Journal of Money and Economy
Vol. 20, No. 2, Spring 2025
pp. 149-186

Original Research Article

Fiscal Shocks and Central Bank Responses in Iran: A Bayesian DSGE Model with Non-Ricardian Households in an Open Economy

Abboud Shaheed* **Monireh Rafat**†
Majid Sameti‡ **Narjes Salam**§

Received: 03 Aug 2025 Approved: 15 Sep 2025

This study examines the impact of various fiscal shocks on key macroeconomic variables in Iran and explores the corresponding monetary policy responses. The analysis is conducted within an economy characterized by household heterogeneity, where a segment of households lacks access to financial markets due to non-Ricardian behavior. To capture these dynamics, the heterogeneity is embedded in a New Keynesian Dynamic Stochastic General Equilibrium (DSGE) framework. This allows us to trace how government spending shocks, tax shocks, and government bond interest rate shocks propagate through the economy and how monetary policy reacts. Using annual data from 2004 to 2024 and applying Bayesian estimation techniques, we estimate the main structural parameters. The results show that spending cuts, higher taxes, and rising bond yields exert contractionary effects on output, consumption, and labor supply. These effects become significantly stronger when non-Ricardian households are explicitly included in the model. Ignoring them leads to underestimation of the magnitude of these changes and may result in suboptimal policy recommendations. Regarding monetary policy, the findings indicate that incorporating non-Ricardian households alters the central bank's interest-rate reaction to fiscal shocks. In particular, the central bank responds more aggressively by easing following tax increases and spending cuts, while increases in bond yields trigger stronger monetary tightening to preserve financial stability. Moreover, sensitivity analysis shows that a higher proportion of non-Ricardian households amplifies the contractionary effects of tax increases, whereas stronger habit persistence and a higher inverse Frisch elasticity of labor supply partially mitigate these effects. Taken together,

*Faculty of Administrative sciences and Economics, University of Isfahan, Isfahan, Iran; Abboud.shaheed@ase.ui.ac.ir.
†Faculty of Administrative sciences and Economics, University of Isfahan, Isfahan, Iran; m.rafat@ase.ui.ac.ir (Corresponding Author).
‡Faculty of Administrative sciences and Economics, University of Isfahan, Isfahan, Iran.; majidsameti@ase.ui.ac.ir.
§Faculty of Administrative sciences and Economics, University of Isfahan, Isfahan, Iran; Narjes.salam@ase.ui.ac.ir

the results suggest that conventional fiscal strategies may be less effective in economies with a substantial share of non-Ricardian households. The findings underscore the importance of coordinated fiscal and monetary policies that explicitly incorporate household heterogeneity in order to safeguard macroeconomic stability.

Keywords: Bayesian estimation, DSGE model, Fiscal shocks, Iranian economy, Non-Ricardian households
JEL Classification: C53, D12, D50, E62, O53

1 Introduction

Persistent budget deficits are among the most critical macroeconomic challenges faced by governments worldwide. If left unaddressed, these deficits can crowd out private investment, suppress long-term growth, and cause permanent output losses (Gruss & Torres, 2012). Policymakers typically use fiscal tools such as tax hikes, spending cuts, or sovereign bond issuance to restore fiscal balance. However, in economies with deep structural vulnerabilities, these conventional measures often their effectiveness.

Iran's economy is particularly vulnerable due to its heavy reliance on oil production and exports as the primary source of GDP. Between 2003 and 2018, oil exports consistently exceeded non-oil exports (National Planning and Budget Organization of Iran), exposing the country to sanctions and volatile global oil prices. The impact of this dependence became especially severe following the U.S. withdrawal from the nuclear agreement in 2018, with oil revenues had fallen to only 6% of the national budget by 2020 (Statistical Center of Iran, 2020). Although the government has attempted to increase domestic revenue through taxation, tax income remains modest, accounting for just 39% of total revenue (Salam et al., 2025). External shocks, such as sharp declines in energy rents, can nonetheless serve as catalysts for structural reforms, encouraging economic diversification and investment in human capital sectors like education and health (Farzanegan, 2011).

A significant structural challenge influencing fiscal policy effectiveness in Iran is the prevalence of non-Ricardian households. Unlike Ricardian consumers, who base their consumption and labor supply on long-term fiscal expectations, non-Ricardian households rely mainly on current income and lack access to credit, making them more sensitive to immediate fiscal changes. Estimates of their population share vary from 26.5% to 52% (Roshan et al., 2014; Tayefeh Jabbari et al., 2022), underscoring their macroeconomic significance.

Several studies have explored the role of non-Ricardian households in Iran's macroeconomic dynamics (Roshan et al., 2014; Haghighat et al., 2017; Gharraie et al., 2019; Tayefeh Jabbari et al., 2022). However, none have specifically examined how these households affect the transmission of government bond interest rate shocks. Moreover, there is no comprehensive analysis of their impact on the propagation of major fiscal shocks—such as tax policy changes, fluctuations in government spending, and bond yield variations—within a unified Bayesian Dynamic Stochastic General Equilibrium (DSGE) model that reflects Iran's open, oil-dependent economy. This paper addresses that gap by investigating the interaction between fiscal shocks and monetary policy responses in the presence of household heterogeneity. It also conducts a sensitivity analysis to assess how changes in three structural parameters—the share of non-Ricardian consumers, the inverse Frisch elasticity of labor supply, and the degree of habit persistence—shape the macroeconomic response to a positive tax shock.

The remainder of this paper is structured as follows: Section 2 reviews the theoretical foundations and surveys the relevant literature on non-Ricardian households. Section 3 presents the research methodology and details the specification of the Bayesian DSGE model. In Section 4, we estimate the model parameters using Bayesian techniques and compute key economic ratios. Section 5 employs Impulse Response Functions (IRFs) to evaluate the effects of negative government spending shocks, positive tax shocks, and increases in government bond interest rates on Iran's macroeconomic variables under two scenarios: one excluding non-Ricardian households and the other including them. This section also presents the results of the sensitivity analysis. Finally, Section 6 summarizes the main findings and discusses their broader policy implications.

2 Review of Related Literature

The life-cycle hypothesis (LCH) has long served as a cornerstone of conventional general equilibrium models, providing a structured framework to explain how households allocate consumption and savings over their lifespan. According to this hypothesis, households save during their working years to finance consumption in retirement, when income typically declines (Fisher, 1987). The key premise is that households smooth consumption over time, maintaining a relatively stable standard of living from early adulthood through old age.

Despite its theoretical elegance and clear predictions, the empirical validity of the LCH has been widely debated. Evidence often challenges its core assumptions. Contrary to the theory's expectation that households dissave during retirement, many elderly households maintain or even accumulate savings, frequently consuming less than younger cohorts across all income groups (Danziger et al., 1982). These findings raise questions about the LCH's ability to fully capture real-world consumption behavior.

The LCH also faces substantial theoretical criticism. Its assumptions of perfect foresight and unlimited rationality imply that households can accurately predict future income and needs, optimally smoothing consumption throughout life. In reality, cognitive and informational constraints limit decision-making. As Bizzotto (2010) and Rasouli & Timmermans (2015) note, individuals often rely on heuristics, focus on limited information, or overlook minor trade-offs, reflecting bounded rationality and highlighting the gap between the LCH's predictions and actual behavior.

Moreover, the LCH assumes unrestricted access to financial markets—an assumption that empirical evidence often contradicts. Many households, particularly low-income ones, face binding liquidity constraints due to limited access to credit and formal savings instruments (De Vos et al., 2020). Some exhibit "hand-to-mouth" behavior, prioritizing immediate consumption over long-term financial planning (Vasilev, 2021). This behavior is captured by the concept of non-Ricardian, or "rule-of-thumb," households, indicating that the aggregate marginal propensity to consume out of current income is higher than predicted by Ricardian frameworks. Rising public debt and uncertainty about future taxation can also lead even traditionally Ricardian households to adopt non-Ricardian behavior (Bhattacharya & Mukherjee, 2013).

Several studies have investigated the behavior of non-Ricardian households and analyzed how their presence affects the transmission mechanisms of various economic shocks. The following section highlights some of the most prominent studies in this area:

Akarsu et al. (2025), using a panel model, investigated how the share of non-Ricardian consumers affects monetary policy effectiveness. They found that countries with higher proportions of such consumers exhibit weaker responses to monetary policy shocks. In contexts where wages are more rigid than prices, real wages of non-Ricardian consumers may decline even when interest rates are reduced, limiting the anticipated increase in aggregate demand. These findings emphasize the interaction between labor market structure and household heterogeneity in shaping policy outcomes.

Building on this perspective Chikonda and Chortareas (2024) developed a New Keynesian model for small open economies to examine the impact of non-Ricardian consumer behavior and the presence of an informal sector on the effectiveness of monetary policy in emerging economies. Their findings reveal that non-Ricardian consumers intensify demand shocks and add complexity to the inflation-control process, while the informal sector amplifies supply shocks. Together, these factors create a conflict between stabilizing output and controlling inflation, thereby disrupting the transmission mechanism of monetary policy in emerging markets.

Similarly, Tayefeh Jabbari et al. (2022) examined fiscal policy applications in the presence of rule-of-thumb households using a DSGE model covering 1981–2017. The results indicate that government spending shocks raise aggregate output, yet consumption responses vary by household type. Non-Ricardian households increase consumption with rising income, whereas Ricardian households reduce it due to negative wealth effects. Hence, including non-Ricardian households strengthens the aggregate consumption response to fiscal expansions compared to baseline models.

The role of financial development in shaping household behavior is also critical. Gharraie et al. (2019) explored how household participation in financial markets affects the impact of monetary shocks in Iran. They found that limited market participation increases the share of non-Ricardian households. Comparing the periods 1989–1998 and 1999–2017, they observed that financial market expansion reduced this share from 54% to 38%, thereby moderating the influence of non-Ricardian households on monetary transmission.

Palas (2017) further analyzed fiscal transmission using a DSGE model under conditions of price and wage rigidities, habit persistence, and cross-border dynamics. Even a modest fraction of non-Ricardian agents can generate strong positive comovement between public spending and private consumption, while monetary policy following the Taylor principle remains sufficient to maintain equilibrium stability.

