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RESEARCH ARTICLE

Investigating the Role of Financial Sanctions in Utility Function and Their Impact on Household Behavior

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This research aims to present a DSGE model that can investigate the effect of utility changes due to the financial sanctions imposed on the dominant economy by defining different utility functions for households. The link between the real economy and financial markets stems from the countries' need for external finance to engage in investment opportunities in each country. Each and every economy often needs foreign funding; however, restrictions can limit the access of the given country to international financial markets. The existence of a crisis in international financial markets such as international sanctions can aggravate the adverse shocks and their destructive effects on an open economy. These restrictions can lead to a sudden stop of financial inflows, which in turn blocks economic activity, accelerating the initial downturn. Further, the resulting deterioration of their ability to finance from an external country produces a negative impact on their investment, which might lead to a decrease in economic activity and exacerbates poor financing conditions and further reduces the economic activities. In fact, starting a small sanction on financial markets naturally produces a large change in any country's economic condition. Given the importance of the role of sanctions in the utility functions for the household and their effects on economic models, this paper seeks to investigate the role of the sanctions in the economic models by designing a dynamic stochastic general equilibrium model and compare the impact of such costs on the behavior of macroeconomic variables and household. Comparison of the results of the impulse-response functions of the variables showed that adding sanctions into the model led to a sharp reduction of the impact of shocks on the study variables. Therefore, the existence of sanctions changes the behavior of variables and prevents a sharp increase in the effects of shocks.

Keywords: dynamic stochastic general equilibrium model, sanctions, international financial markets, initial downturn

JEL classification: E32, E37, E44, E50, E52, E61

In the economic literature, researchers have created and investigated the effect of financial sanctions and their dynamics on the equilibrium path using the changes and modifications made to standard models.

Based on earlier work by Bernanke and Gertler (1989), a model is developed in which financial costs have come to be known as the financial accelerator. In this model, agents face an external finance premium. Besides, Carlstrom and Fuerst (1997) argued that financial frictions might significantly change the magnitude and the persistence of fluctuations in economic activity.

In most cases, it has been possible to review the dynamics of the variable's movement path due to sanctions in a standard open economy model. The factor that can be considered important in these models is that the financial sanctions in the utility functions of the households can exert a significant impact on the results of the households' behaviors. If sanctions occur, the steady state path of the model will be different from the state in which there is no sanction. Therefore, any household's utility function can change the effect of transient shocks on the economic status. For this reason, I used this model to empirically evaluate the importance of financial sanction in the amplification and propagation of the effects of transitory shocks on the economy. Then, the main structural parameters of the model were estimated.

It is almost clear that such variables in the model framework will lead to the exact designation of the characteristics and behavior of these models. Therefore, the main goal of this paper is to evaluate how this variable in the household's utility function affects the equilibrium dynamics and the direction of movement of variables during business cycles. As a result, due to the sanctions' effects on the utility function on economic models, this paper mainly focuses on the business cycle model in the Iranian economy with the presence of financial sanctions in the utility function. Later, the effects of this subject on the behavior of Iranian macroeconomic variables are tested. This stage will be conducted by using the quarterly data from 2010 to 2020, extracted from the Iranian Central Bank and the Statistics Centre of Iran and, if need be, domestic, international, and World Bank financial statistics.

Today, in the economic literature, the financial frictions method is commonly used in the studies conducted on monetary and fiscal policies, but the importance of using the type of utility function and the changes resulting from the financial frictions have not been emphasized in most studies. Therefore, policymakers should pay attention to the role and effects of financial frictions in utility functions in their policies because the financial frictions exert an influence on households' behavior directly.

Given the dominant situations in economies, the financial sanctions can be a decisive factor that slows down the achievement of economic goals extremely by reducing or increasing the effect of policies, which may be due to the reaction effects of the frictions in household's utility functions and their impact on policies. Therefore, an important question arises is whether determining the financial sanctions and the variables that affect it can change the effects of economic policies in obtaining the economic targets or not. Accordingly, in the framework of a dynamic stochastic general equilibrium model, the role and change of the sanctions in the utility function and its effects will be investigated. To estimate the models, we used a DSGE procedure with macro data on output, investment, the nominal interest rate, and inflation; the economic sector, along with their several details, were entered into the model singly to examine their effects by applying scenario of the sanctions in utility functions.

