policy and contribute to the broader literature on macroprudential regulation in emerging economies.

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