Haghighat et al. (2017) assessed Iran’s fiscal policy through a DSGE model emphasizing non-Ricardian households. Their study showed that government spending shocks initially reduced consumption for both Ricardian and non-Ricardian households. Ricardian households eventually restored consumption through financial market access, whereas non-Ricardian households experienced prolonged declines before gradually increasing consumption as output recovered. Lower consumption taxes further boosted non-Ricardian household spending above steady-state levels, while Ricardian consumption rose temporarily before falling below the steady state.

Roshan et al. (2014) focused on rule-of-thumb consumption behavior in Iran using the generalized method of moments (GMM) over 1978–2011. They estimated that approximately 26.5% of households followed rule-of-thumb consumption, while the remainder based decisions on permanent income and intertemporal planning.

Finally, Coenen and Straub (2005) employed a New Keynesian DSGE model that incorporates non-Ricardian households and applies Bayesian inference. Their results indicated that including these households increases private consumption responsiveness to fiscal shocks, though the overall impact remained limited due to the relatively small share of non-Ricardian households and strong negative wealth effects from persistent government spending.

Collectively, these studies highlight the significant role of non-Ricardian households in shaping fiscal and monetary policy effectiveness. They illustrate how consumer heterogeneity, liquidity constraints, and financial development influence macroeconomic dynamics. While much of the literature has focused on tax and government spending shocks, other channels—particularly government bond interest rate shocks—remain underexplored. This gap is especially relevant in economies such as Iran, where sovereign debt dynamics, financial market imperfections, and household heterogeneity interact in complex ways.

To address this gap, the present study develops a Bayesian-estimated DSGE model tailored to Iran, explicitly incorporating non-Ricardian households. It evaluates how their presence affects fiscal shock transmission, with particular emphasis on government bond interest rate shocks. By analyzing the interplay between monetary policy and fiscal shocks under structural constraints, the study provides insights into macroeconomic stabilization and offers policymakers evidence-based guidance on how household heterogeneity shapes the effectiveness of fiscal and monetary policies in Iran.

3 Model

This model draws inspiration from the works of Nasiri et al. (2023), Mu et al. (2022), Mu and Yan (2021), Nakhli et al. (2020), Khiabani and Amiri (2012), Furlanetto and Seneca (2012), and Galí et al. (2007). The framework is designed for an open economy and encompasses the primary economic agents: Ricardian households, non-Ricardian households, firms, the foreign trade sector, the oil sector, the government, and the central bank. This study employs a DSGE model to analyze the impact of various exogenous shocks on Iran’s macroeconomic indicators—particularly output, consumption, and labor supply. These shocks include fluctuations in government expenditures, taxation, and government bond interest rates. The following subsections describe each of these agents and their corresponding optimization problems and equilibrium conditions. Figure 1 presents a conceptual model illustrating sectoral interactions involving both Ricardian and Non-Ricardian households.

3.1 Households

The research model includes Ricardian and non-Ricardian consumers. The instantaneous utility function for both household types is expressed as follows:

$$U_t^i = log\left(\varepsilon_t^{pf} C_t^i - h\bar{C}_{t-1}^i\right) - \frac{(\varepsilon_t^L L_t^i)^{1+\gamma_l}}{1+\gamma_l} + \frac{1}{1-\gamma_m}.(\frac{M_t}{P_t})^{1-\gamma_m} + \frac{1}{1-\gamma_{me}}.(\frac{M_t^e}{P_t^f})^{1-\gamma_{me}} \quad (1)$$

In Equation (1), $i \in \{r.m\}$ denotes the household type, where $\underline{r}$ represents Ricardian households and $\underline{m}$ corresponds to non-Ricardian households. C_t^i indicates the consumption of household $\underline{i}$ at time $\underline{t}$, while $\bar{C}_{t-1}^i$captures the total consumption of household $\underline{i}$ in the previous period. L_t^i reflects the labor supply at time $\underline{t}$. Additionally, $\frac{M_t}{P_t}$ and $\frac{M_t^s}{P_t^f}$ represent, respectively, the real balances of domestic and foreign currencies held by the household at time $\underline{t}$. The model parameters include the habit formation coefficient in consumption h, the inverse Frisch elasticity of labor supply γ_l, the preference shock ε_t^{pf}, the labor supply shock ε_t^L, the intertemporal discount rate $\underline{\beta}$, the elasticity of real domestic money balances γ_m, and the elasticity of real foreign money balances γ_{me}. It is assumed that $\beta \in [0,1]$, where $1 - \beta$ indicates the share of Ricardian consumers and β corresponds to the proportion of non-Ricardian consumers.

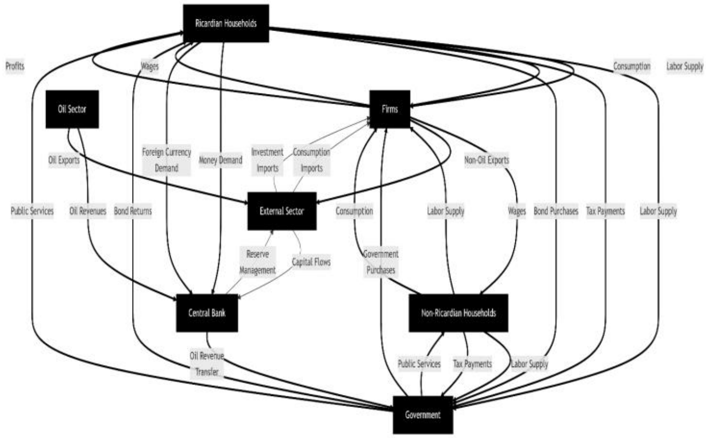

Figure 1. A Conceptual Model of Sectoral Interactions with Ricardian and Non-Ricardian Households
Source: Research finding

3.1.1 Ricardian Households

Ricardian households are subject to a budget constraint, under which their sources of income include nominal wage income W_t from labor supply, rental income from capital K_{t-1} at the rate R_t^k, returns on government bonds B_{t-1} at the interest rate r_{t-1}^{bg}, domestic money holdings M_{t-1}, foreign currency balances M_{t-1}^e, and dividends from ownership of intermediate goods-producing firms DIV_t. Their expenditures, on the other hand, consist of spending on consumption goods C_t^r, capital goods I_t, tax payments T^r, purchases of new government bonds B_t, holdings of foreign currency $s_t.M_t^e$, and precautionary demand for domestic money M_t. In this model, s_t denotes the nominal exchange rate used to convert foreign currency balances and other currency-denominated variables into rials.

$$P_tC_t^r + P_t^I I_t + M_t + B_t + s_t.M_t^e = W_tL_t^r + R_t^k K_{t-1} + \left(1 + r_{t-1}^{bg}\right)B_{t-1} + M_{t-1} + s_t.M_{t-1}^e + DIV_t - \ P_tT^r \quad (2)$$

Within the framework of this model, all nominal variables are expressed in real terms. Specifically, rial-denominated variables are adjusted using the domestic consumer price index P_t, while foreign currency-denominated variables are deflated using the foreign price index P_t^f . Accordingly, the real budget constraint of Ricardian households is formulated as follows:

$$c_t^r + \frac{P_t^I}{P_t} I_t + m_t + b_t + re_t . m_t^e = w_t l_t^r + r_t^k K_{t-1} + \left(1 + r_{t-1}^{bg}\right) \frac{b_{t-1}}{\pi_t} + \frac{m_{t-1}}{\pi_t} + re_{t-1} . \gamma_t . \frac{m_{t-1}^e}{\pi_t} + div_t - t^r \tag{3}$$

The real exchange rate re_t, the gross growth rate of the nominal exchange rate γ_t, and the gross inflation rate π_t are defined as follows:

$$re_t = \frac{s_t . P_t^*}{P_t} \tag{4}$$

$$\gamma_t = \frac{s_t}{s_{t-1}} \tag{5}$$

$$\pi_t = \frac{P_t}{P_{t-1}} \tag{6}$$

The capital accumulation equation incorporates the concept of investment adjustment costs based on the framework of Rotemberg (1982). It is specified as follows:

$$K_t = K_{t-1}(1-\delta) + \left[1 - S\left(\frac{I_t}{I_{t-1}}\right)\right] . I_t \tag{7}$$

Here , δ represents the capital depreciation rate, and $S\left(\frac{I_t}{I_{t-1}}\right)$ is a convex adjustment cost function satisfying $S(1) = S'(1) = 0$.

By constructing the Lagrangian function and applying the first-order optimality conditions for Ricardian households—with respect to consumption, labor supply, capital, investment, bonds, and the balances of domestic and foreign currencies—we derive the system of equations (9) through (12) as follows:

$$L_t = maxE_t \sum_{t=0}^{\infty} \beta^t \left\{ \log\left(\varepsilon_t^{pf} c_t^r - h\bar{c}_{t-1}^r\right) - \frac{(\varepsilon_t^L l_t^r)^{1+\gamma_l}}{1+\gamma_l} + \frac{1}{1-\gamma_m} . (m_t)^{1-\gamma_m} + \frac{1}{1-\gamma_{me}} . (m_t^e)^{1-\gamma_{me}} \right\} - \lambda_t^r \left\{ c_t^r + \frac{P_t^I}{P_t} I_t + m_t + b_t + re_t . m_t^e - w_t l_t^r - r_t^k K_{t-1} - \left(1 + r_{t-1}^{bg}\right) \frac{b_{t-1}}{\pi_t} - \frac{m_{t-1}}{\pi_t} - re_{t-1} . \gamma_t . \frac{m_{t-1}^e}{\pi_t} - div_t + t^r \right\} - \mu_t^r \{ K_t - K_{t-1}(1-\delta) - \left[1 - S\left(\frac{I_t}{I_{t-1}}\right)\right] . I_t \} \tag{8}$$

$$\left(\frac{\varepsilon_t^{pf}}{\varepsilon_t^{pf} c_t^r - h\bar{c}_{t-1}^r} - \beta^t \frac{h}{\varepsilon_{t+1}^{pf} c_{t+1}^r - h\bar{c}_t^r} \right) = \frac{(\varepsilon_t^L)^{1+\gamma_l} (l_t^r)^{\gamma_l}}{w_t} \tag{9}$$

$$(m_t)^{-\gamma_m} . \frac{\left(1 + r_t^{bg}\right)}{r_t^{bg}} = \frac{(\varepsilon_t^L)^{1+\gamma_l} (l_t^r)^{\gamma_l}}{w_t} \tag{10}$$

$$\frac{(m_t^e)^{-\gamma me}}{(m_t)^{-\gamma m}} = re_t.\frac{\left(1+r_t^{bg}-\gamma_{t+1}\right)}{r_t^{bg}} \tag{11}$$

$$r_{t+1}^k = \frac{P_t^I}{P_t}\frac{\left(1+r_t^{bg}\right)}{\pi_{t+1}} - \frac{P_{t+1}^I}{P_{t+1}}(1-\delta) \tag{12}$$

Equation (9) captures the trade-off between the marginal utility of consumption—adjusted for habit formation—and the disutility of labor, thereby determining the optimal balance between consumption decisions and labor effort. Equation (10) represents the condition for domestic money demand, where the marginal utility of holding money—adjusted by the return on government bonds—is equated to the marginal cost of labor. Equation (11), which governs foreign currency demand, defines the optimal allocation of wealth between domestic and foreign money holdings. Finally, Equation (12), the Euler equation for capital returns, determines the required rate of return on physical capital.