The present paper is organized into several sections. Following the introduction and in the second section, the theoretical foundations and research background are presented. The third section expounds on the model, while in the fourth section, the explanation of the model and model equations will be considered and the experimental findings of the research will be discussed. In the fifth section, the conclusion of the empirical findings will be stated.

Theoretical Background and Review of Related Literature

According to the previous studies, it can be mentioned that dynamic stochastic general equilibrium models have been developed in the form of two schools of thought: Neo-Keynesian business and real cycles. Although these models were first used by the real business cycle (RBC) school of thought, this school has left little room for analyzing the effect of policies on economic changes. This is because in order to realize

macro-dynamics, even assuming full flexibility and full competition in wages and prices in the real business cycle research program, the behavior of nominal prices and wages has no place. Furthermore, changes in employment and production are ascribed only to real factors such as productivity shocks. As a result, to solve this problem and for coordinating with the economic evidence, the economists have adjusted this framework by introducing nominal sticking and assuming the existence of incomplete competition in the markets as well as sticking to the general principles of creating dynamic stochastic general equilibrium models. This is done so that such models have currently become one of the most favorite instruments for economists, researchers, and central banks in modern economic analysis.

As a prevailing economy, the global economy and its effects has a great impact on an open economy at the present time. Economic boom and recession in large countries, the progress of technology, close interactions of financial markets and their restrictions, and free of capital flow will affect the recession and boom of an open economy. However, the strengths and weaknesses, as well as the manner of this effect for the economy of each country, will be different from another country according to the intensity of sanctions, structural specifications, and the degree of economic openness. RBC models for an open economy were developed and expanded in the 1990s when researchers (Kydland & Prescott, 1977; Rotemberg, 1982; Svensson, 1999; Taylor, 1993) examined global interest rate shocks, exchange rate shocks, technology shocks, externally conducted shocks, and so on.

One study investigated the use of political rules as one of the admitted methods in the perusal of fiscal and monetary policies, especially from the 1990s onwards. The main finding of the upper survey showed that noticing the financial phenomena plays an important role in smoothing the effects of business cycles, but the role of these phenomena in smoothing business cycles has received less attention when compared to theoretical topics (Eichenbaum, 1997).

In an open economy model, Mendoza (1991) examined the role of global real interest rate shocks with financial frictions on Canadian cyclical fluctuations and concluded that such shocks have an observable effect on the Canadian business cycles.

Another study found that cutting capital gain taxes will raise operating welfare in the economy; however, in economic models with a heterogeneous factor, the wealthy household gains, but most households experience great welfare losses. In fact, heterogeneity will change the outcome (Domeij & Heathcote, 2004).

Another study investigated the optimal fiscal and monetary policies with imperfect competition in a productive economy at flexible prices without capital. Their findings revealed that in such an economy, the nominal interest rate operates as an indirect tax on monopoly profits. Besides, the labor income tax in this market, like a highly competitive market, has a significantly uniform path, although the inflation rate is very volatile and has a serial uncorrelatedness (Schmitt-Grohe & Uribe, 2004).

Izadi and Marzban (2016) compared the models of a small open economy with complete and incomplete asset markets and their stable states, which depend on the initial conditions of the model and equilibrium dynamics. In their model, four different characteristics were considered for the reliability of the model: (a) Model with interest rate risk (flexible debt), (b) A model with convex portfolio adjustment costs, (c) A model with complete asset markets, and (d) a model without stationarity-inducing features. The main finding was that all the proposed models presented almost the same dynamics in alternating business cycles, and the only significant difference between these models was that the consumption dynamics in the complete asset market model had a smoother level (Izadi & Marzban, 2016).

Marzban et al. (2016) computed the welfare under different fiscal and monetary policies using a dynamic stochastic general equilibrium model in the optimal monetary and fiscal policy framework for the Iranian economy. They stated different scenarios to examine the effects of using tax instruments under financial frictions. Their results indicated that the number of financial policy instruments available to the planner acts as an important factor in the rate of welfare changes in an optimal fiscal and monetary policy model. Thus, it was suggested that the planner determine the policies in an optimal fiscal and monetary policy model, considering the available policy instruments and the effects of economic shocks on the rate of welfare changes.

Izadi (2018) examined an optimal fiscal policy model in the presence of heterogeneity of factors in the framework of a dynamic stochastic general equilibrium model. In this case, a constraint was created, which was

called government preferences. Studies have shown that the role of these preferences and the government's tendency towards the rich or poor people can change the results of optimal policies in the economy. Using a dynamic stochastic general equilibrium model and examining the role of government preferences, the results showed that the role of financing government expenditures through taxes in the policy-making system would be somewhat dependent on government preferences in such models.

Studying the effects of optimal fiscal and monetary policies for the Iranian economy, Marzban et al. (2018) considered the optimal tax constraint using a dynamic stochastic general equilibrium model. The results showed that under different scenarios with assumptions of flexibility or price stickiness in the model with the presence of financial friction, the Friedman rule or zero inflation was identified as the optimal policy. Also, because governments usually try to minimize the distortion caused by taxes imposed on various sectors of the economy, a need for a negative tax that reflects the imposition of subsidies under favorable Ramsey conditions in the model is confirmed. On the other hand, according to the research findings, the inflation levels depended not only on the nominal and actual stickiness of the model but also on the number of tools available to the Ramsey planner (Marzban et al., 2018).

Izadi and Sayareh (2019) presented a calibrated and adjusted dynamic stochastic general equilibrium model for the Iranian economy in which the workforce can move from the domestic economy to abroad. In this model, a small open economy framework is considered to facilitate studying the role of labor separation. The average domestic labor supply is divided into two parts, domestic and foreign labor, due to the heterogeneity of the factors. Due to separable labor force in such models, the results created a special difference and showed that domestic production is reduced due to the positive shock in foreign wages, and this, in turn, caused the labor force to move away from domestic production and tend towards employment in foreign markets, whereas private consumption increased and foreign bonds decreased (Izadi & Sayareh, 2019).

Surveying the change of annual productivity growth, Izadi and Marzban (2019) aimed to explain the optimal monetary and fiscal policies for the Iranian economy based on the Ramsey problem and within the framework of an average-scale model of dynamic stochastic general equilibrium. Their model outputs present that despite price stickiness in a monopolistic competitive market, zero and near-zero inflation appears as the optimal result of the model. Izadi and Marzban (2019) showed that with increased productivity rates such as increased knowledge and labor productivity, the level of production and supply increases; therefore, inflation does not occur even with increased total demand. In fact, any policy that encourages work and activity motivation for people in society will lead to increased production and employment, and this increased annual productivity will reduce inflation.

The computation of the sanction effect for monetary and fiscal authorities is based on a solution trying to maximize the discounted expected utility of the representative household. From an empirical point of view, the use of Bayesian procedures to estimate the structural parameters provides the necessary flexibility to deal with model comparisons and the impulse response analysis from the optimal Anti-sanctions policy.

Model and Research Methodology

In this section, the full model is described, with the characterization of the household, the firms, and added section of sanctions in the model. The model is an extension for a small open economy for the sanction's analysis, similar to a financial friction mechanism proposed by Izadi in 2018. Also, the basic model is an open economy DSGE model similar to that of Izadi and Marzban (2019) with some changes. The key addition to this model is a financial friction mechanism offered by Bernanke and Gertler (1989). As a result, we assume that the economy is characterized by price stickiness, capital adjustment costs, and financial market frictions (sanctions). The economy is populated by a representative household and a monetary authority. The presence of asymmetric information and nominal rigidity gives monetary policy an influence on real activity in the short run.