3.1.2 Non-Ricardian Households

As previously noted, non-Ricardian consumers are constrained by liquidity limitations and lack access to financial markets. Consequently, they determine their consumption entirely based on current income and are unable to save or finance expenditures through borrowing. These households face a budget constraint in which income earned from supplying labor at a nominal wage W_t is allocated to consumption expenses C_t^m and tax payments T_t^m:

$$P_t.(C_t^m + T_t^m) = W_t L_t^m \tag{13}$$

The real form of the non-Ricardian household's budget constraint is given by:

$$c_t^m + t_t^m = w_t l_t^m \tag{14}$$

By constructing the Lagrangian function and applying the first-order optimality conditions, the equation (16) is derived as follows:

$$L_t = maxE_t \sum_{t=0}^{\infty} \beta^t \left\{\log\left(\varepsilon_t^{pf} c_t^m - h\bar{c}_{t-1}^m\right) - \frac{(\varepsilon_t^L l_t^m)^{1+\gamma_l}}{1+\gamma_l}\right\} - \lambda_t^m \{c_t^m + t_t^m - w_t l_t^m\} \tag{15}$$

$$\left(\frac{\varepsilon_t^{pf}}{\varepsilon_t^{pf} c_t^m - h\bar{c}_{t-1}^m} - \beta^t \frac{h}{\varepsilon_{t+1}^{pf} c_{t+1}^m - h\bar{c}_t^m}\right) = \frac{(\varepsilon_t^L)^{1+\gamma_l}(l_t^m)^{\gamma_l}}{w_t} \tag{16}$$

Aggregate variables are computed as simple weighted averages:

$$c_t = \beta . c_t^r + (1 - \beta) . c_t^m \quad (17)$$
$$l_t = \beta . l_t^r + (1 - \beta) . l_t^m \quad (18)$$

The consumption bundle of Ricardian and non-Ricardian consumers comprises both imported and domestically produced goods. Based on the theoretical framework proposed by Tavakolian and JalaliNaeeni (2017), it is assumed that these goods are combined through a CES function with a substitution parameter λ_c, where ϵ_c denotes the share of domestic goods in the consumption basket. Households aim to minimize their consumption expenditures subject to this structure:

$$Min \ \ P_t . c_t - P_t^{cd} . c_t^d - P_t^{cm} . c_t^{im} \quad (19)$$
$$s.t. \ \ c_t = [\epsilon_c^{\frac{1}{\lambda_c}} . c_t^{d^{\frac{\lambda_c - 1}{\lambda_c}}} + (1 - \epsilon_c)^{\frac{1}{\lambda_c}} . c_t^{im^{\frac{\lambda_c - 1}{\lambda_c}}}]^{\frac{\lambda_c}{\lambda_c - 1}} \quad (20)$$

The optimization procedure results in the derivation of demand functions for both domestic and imported consumption goods.

$$c_t^d = \epsilon_c . (\frac{P_t^{cd}}{P_t})^{-\lambda_c} . c_t \quad (21)$$
$$c_t^{im} = (1 - \epsilon_c) . (\frac{P_t^{cm}}{P_t})^{-\lambda_c} . c_t \quad (22)$$

As a result, the household consumption price index is defined as a weighted average of domestic and imported prices:

$$P_t^{1 - \lambda_c} = \epsilon_c . P_t^{cd^{1 - \lambda_c}} + (1 - \epsilon_c) . P_t^{cm^{1 - \lambda_c}} \quad (23)$$

Household investment is also divided into domestic investment and foreign investment. According to Tavakolian and JalaliNaeeni (2017), households purchase their capital goods by combining domestically produced capital goods I_t^d and imported capital goods I_t^{im} within a CES framework with a substitution elasticity of λ_I . In this combination, the share of domestic investment in total household investment is ϵ_I. The ultimate goal of the household is to optimize investment expenditures using a cost-minimization approach.

$$Min \ P_t^I . I_t - P_t^{Id} . I_t^d + P_t^{Im} . I_t^{im} \quad (24)$$
$$s.t. \quad I_t = [\epsilon_I^{\frac{1}{\lambda_I}} . I_t^{d^{\frac{\lambda_I - 1}{\lambda_I}}} + (1 - \epsilon_I)^{\frac{1}{\lambda_I}} . I_t^{im^{\frac{\lambda_I - 1}{\lambda_I}}}]^{\frac{\lambda_I}{\lambda_I - 1}} \quad (25)$$

Following the optimization process, demand for domestic and imported capital goods is determined as follows:

$$I_t^d = \epsilon_I . (\frac{P_t^{Id}}{P_t^I})^{-\lambda_I} . I_t \tag{26}$$

$$I_t^{im} = (1-\epsilon_I) . (\frac{P_t^{Im}}{P_t^I})^{-\lambda_I} . I_t \tag{27}$$

Consequently, the household investment price index is calculated as a weighted average of domestic and imported capital goods prices:

$$P_t^{I^{1-\lambda_I}} = \epsilon_I . P_t^{Id^{1-\lambda_I}} + (1-\epsilon_I) . P_t^{Im^{1-\lambda_I}} \tag{28}$$

3.2 Firms

3.2.1 Intermediate Goods Sector

An intermediate goods firm produces $y_{i,t}$ using the following technology:

$$y_{i,t} = K_{i,t}^{\Omega} (\varepsilon_t^a l_{i,t}^y)^{1-\Omega} \tag{29}$$

Here, $K_{i,t}$ denotes physical capital, $l_{i,t}^y$ is labor allocated to intermediate goods production, ε_t^a is a technology shock, and Ω is the capital share in production.

The intermediate goods firm solves the following optimization problem:

$$Min: \left[r_t^k K_{i,t} + w_t l_{i,t}\right] - \Lambda_t [K_{i,t}^{\Omega} (\varepsilon_t^a l_{i,t}^y)^{1-\Omega} - y_{i,t}] \tag{30}$$

Here, r_t^k is the capital utilization cost, and w_t is the real wage rate.

The dividend equation is given by:

$$div_t = y_{i,t} - r_t^k K_{i,t} - w_t l_{i,t}^y \tag{31}$$

First-order conditions from the optimization problem yield:

$$\frac{r_t^k}{[\Omega . K_{i,t}^{\Omega-1} (\varepsilon_t^a l_{i,t}^y)^{1-\Omega}]} = \frac{w_t}{[(1-\Omega) K_{i,t}^{\Omega} (\varepsilon_t^a)^{1-\Omega} (l_{i,t}^y)^{-\Omega}]} \tag{32}$$

$$w_t = mc^{\frac{1}{1-\Omega}} . (1-\Omega) (\frac{\Omega}{r_t^k})^{\frac{\Omega}{1-\Omega}} \varepsilon_t^a \tag{33}$$

Following Nakhli et al. (2020), the intermediate goods firm divides its output between domestic y_t^d and export y_t^{ex} markets according to a CES function with elasticity parameter λ_y, where ϵ_y represents the domestic share. The firm then maximizes profits by optimizing this allocation:

$$Max \quad P_t^y . y_t = P_t^d . y_t^d + P_t^{ex} . y_t^{ex} \tag{34}$$

$$s.t. \quad y_{i,t} = [\epsilon_y^{\frac{1}{\lambda_y}} y_{i,t}^{d\ \frac{\lambda_y+1}{\lambda_y}} + (1-\epsilon_y)^{\frac{1}{\lambda_y}} y_{i,t}^{ex\ \frac{\lambda_y+1}{\lambda_y}}]^{\frac{\lambda_y}{\lambda_y+1}} \tag{35}$$

Here, P_t^{ex} is the export price index (in foreign currency), which is converted to domestic currency (rial) using the nominal exchange rate. P_t^d is the domestic market price index, and P_t^y is the aggregate price index of intermediate goods production.

The firm allocates its output between domestic and export markets according to:

$$y_{i,t}^d = \epsilon_y (\frac{P_t^d}{P_t^y})^{\lambda_y} y_{i,t} \tag{36}$$

$$y_{i,t}^{ex} = (1-\epsilon_y)(\frac{s_t P_t^{ex}}{P_t^y})^{\lambda_y} y_{i,t} \tag{37}$$

Consequently, the intermediate goods firm's price index is calculated as a weighted average of the price of goods supplied to the domestic market and the price of exported goods:

$$P_{i,t}^{y\ 1+\lambda_y} = \epsilon_c P_{i,t}^{d\ 1+\lambda_y} + (1-\epsilon_c)[s_t P_{i,t}^{ex}]^{1+\lambda_y} \tag{38}$$

3.2.2 Final Goods Sector

Each firm maximizes its profit function subject to the production constraint:

$$Max : \prod_t = P_t[\int_0^1 (y_{i,t})^{\frac{\lambda_P - 1}{\lambda_P}} di]^{\frac{\lambda_P}{\lambda_P - 1}} - \int_0^1 P_{i,t}^y y_{i,t} di \tag{39}$$

Here, λ_P is the elasticity of substitution across intermediate goods, and $\frac{\lambda_P - 1}{\lambda_P}$ is the long-run equilibrium price markup.