In this section, the models are presented for a small open economy. In this intertemporal problem, the household maximizes its discounted utility by choosing current period consumption, investment, wages, bond holdings, and physical capital accumulation.

$$max \sum_{t=0}^{\infty} \beta^t [ln\, c_t^i + \psi_1 * log(k_{t+1}^i) + \psi_2 * log(b_{t+1}^i) + \psi_3 k_{t+1}^i + \psi_4 b_{t+1}^i] \quad (1)$$

Control Variables

$$c_t^i, b_{t+1}^i, k_{t+1}^i \quad (2)$$

Budget Constraint

$$c_t^i + b_{t+1}^i + k_{t+1}^i = (1 + r_t^i - \delta)k_t^i + w_t^i + R_t b_t^i \quad (3)$$

Firm Problem: Cobb-Douglas, Perfect Competition

$$y_t^i = A_t^i k_t^{i\alpha} l_t^{i(1-\alpha)} \quad (4)$$

Salary and Interest Rate

$$w_t^i = (1-\alpha) A_t^i k_t^{i\alpha} \quad (5)$$

$$r_t^i = \alpha A_t^i k_t^{i(\alpha-1)} \quad (6)$$

Stochastic Shocks

$$Z_{t+1} = \rho_z Z_t + \epsilon_{t+1}^z \qquad \rho_z \epsilon [0,1)\ ;\ \ \epsilon_t^z \sim N(0, \sigma) \quad (7)$$

Euler Equation

$$\psi_1 / k_{t+1}^i + \psi_3 + \frac{\beta r_{t+1}^i}{c_{t+1}^i} + \frac{1}{c_t^i} = 0 \quad (8)$$

$$\psi_2 / k_{t+1}^i + \psi_4 + \frac{\beta r_{t+1}^i}{c_{t+1}^i} + \frac{1}{c_t^i} = 0 \quad (9)$$

In this problem, β is the intertemporal discount factor for the utility function, E is the operator of expectations, w_t^i is the wage, k_t^i is physical capital accumulation, δ is the depreciation rate, c_t^i is consumption, and b_t^i is governmental bonds. The country increases its debt and issues bonds to cover its expenses. Due to budget constraints, the household is able to allocate wealth and purchase nominal bonds from the government in one term. The bonds are held at the interest rate of r_t^i.

This economy is assumed to have a production sector in which there is a set of firms that operate in a fully competitive environment. Firms demand labor and capital for production. In this sector, a Cobb-Douglas function is considered for the production with technological shock with the new Keynesian Phillips curve.

Here, k_t^i, l_t^i, and a_t are capital, labor, and steady technological momentum of the firm (in the firm segment), respectively. According to Bernanke and Gertler (1989), we assume the marginal external financing cost(f) is equal to a gross premium for external funds *S(FS)*[1] and the gross real opportunity costs equivalent to the risk-free interest rate R_t divide inflation Π_t.

$$E_t f_{t+1} = E_t \left[\frac{S(FS).r_t^i}{\pi_{t+1}} \right] \quad (10)$$

The government follows some basic rules to set monetary and fiscal policy. In terms of monetary policy, a standard Taylor rule includes the deviations of inflation and deviations of output from its steady-state.

$$\left(\frac{r_t^i}{r}\right) = \left(\frac{y_t}{y}\right)^{\alpha_y} \left(\frac{\pi_t}{\pi}\right)^{\alpha_\pi} exp(\epsilon_{R_t}) \quad (11)$$