The model adopts Calvo's (1983) pricing framework where the fraction $(1-\xi_P)$ of firms have the ability to adjust their prices to the optimal level. Consequently, firms that do not reoptimize their prices update them based on the adjusted inflation rate of final goods π_t and the degree of price indexation τ_p. A final goods-producing firm that is unable to adjust its prices over the next s periods solves the following profit maximization problem:

$$Max \ E_t \sum_{s=0}^{\infty}(\beta\xi_P)^s \left[\frac{P_{i,t+s}^{*y}}{P_{t+s}} - mc_{t+s}\right].(\frac{P_{i,t+s}^{*y}}{P_{t+s}})^{-\lambda_P} y_{t+s} \quad (40)$$

The solution yields the following nonlinear inflation equation:

$$(1+\pi_t)^{1-\lambda_P} = \xi_P[(\pi_{t-1})^{\tau_P}]^{1-\lambda_P} + (1-\xi_P)(\frac{\lambda_P}{(\lambda_P-1)} mc_t(1+\pi_t))^{1-\lambda_P} \quad (41)$$

Equation (41) represents a nonlinear relationship that links the current adjusted inflation rate of final goods to the previous period's adjusted inflation rate and marginal production costs.

3.3 Foreign Trade Sector

3.3.1 Exports

The non-oil export aggregator employs a profit-maximization optimization process to determine its demand from each exporting firm. The objective function is defined as follows:

$$Max_{y_{i,t}^{ex}} \quad P_t^{ex}[\int_0^1 y_{i,t}^{ex\frac{\lambda_x-1}{\lambda_x}} di]^{\frac{\lambda_x}{\lambda_x-1}} - \int_0^1 P_{i,t}^{ex}.y_{i,t}^{ex}\, di \quad (42)$$

Here, λ_x represents the elasticity of substitution in the supply of non-oil export goods by firms to foreign markets, and the ratio $\frac{\lambda_x}{\lambda_x-1}$ is the long-run equilibrium price markup.

Following Calvo's (1983) price-setting framework, only a fraction (1-ξ_x) of exporting firms can set prices optimally each period.The remaining firms update their prices based on the adjusted inflation rate of non-oil exports π_t^{ex} and the degree of price indexation for non-oil exports τ_x. The non-oil exporting firm, which will be unable to adjust its price for the next s periods, solves the following profit maximization problem:

$$Max \qquad E_0 \sum_{s=0}^{\infty}(\beta\xi_x)^s(\frac{P_{i,t+s}^{*ex}}{P_{t+s}^{ex}} - mc_{t+s}^{ex})[\frac{P_{i,t+s}^{*ex}}{P_{t+s}^{ex}}]^{-\lambda_x} y_{t+s}^{ex} \quad (43)$$

The solution yields the following nonlinear inflation equation:

$$(1+\pi_t^{ex})^{1-\lambda_x} = \xi_x[(\pi_{t-1}^{ex})^{\tau_x}]^{1-\lambda_x} + (1-\xi_x)(\frac{\lambda_x}{(\lambda_x-1)} mc_t^{ex}(1+\pi_t^{ex}))^{1-\lambda_x} \quad (44)$$

Equation (44) represents a nonlinear relationship that links the current adjusted inflation rate of non-oil export goods to the previous period's adjusted inflation rate and marginal production costs.

3.3.2 Imports

The import aggregator determines the optimal demand from each importing firm by solving the following profit maximization problem:

$$Max_{C_t^m(i)} \quad P_t^{cm}[\int_0^1 c_{i,t}^{m\frac{\lambda_{cm}-1}{\lambda_{cm}}} di]^{\frac{\lambda_{cm}}{\lambda_{cm}-1}} - \int_0^1 P_{i,t}^{cm}.c_{i,t}^m \, di \tag{45}$$

Here, λ_{cm} represents the elasticity of substitution between imported goods from different firms, while $\frac{\lambda_{cm}-1}{\lambda_{cm}}$ denotes the markup price under long-run economic equilibrium conditions.

Similarly, in the consumer goods import sector, a fraction (1-ξ_cm) of firms are Calvo-type price optimizers. The remaining firms update their prices based on the adjusted inflation rate of imported consumer goods π_t^{cm} and the degree of price indexation for consumer imports τ_{cm}. The consumer goods import firm, which will be unable to adjust its price for the next s periods, solves the following profit maximization problem:

$$Max \qquad E_0 \sum_{s=0}^{\infty}(\beta\xi_{cm})^s(\frac{P_{i,t+s}^{*cm}}{P_{t+s}^{cm}} - mc_{t+s}^{cm})[\frac{P_{i,t+s}^{*cm}}{P_{t+s}^{cm}}]^{-\lambda_{cm}} c_{t+s}^m \tag{46}$$

The solution yields the following nonlinear inflation equation:

$$(1+\pi_t^{cm})^{1-\lambda_{cm}} = \xi_{cm}[(\pi_{t-1}^{cm})^{\tau_{cm}}]^{1-\lambda_{cm}} + (1-\xi_{cm})(\frac{\lambda_{cm}}{(\lambda_{cm}-1)} mc_t^{cm}.(1+\pi_t^{cm}))^{1-\lambda_{cm}} \tag{47}$$

Equation (47) represents a nonlinear relationship that links the current adjusted inflation rate of imported consumer goods to the previous period's adjusted inflation rate and marginal production costs.

The second category of importing firms consists of capital goods importers. The capital goods aggregator determines the optimal demand from each importing firm by solving the following profit maximization problem:

$$Max_{I_t^m(i)} \quad P_t^{Im}[\int_0^1 I_{i,t}^{m\frac{\lambda_{Im}-1}{\lambda_{Im}}} di]^{\frac{\lambda_{Im}}{\lambda_{Im}-1}} - \int_0^1 P_{i,t}^{Im}.I_{i,t}^m \, di \tag{48}$$

Here, λ_{Im} represents the elasticity of substitution between imported capital goods, while $\frac{\lambda_{Im}-1}{\lambda_{Im}}$ denotes the markup price under long-run economic equilibrium conditions.

Price setting in the capital goods import sector is also subject to Calvo contracts, with a fraction (1-ξ_Im) of firms adjusting prices optimally. The remaining firms update their prices based on the adjusted inflation rate of imported capital goods π_t^{Im} and the degree of price indexation for capital goods imports τ_{Im}. The capital goods importing firm, which will be unable to adjust its price for the next s periods, solves the following profit maximization problem:

$$Max \qquad E_0 \sum_{s=0}^{\infty} (\beta \xi_{Im})^s \left(\frac{P_{i,t+s}^{*Im}}{P_{t+s}^{Im}} - mc_{t+s}^{Im}\right)\left[\frac{P_{i,t+s}^{*Im}}{P_{t+s}^{Im}}\right]^{-\lambda_{Im}} I_{t+s}^{m} \tag{49}$$

The solution yields the following nonlinear inflation equation:

$$(1+\pi_t^{Im})^{1-\lambda_{Im}} = \xi_{Im}[(\pi_{t-1}^{Im})^{\tau_{Im}}]^{1-\lambda_{Im}} + (1-\xi_{Im})\left(\frac{\lambda_{Im}}{(\lambda_{Im}-1)} mc_t^{Im}.(1+\pi_t^{Im})\right)^{1-\lambda_{Im}} \tag{50}$$

Equation (50) represents a nonlinear relationship that links the current adjusted inflation rate of imported capital goods to the previous period's adjusted inflation rate and marginal production costs.

3.4 Oil Sector

Using Amiri and Khiabani's (2012) equations, this study models the oil sector. With oil prices set exogenously, export revenues in Rials are computed as follows:

$$o_t = re_t.P_t^o.y_t^o \tag{51}$$

Here, P_t^o represents the oil price, y_t^o denotes the oil production, and re_t is the real exchange rate. Additionally, both the oil price and the oil production follow first-order autoregressive (AR(1)) processes:

$$logP_t^{oil} = \rho_{P^{oil}}\, logP_{t-1}^{oil} + \varepsilon_t^{P^{oil}}, \varepsilon_t^{P^{oil}}: N(0, \sigma_{P^o}^2) \tag{52}$$

$$logy_t^{oil} = \rho_{Y^{oil}}\, logy_{t-1}^{oil} + \varepsilon_t^{Y^{oil}}, \varepsilon_t^{Y^{oil}}: N(0, \sigma_{Y^o}^2) \tag{53}$$

Where, $\rho_{P^{oil}}$ denotes the autoregressive coefficient of the oil price process, and $\rho_{Y^{oil}}$ represents the autoregressive coefficient of the oil production process.

3.5 Government

The government's objective is to maximize its capacity to provide public goods. The production process follows the function proposed by Mu et al. (2022):

$$kg_t = (g_t \varepsilon_t^g)^{\Psi_g} (l_t^{kg})^{1-\Psi_g} \tag{54}$$

In this framework, kg_t denotes public goods, g_t is government expenditures, ε_t^g captures government expenditure shocks, Ψ_g reflects the proportion of government spending dedicated to public goods production, and l_t^{kg} indicates the labor input used to produce these goods.

The government's sources of revenue comprise tax income, revenue from bond issuance, foreign currency income from oil exports, rental rate of public goods, and government borrowing. These funds are allocated toward repaying both principal and interest on previously issued bonds, financing public expenditures, and covering wages for labor involved in the production of public goods. Thus, the budget constraint can be represented as follows:

$$t_t + b_t + (gd_t - gd_{t-1}) + r_t^{kg} kg_t + o_t = \left(1 + r_{t-1}^{bg}\right) \frac{b_{t-1}}{\pi_t} + g_t \varepsilon_t^g + w_t l_t^{kg} \tag{55}$$

The rental rate of public goods r_t^{kg} is defined as follows:

$$r_t^{kg} = \frac{g_t + w_t l_t^{kg}}{y_t} \tag{56}$$

The government's optimization problem is formulated as follows:

$$Max\!: E_t \sum_{t=0}^{\infty} \beta^t \left\{ r_t^{kg} kg_t \right\} - \text{Ꭓ}_t \Big[t_t + b_t + (gd_t - gd_{t-1}) + r_t^{kg} kg_t + o_t - \left(1 + r_{t-1}^{bg}\right) \frac{b_{t-1}}{\pi_t} - g_t \varepsilon_t^g - w_t l_t^{kg} \Big] - \text{Ꝃ}_t \left[kg_t - (g_t \varepsilon_t^g)^{\Psi_g} \left(l_t^{kg}\right)^{1-\Psi_g} \right] \tag{57}$$

First-order conditions (FOCs) are derived by differentiating with respect to the control variables and setting the derivatives to zero, yielding the optimality condition:

$$l_t^{kg} = \frac{g_t . \varepsilon_t^g . (1 - \Psi_g)}{\Psi_g . w_t} \tag{58}$$

3.6 Central Bank

As specified in Equation (59), the central bank's real balance sheet consists of three main components: Net foreign assets fr_t, net government liabilities to the central bank gd_t, and banking sector liabilities to the central bank bd_t.

$$m_t = re_t . fr_t + gd_t + bd_t \tag{59}$$

The central bank's foreign assets are a function of: oil exports, non-oil exports, imports of consumer and capital goods, and Ricardian consumers demand for foreign exchange. The change in the real value of the central bank's foreign assets is calculated as follows:

$$fr_t - \frac{fr_{t-1}}{P_t^f} = o_t + \frac{P_t^{ex}}{P_t^f} y_t^{ex} - m_t^s - \frac{(P_t^{cm} c_t^m + P_t^{im} I_t^m)}{s_t P_t^f} \tag{60}$$

The growth of nominal money supply in a given period is calculated as the ratio of the current period's nominal money supply to that of the previous period. Its real form, adjusted for inflation, is expressed as follows:

$$\dot{m}_t = \left(\frac{m_t}{m_{t-1}}\right) . \pi_t \tag{61}$$

The Taylor Rule, as applied by Morita (2024), can be represented by the following equation:

$$i_t = r^* + \pi_t + \alpha(\pi_t - \pi^*) + b(y_t - y^*) \tag{62}$$

This rule specifies how the nominal interest rate i_t is adjusted in response to deviations in actual inflation from its target level π^*, as well as differences between actual output and its potential level y^*. The magnitude of the adjustment is governed by two core parameters: α, which captures the responsiveness of interest rate changes to inflationary pressures, and b, which quantifies the sensitivity to the output gap. Additionally, the formulation includes r^*, the long-term equilibrium real interest rate, serving as the anchor around which nominal rates oscillate in pursuit of macroeconomic stability.

3.7 Market Clearing

Real aggregate output is comprised of the combined value of total investment, household consumption, government spending, and net exports:

$$y_t = c_t + I_t + g_t + ex_t - im_t \tag{63}$$

Total exports, as per Equation (64), consist of the sum of non-oil exports and oil exports:

$$ex_t = y_t^{ex} + o_t \tag{64}$$

Total imports, according to Equation (65), comprise imports of consumer goods and imports of capital goods:

$$im_t = c_t^{im} + I_t^{im} \tag{65}$$

On the other hand, equilibrium must also be maintained in the labor market, whereby the aggregate labor supply from households matches the total labor demand stemming from both the intermediate goods production sector and the government sector:

$$l_t = l_{i,t}^{y} + l_t^{kg} \tag{66}$$

After estimating the model parameters and calculating the model ratios, we compute the steady-state values for all variables. The analysis then numerically solves the resulting system of nonlinear equations using MATLAB and the Dynare toolbox.

4 Empirical Results

4.1 Parameter Estimation and Ratio Calculation

This study applied a Bayesian framework to estimate structural parameters, utilizing annual macroeconomic data spanning 2004 to 2024. The dataset, obtained from the Iranian Statistical Center (2024) and the Central Bank of Iran (2023), encompassed key macroeconomic variables, including total output, private consumption, government expenditures, capital stock, and public goods production. We log-transformed and detrended all time series using a Hodrick-Prescott filter. Table (1) in Appendix (1) presents the findings. Furthermore, we computed essential economic ratios from the time series data. These ratios included consumption-to-output, capital-to-output, government expenditures-to-output, oil production-to-output, and public goods-to-government expenditures. Table (2) in Appendix (2) displays these results.

We evaluated the robustness of our results using Markov Chain Monte Carlo (MCMC) diagnostics. Convergence depends on two key conditions: (1) the between-chain variance must approach zero, ensuring chain homogeneity, and (2) the within-chain variance must stabilize as iterations increase, indicating efficient sampling. Figure 2 displays the diagnostic results via two plotted lines: the blue line shows the Gelman-Rubin statistic (combining within- and between-chain variance), while the red line indicates within-chain variance. Meeting both convergence criteria confirmed the reliability of our parameter estimates.

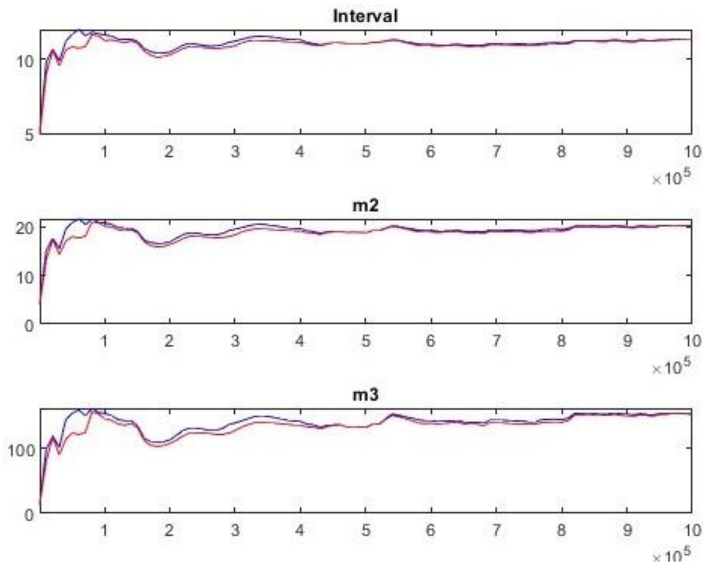

Figure 2. MCMC Diagnostics of the Model
Source: Research findings

4.2 Impulse Response Functions

This section investigates the transmission of external financial shocks to the Iranian economy, focusing on aggregate output, household consumption, and labor supply. The analysis contrasts two scenarios: an economy composed solely of Ricardian households ($\lambda = 0$) and an economy that incorporates both Ricardian and non-Ricardian consumers. Three exogenous shocks are considered: a positive tax shock, an increase in government bond interest rates, and a reduction in public spending.

In the first scenario, where Ricardian equivalence strictly holds, a tax increase compresses disposable income and directly undermines household purchasing power, thereby contracting private consumption (c). Simultaneously, the substitution effect reduces labor supply (l), reinforcing the initial downturn. The decline in consumption lowers firms' revenues, while higher tax liabilities diminish profitability, discourage capital investment (II), and reduce dividend payouts (div). These mutually reinforcing dynamics generate a contractionary feedback loop that culminates in a pronounced decline in aggregate output (y). Firms respond by reducing costs through layoffs and wage cuts, which exacerbate labor market deterioration and intensify the recessionary spiral.

Figure 3 illustrates the impulse response functions of economic variables after a positive tax shock, excluding Non-Ricardian consumers.

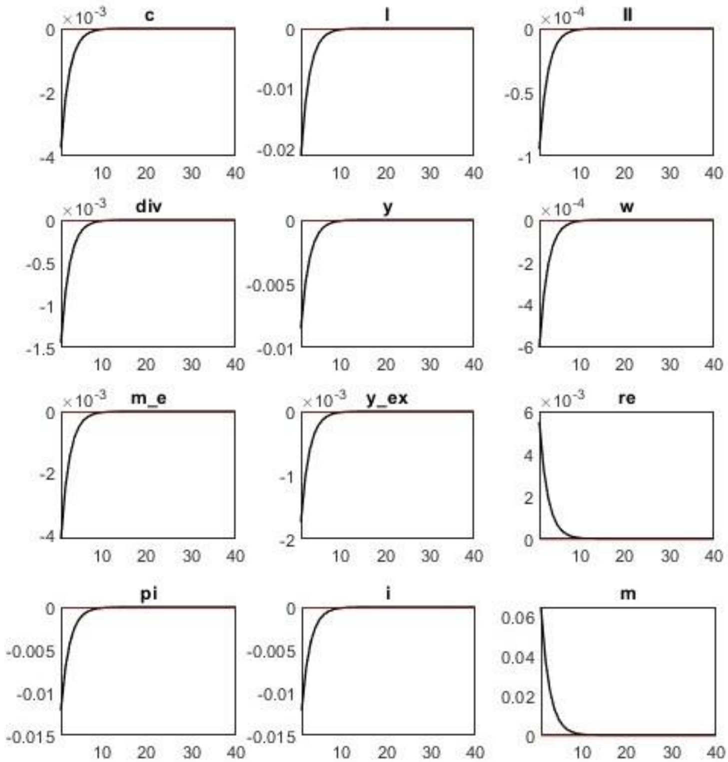

Figure 3. IRFs of Economic Variables Following a Positive Tax Shock excluding Non-Ricardian Consumers
Source: Research findings

Lower household income also constrains demand for foreign exchange (m^e), as individuals reduce purchases of foreign currencies. Simultaneously, non-oil exports (y^{ex}) contract because recessionary pressures limit producers' capacity to sustain export activities; many firms either downscale production or suspend operations altogether. The resulting decline in foreign currency inflows exerts upward pressure on the exchange rate (re), accelerating domestic currency depreciation.

At this level of analysis, it is essential to clearly distinguish between theoretical model assumptions and institutional realities. In practice, the Central Bank of Iran has frequently resorted to monetary financing—expanding the monetary base to absorb fiscal imbalances. While such interventions provide immediate fiscal relief, they systematically generate inflationary pressures that, under conventional policy responses, necessitate higher interest rates. This self-reinforcing dynamic often exacerbates macroeconomic instability rather than containing it.

By contrast, the analytical framework employed in this study assumes a fully independent central bank that strictly follows a Taylor-rule policy, explicitly excluding the possibility of direct monetary financing. Within this structure, inflation (pi) declines mechanically as aggregate demand contracts, rather than being reignited by fiscal-monetary interactions. Monetary policy, therefore, acts countercyclically—lowering interest rates (i) and expanding liquidity—to cushion recessionary shocks.

In the second scenario, where Ricardian and non-Ricardian households coexist, the contractionary effects of a positive tax shock are amplified. Non-Ricardian households—lacking access to credit markets—experience a sharp fall in current income and are forced to curtail consumption sharply, unlike Ricardian households that can smooth consumption through savings or borrowing.

Figure 4 presents the impulse response functions of economic variables to a positive tax shock, accounting for Non-Ricardian consumers.

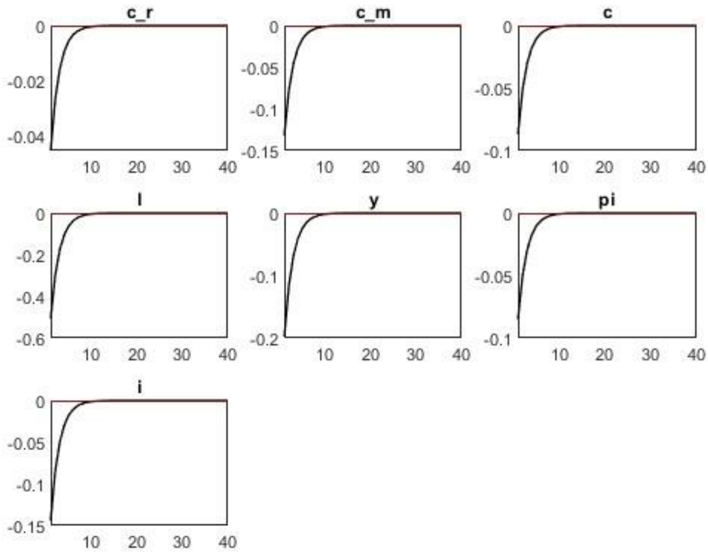

Figure 4. IRFs of Economic Variables Following a Positive Tax Shock considering Non-Ricardian Consumers
Source: Research findings

Labor supply contracts more significantly among non-Ricardian households, particularly semi-skilled and unskilled workers who are disproportionately concentrated in this segment. The combined reduction in consumption and labor supply intensifies the decline in aggregate output and reinforces disinflationary dynamics. The central bank, in turn, adopts a more accommodative monetary stance by further reducing policy interest rates to counterbalance the shock.

Finally, convergence path analysis indicates that, following the exogenous disturbances, the trajectories of key macroeconomic variables gradually revert toward their steady-state values. This convergence underscores the presence of a resilient adjustment mechanism.

The study next examines the impact of negative government spending shocks on key Iranian macroeconomic variables. In the first scenario, where all households are Ricardian, reductions in government spending (g) significantly constrain the provision of public goods (kg), including infrastructure and healthcare, thereby undermining overall economic productivity. These fiscal cuts often translate into lower public sector wages, which reduce the incentive for private firms to offer competitive salaries. As a result, firms can lower compensation without affecting employment levels, leading to a contraction in aggregate wage income (w) that, in turn, depresses household consumption (c) and labor supply (l).

In the corporate sector, a decline in private consumption and government spending leads to reduced revenues. This, in turn, limits the resources available for firms to undertake new investments, resulting in lower investment levels (II). The simultaneous contraction in government expenditure, consumption, and investment weakens overall output (y). Consequently, the tax base shrinks, leading to a drop in government tax revenues (t).

A decline in personal income reduces households' ability to purchase foreign currency (m^e) and imported goods (im), while non-oil exports (y^{ex}) fall due to weakened productive capacity and recessionary pressures. The net effect is a depreciation of the rial, alongside downward pressure on inflation (pi). Inflation does not rise as might be expected in the Iranian economy because, within the model, the central bank is assumed to be fully independent and follows a Taylor-rule framework, abstracting from direct monetary financing. As a result, monetary policy responds countercyclically by lowering interest rates (i) and expanding liquidity to mitigate the contractionary impact of the shock.

Figure 5 depicts the impulse response functions of economic variables after a negative government spending shock, excluding Non-Ricardian consumers.

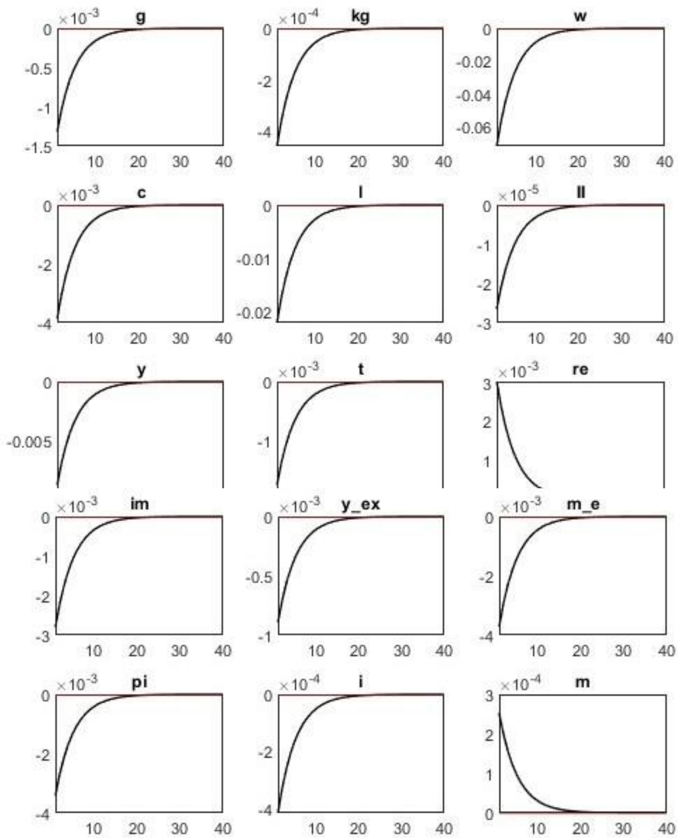

Figure 5. IRFs of Economic Variables Following a Negative Government Spending Shock excluding Non-Ricardian Consumers
Source: Research findings

In the second scenario, including non-Ricardian households amplifies declines in consumption, labor supply, and output. This sharper contraction intensifies disinflationary pressures, prompting more aggressive monetary easing. Convergence path analysis shows that, despite the initial severity, macroeconomic variables gradually stabilize around their long-run equilibrium.

Figure 6 illustrates the IRFs of economic variables following a negative government spending shock, taking Non-Ricardian consumers into account.

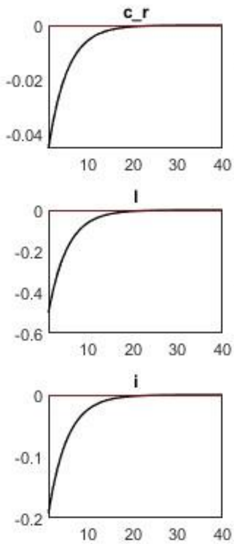

Figure 6. IRFs of Economic Variables Following a Negative Government Spending Shock considering Non-Ricardian Consumers
Source: Research findings

We extend the analysis by exploring the impact of positive government bond interest rate shocks on key macroeconomic variables. In the first scenario, where all households exhibit Ricardian behavior, an increase in government bond yields prompts the central bank to adjust its policy rate (i) to maintain financial stability. This intervention aims to prevent an excessive shift of liquidity from the banking sector toward government securities. The resulting increase in the policy rate suppresses borrowing incentives across households and firms, contracting the money supply (m) through reduced credit creation. Moreover, the combination of higher borrowing costs and a portfolio shift toward government bonds over productive capital leads to a marked decline in private investment (II).

Lower levels of investment produce far-reaching economic repercussions. Declining dividend payouts (div) and wages (w) erode household purchasing power, reducing consumption (c). As wages fall, labor supply (l) contracts accordingly. Simultaneously, elevated interest rates increase borrowing costs for Ricardian consumers, further dampening private expenditure. The concurrent contraction in private consumption and investment leads to a decline in aggregate output (y). This weakening of overall demand eases inflationary pressures, resulting in lower inflation (pi). Additionally, the shrinking tax base diminishes government tax revenues (t), ultimately constraining the state's capacity to finance public spending (g) broadly and to provide public goods (kg) specifically.

Figure 7 depicts the impulse response functions of economic variables to a positive government bond interest rate shock, excluding Non-Ricardian consumers.

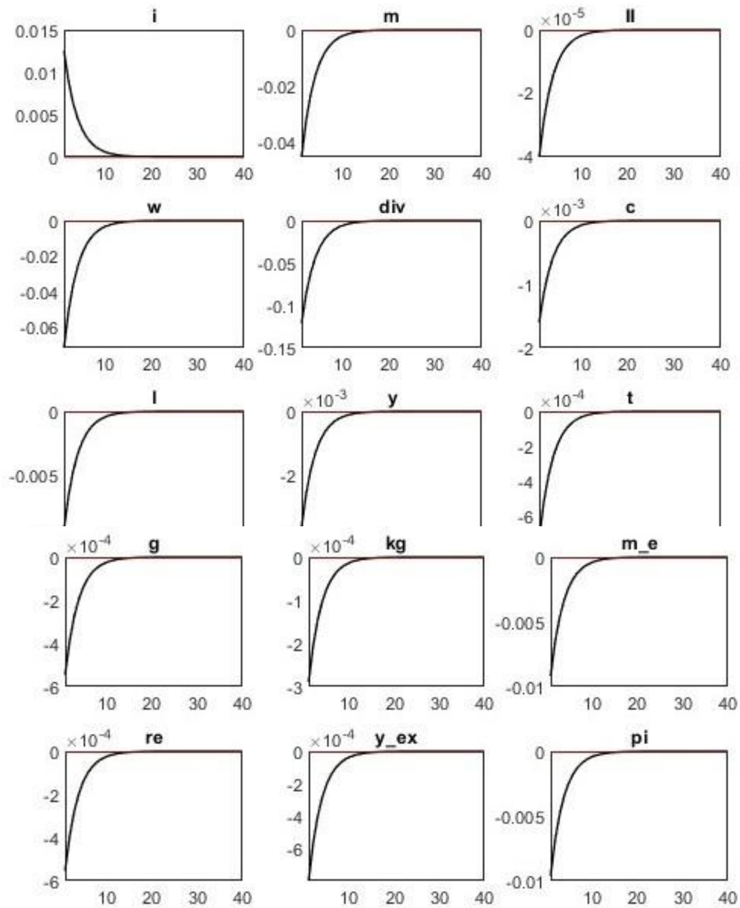

Figure 7. IRFs of Economic Variables in Response to a Positive Government Bond Interest Rate Shock excluding Non-Ricardian Consumers
Source: Research findings

Declining household income also reduces the demand for foreign currency for imports and savings. If this reduction in demand for foreign currency outweighs the contraction in its supply (e.g., from lower exports), it could lead to an appreciation of the national currency. As a consequence, non-oil exports (y^{ex}) suffer from reduced competitiveness in international markets.

During the second scenario, a positive government bond interest rate spike results in a sharper reduction in consumption, labor supply, and aggregate output due to the influence of non-Ricardian households. Inflation also decreases more markedly. Despite the disinflationary trend and emerging recessionary conditions, the central bank opts to keep interest rates elevated to safeguard financial system stability. Finally, convergence path analysis reveals that, following the shock, key macroeconomic variables gradually revert to their long-run equilibrium levels.

Figure 8 presents the impulse response functions of economic variables to a positive government bond interest rate shock, considering Non-Ricardian consumers.

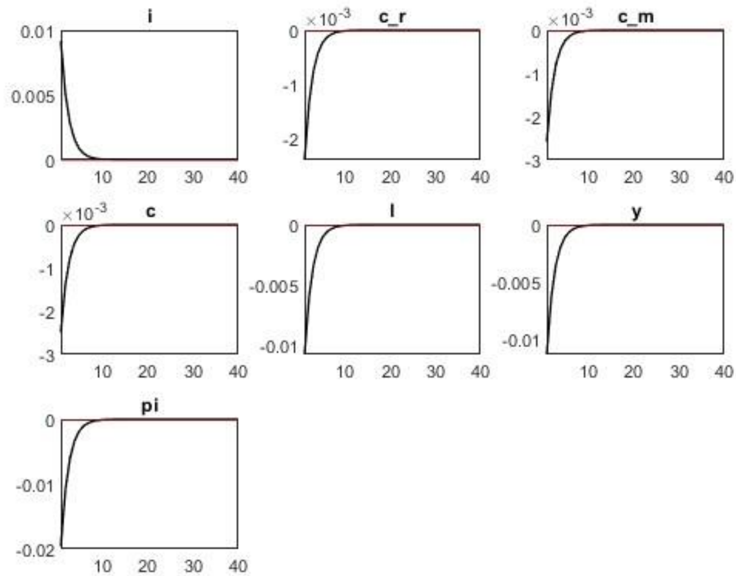

Figure 8. IRFs of Economic Variables in Response to a Positive Government Bond Interest Rate Shock considering Non-Ricardian Consumers
Source: Research findings

In the final part of the results analysis, we present the sensitivity analysis of consumption, labor supply, and aggregate output—with respect to three main parameters: the share of non-Ricardian consumers, the degree of habit persistence in consumption, and the inverse Frisch elasticity, following a positive tax shock.

The results presented in Figure 9 indicate that a higher share of non-Ricardian consumers leads to a larger decline in aggregate consumption, labor supply, and output, thereby forcing the central bank to implement a sharper reduction in the interest rate. In addition, Figure 10 shows that an increase in the inverse Frisch elasticity reduces the responsiveness of labor supply, as individuals become less able to reduce their working hours in response to lower wages; as a result, the declines in both consumption and output become less pronounced, which in turn lowers the need for an aggressive interest rate cut by the central bank. Furthermore, Figure 11 illustrates that stronger habit persistence cushions the decline in consumption. This dampened response also extends to labor supply and aggregate output, implying that the central bank will need to implement less monetary easing.

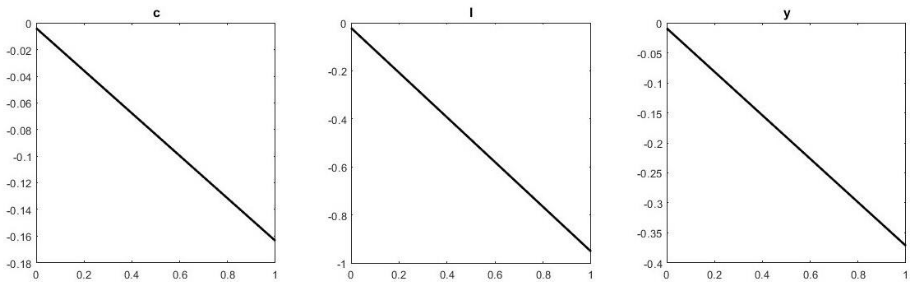

Figure 9. Sensitivity of Macroeconomic Variables to the Share of Non-Ricardian Consumers after a Positive Tax Shock
Source: Research findings

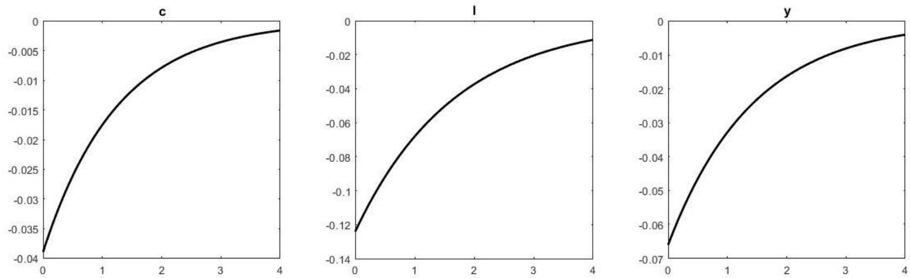

Figure 10. Sensitivity of Macroeconomic Variables to the Inverse Frisch Elasticity after a Positive Tax Shock
Source: Research findings

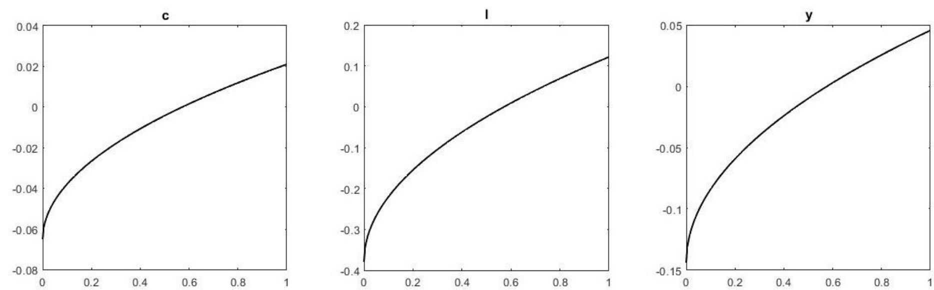

Figure 11. Sensitivity of Macroeconomic Variables to the Habit Persistence in Consumption after a Positive Tax Shock
Source: Research findings.

5 Conclusion and Policy Recommendations

The analysis emphasized the role of non-Ricardian households in amplifying these dynamics. To investigate these relationships, the study applied a New Keynesian DSGE model, using Bayesian estimation techniques on annual data (2004–2023) to enhance parameter accuracy and the reliability of the findings.

A comparative analysis of two scenarios—one excluding non-Ricardian consumers and the other including them—revealed that the presence of non-Ricardian households intensified the adverse effects of fiscal shocks. Their inclusion notably exacerbated declines in consumption, output, and labor supply, while deepening disinflationary pressures. In response, the central bank implemented more aggressive interest rate cuts, particularly following positive tax shocks and reductions in government spending. Conversely, when confronted with rising government bond yields, the central bank prioritized financial system stability by increasing its policy rate. It is important to note, however, that these results are derived under the assumption of a fully independent central bank operating according to a Taylor-rule framework. In reality, the Central Bank of Iran’s policy decisions are often influenced by fiscal needs, external constraints, and political considerations. As a result, the model’s predicted responses—such as moderate inflation and orderly adjustment of macroeconomic variables—may appear overly stable compared to actual economic conditions.

Overall, the findings align with previous studies by Tayefeh Jabbari et al. (2022), Gharraie et al. (2019), Haghighat et al. (2017), Palas (2017), Morita (2015), and Gunter & Straub (2005), while diverging from the conclusions of Rossi (2007).

Furthermore, the study conducted a sensitivity analysis to assess how core macroeconomic variables responded to changes in three key parameters following a positive tax shock: the share of non-Ricardian consumers, the degree of consumption habit persistence, and the inverse Frisch elasticity of labor supply. The results indicated that a higher proportion of non-Ricardian consumers amplified the contractionary impact of the shock, whereas stronger habit persistence and greater inverse Frisch elasticity helped mitigate its severity.

Given the amplifying role of non-Ricardian households in the contractionary effects of fiscal shocks, the study proposed several targeted policy recommendations:

First, in tax policy, the government should broaden the tax base rather than increase tax rates by curbing tax evasion and integrating the informal sector into the formal economy. For public expenditure, the government should prioritize efficient resource allocation over arbitrary budget cuts. In terms of public financing, the government should limit its dependence on high-yield bonds and pursue more sustainable alternatives, such as public-private partnerships for vital infrastructure projects.

Second, the government should implement targeted measures to support non-Ricardian households. These include temporary cash transfers to low-income families to stimulate consumption, tax incentives for long-term savings, and access to secure investment instruments. Strengthening financial support for small and medium-sized enterprises could also reduce these households’ dependency on wage-based income.

Third, the government should offer tax incentives to firms that hire non-Ricardian individuals, namely those with low income or limited skills.

Additionally, adopting a flexible progressive tax system that lowers income taxes for low-income groups while increasing wealth and capital gains taxes during economic expansion would help ensure that labor supply does not decline following fiscal shocks.

Lastly, the central bank must calibrate interest rates carefully to reduce potential adverse macroeconomic consequences and maintain financial system stability.

References

Akarsu, O., Aktug, E., & Kucukbayrak, M. (2025). Hand-to-mouth households in the Eurosystem and the transmission of monetary policy. *Available at SSRN 5401658*.

Bizzotto, M. (2010). *Self-organization, embodied cognition and the bounded rationality concept*. Semantic Scholar. https://www.semanticscholar.org/paper/cc13e132ecb843b5c3ecc7501759a095ed040661

Bhattacharya, R., & Mukherjee, S. (2013). Non-Keynesian effects of fiscal policy in OECD economies: an empirical study. *Applied Economics, 45(29), 4122–4136*.

Calvo, G. A. (1983). Staggered prices in a utility-maximizing framework. *Journal of Monetary Economics, 12(3), 383–398*.

Central Bank of the Islamic Republic of Iran (CBI). (2023). Economic time series database. *Retrieved from* https://tsdview.cis.cbi.ir/single-data

Chikonda, M. C., & Chortareas, G. (2024). Informality, rule-of-thumb consumers, and the effectiveness of monetary policy in emerging economies. *The Quarterly Review of Economics and Finance, 97*, 1–14

Coenen, G., & Straub, R. (2005). Does government spending crowd in private consumption? Theory and empirical evidence for the Euro area (ECB Working Paper No. 513). European Central Bank. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp513.pdf

Danziger, S., Gaag, J., Smolensky, E., & Taussig, M. K. (1982). The life-cycle hypothesis and the consumption behavior of the elderly. *Journal of Post Keynesian Economics, 5(2), 208–227*. https://doi.org/10.1080/01603477.1982.11489357

De Vos, C., Obokoh, L. O., & Abiola, B. (2020). Determinants of savings among non-Ricardian households in South Africa. *International Journal of Social Economics, 47(9), 1169–1186*.

Farzanegan, M. R. (2011). Oil revenue shocks and government spending behavior in Iran. *Energy Economics, 33(6), 1055–1069*.

Fisher, M. R. (1987). *Life cycle hypothesis*. In J. Eatwell, M. Milgate, & P. Newman (Eds.), The New Palgrave Dictionary of Economics (pp. 1-4). Palgrave Macmillan. https://doi.org/10.1057/978-1-349-95121-5_914-1

Furlanetto, F., & Seneca, M. (2012). Rule-of-thumb consumers, productivity, and hours. *The Scandinavian Journal of Economics*, *114*(2), 658-679.

Galí, J., López-Salido, J. D., & Vallés, J. (2007). Understanding the effects of government spending on consumption. *Journal of the European Economic Association*, 5(1), 227-270.

Gruss, B., & Torres, J. M. (2012). Macroeconomic and welfare costs of U.S. fiscal imbalances (IMF Working Paper No. WP/12/38). International Monetary Fund. https://doi.org/10.5089/9781463933814.001.A001

Gharraie, R., Eslamloueyan, K., Hadian, E., & Dehghan, Z. (2019). The role of household participation in financial market in effectiveness of monetary shock on macroeconomic dynamics in Iran. *Quarterly Journal of Applied Theories of Economics*, 6 (3), 1–22. [In Persian]

Haghighat, J., Habibzadeh, A., & Moharam Joudi, N. (2017). Fiscal policy of Iran's economy in a DSGE model (Focusing on non-Ricardian households). *Journal of Economic Research (Tahghighat-e-Eghtesadi),* 52 (3), 551–580. [In Persian]

Khiabani, N., & Amiri, H. (2012). Designing a dynamic stochastic general equilibrium model of open economy to examine the impact of oil price shocks on macroeconomic variables. *Quarterly Journal of Quantitative Economics (JQE),* 9 (3), 25–59. [In Persian]

Mu, J., Yan, L., & Wu, S. (2022). Growing with inequality: A DSGE model with heterogeneous human capital and endogenous economic growth. *Applied Economics*. https://doi.org/10.1080/00036846.2022.2117778

Morita, H. (2015). State-dependent effects of fiscal policy in Japan: Do rule-of-thumb households increase the effects of fiscal policy. *Journal of Macroeconomics*, 43(C), 49-61.

Morita, T. (2024). Multicountry Time Varying Taylor Rule: Modeling Unconventional Monetary Policies and Bond Premiums. Journal of Financial Stability, 68, 102284. https://doi.org/10.1007/s11294-024-09897-y

Mu, J., & Yan, L. (2021). *A DSGE model with endogenous economic growth and fiscal expenditure* (Working Paper). Capital University of Economics and Business.

Mousavi, M. H., Khojasteh, E., & Dehghani, F. (2023). The effect of habit formation on consumers behavior in Iran. *Economic Modeling*, (61), 47–68. [In Persian]

Nakhli, S. R., Rafat, M., Bakhshi Dastjerdi, R. and Rafei, M. (2020). A DSGE Analysis of the Effects of Economic Sanctions: Evidence from the Central Bank of Iran. *Iranian Journal of Economic Studies, 9(1), 35-70.*

Nasiri, S., Davoodi, P., Samsami, H., & Tavakolian, H. (2023). Optimal monetary policy and estimating the credibility of monetary policy in Iran using the DSGE approach. *Economics Research, 23 (88), 5–53*. [In Persian]

Palas, M. (2017). The role of heterogeneous households in the DSGE model: Application to the Czech Republic [Master's thesis, Charles University]. Charles University Digital Repository. https://dspace.cuni.cz/handle/20.500.11956/2193

Rasouli, S., & Timmermans, H. (2015). Models of bounded rationality under certainty. In D. A. Hensher (Ed.), Handbook of choice modelling (pp. 157–181). Edward Elgar Publishing.

Rossi, R. (2007). *Rule of thumb consumers, public debt and income tax* (Working Paper No. 2007_44). University of Glasgow, Business School - Economics.
Roshan, R., Pahlevani, M., & Shahiki Tash, M. (2014). Investigating the rule-of-thumb in consumption by GMM approach in Iran. *Economic Modeling*, 25 (1), 53–65. [In Persian].
Rotemberg, J. J. (1982). Monopolistic price adjustment and aggregate output. The Review of Economic Studies, 49(4), 517-531.
Salam, N., Sameti, M., Rafat, M. and Shaheed, A. (2025). Fiscal Shocks, Economic Growth, and Income Inequality in Iran: A DSGE Model Analysis with Emphasis on Human Capital. *Iranian Journal of Economic Studies, 14(1), 7-33*.
Shakeri, A. (2020). *Macroeconomics: Theories and policies* (Vol. 2). Rafe Publishing. [In Persian].
Statistical Center of Iran. (2020). Iran statistical yearbook 1399. Tehran: Statistical Center of Iran. Retrieved from https://amar.org.ir/Portals/0/PropertyAgent/6200/Files/36993/salnameh-1399.pdf
Statistical Center of Iran (SCI). (2024). Economic accounts database. Retrieved from https://amar.org.ir/economic-accounts

Tayefeh Jabbari, R., Mohammadi, T., & Bahrami, J. (2022). Applications of fiscal policy with the presence of households with finger consumption using dynamic stochastic general equilibrium model approach. *Quarterly Journal of Applied Theories of Economics*, *9*(1), 27–56. [In Persian]
Tavakolian, H., & JalaliNaeeni, A. (2017). Optimal and discretionary monetary and exchange policies in Iran: A DSGE approach. *Iran Economic Research*, 22 (70), 33–98. [In Persian]
Vasilev, A. (2021). An RBC model with non-Ricardian households: lessons for Bulgaria (1999–2018). Journal of Economics and Development, 23(1), 34–46.

Appendix 1

Table 1

The results of estimating the parameters using Bayesian Analysis

Parameter	**Description**	**Prior PDF**	**Prior Mean**	**Posterior Mean**	**Posterior Standard Deviation**
h	the habit formation coefficient in consumption	Gamma	0.510	0.5096	0.0500
β	the intertemporal discount rate	Gamma	0.960	0.9602	0.0100
γ_l	the inverse Frisch elasticity of labor supply	Gamma	2.930	2.9134	0.3000
γ_m	the elasticity of real domestic money balances	Gamma	1.280	1.2783	0.2000

γ_{me}	the elasticity of real foreign money balances	Gamma	1.330	1.3401	0.2000
δ	the capital depreciation rate	Gamma	0.011	0.0109	0.0050
Ω	is the capital share in production	Beta	0.412	0.4194	0.1000
Ψ_g	the proportion of government spending dedicated to public goods production	Beta	0.530	0.3357	0.1000
te_t^r	Ricardian consumer tax rate	Beta	0.200	0.1933	0.0300
te_t^m	Non-Ricardian consumer tax rate	Beta	0.080	0.0794	0.0300
ϐ	Percentage of non-Ricardian consumers	Beta	0.520	0.5227	0.0500
λ_c	The elasticity of substitution in demand between imported and domestically produced goods	Gamma	2.460	2.4481	0.3000
ϵ_c	the share of domestic goods in the consumption basket	Beta	0.900	0.8995	0.0200
λ_I	The elasticity of substitution between domestic investment and foreign investment	Gamma	1.540	1.5318	0.2000
ϵ_I	the share of domestic investment in total household investment	Beta	0.840	0.8396	0.8396
λ_y	The elasticity of substitution between output for the domestic market and output for export	Gamma	2.770	2.7916	0.3000
ϵ_y	the share of domestic output in total output	Beta	0.900	0.8999	0.0200
λ_x	The elasticity of substitution between non-oil export goods	Gamma	1.690	1.6899	0.2000
ξ_x	the fraction of exporting firms that don't have the ability to adjust their prices to the optimal level	Beta	0.500	0.5156	0.1000
τ_x	the degree of price indexation for non-oil exports	Beta	0.250	0.2409	0.1000
λ_{cm}	the elasticity of substitution between imported consumption goods from different firms	Gamma	2.380	2.3903	0.3000
ξ_{cm}	the fraction of consumer goods import firms that don't have the ability to adjust their prices to the optimal level	Beta	0.500	0.5098	0.1000
τ_{cm}	the degree of price indexation for consumer imports	Beta	0.300	0.2934	0.1000
λ_{Im}	the elasticity of substitution between imported capital goods	Gamma	1.730	1.7468	0.2000
ξ_{Im}	the fraction of investment goods import firms that don't have the ability to adjust their prices to the optimal level	Beta	0.500	0.4978	0.1000
τ_{Im}	the degree of price indexation for capital goods imports	Beta	0.150	0.1453	0.1000
λ_P	the elasticity of substitution across intermediate goods	Gamma	1.690	1.6793	0.2000

ξ_P	the fraction of final goods firms that don't have the ability to adjust their prices to the optimal level	Beta	0.500	0.5082	0.1000
τ_p	the degree of price indexation in final goods firms	Beta	0.200	0.1971	0.0500
a	the responsiveness of interest rate changes to inflationary pressures	Norm	0.694	0.6954	0.0500
b	the responsiveness of interest rate changes to the output gap	Norm	0.404	0.4039	0.0500
ρ_{bg}	AR (1) coefficient of interest rate process	Beta	0.700	0.7137	0.1000
ρ_g	AR (1) coefficient of government spending process	Beta	0.790	0.809	0.1000
ρ_t	AR (1) coefficient of tax process	Beta	0.590	0.5893	0.1000

Source: Research finding

Appendix 2

Table 2
The Essential Economic Ratios

Ratio	Description	Value
$\frac{C}{Y}$	Consumption-to-total-output ratio	0.442369366
$\frac{K^m}{Y}$	Capital-to-total-output ratio	0.275837
$\frac{G}{Y}$	Government-spending-to-total-output ratio	0.158808
$\frac{Y^o}{Y}$	Oil-production-to-total-output ratio	0.430238721
$\frac{PG}{G}$	Public-goods-to-government spending ratio	0.532242

Source: Research finding