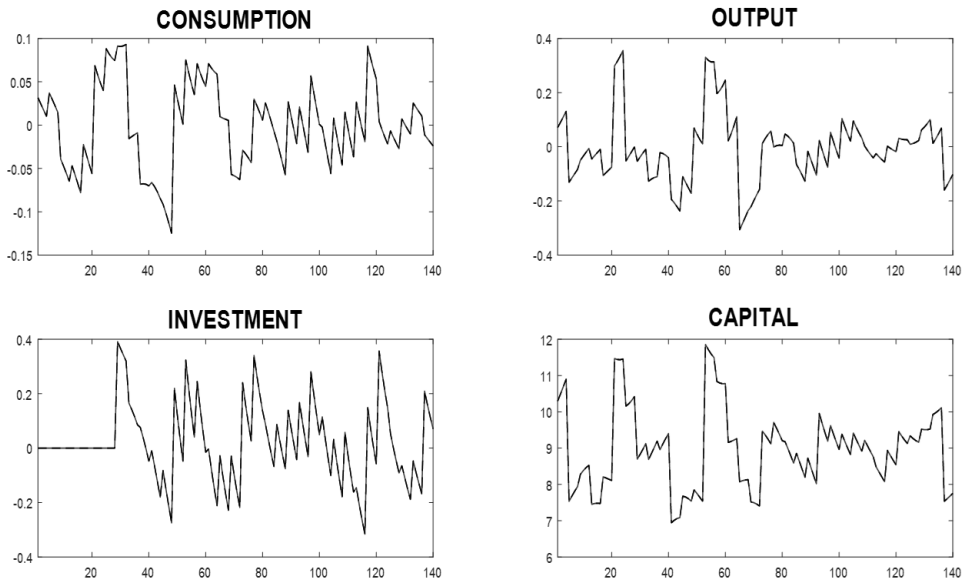
Regarding optimization in the model by selecting k and b, values of the parameters ψ and φ are selected.

Research Results and Discussion

The research model was used to solve the problem, which includes the equations extracted from the optimization as well as the identities in the model. A part of the steady state described by the model is specified by the parameters listed in Table 1, where the parameter values have been replaced by the calibration method in the software. In this study, the capital's depreciation rate is 0.0139, the share of capital in production is 44%, and β is considered as the discount factor of 0.97.

Table 1. *Parameter of Calibration*

Parameter	Description	Value	Source
δ	Depreciation rate	0.0139	Izadi & Marzban (2019)
θ	Capital share	0.44	Marzban et al. (2016)
β	Discount factor	0.9745	Marzban et al. (2018)
ψ	Investment adjustment cost	0.028	Izadi & Marzban (2016)
Φ	Debt elasticity of interest rate risk premium	0.01	Izadi (2018)
ρ_z	The parameter of an autoregressive process of the productivity shock	0.59	Izadi & Sayareh (2019)
$\boldsymbol{\varepsilon_t^z}$	The parameter of the productivity shock	0.0164	Izadi & Marzban (2016)



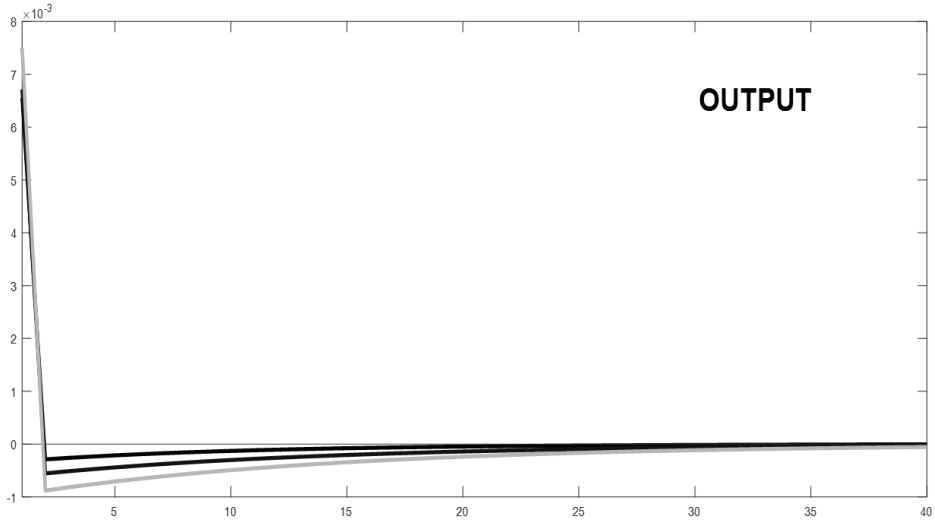
Note. *black line: Actual, red line: Forecast.*
Source: *Research calculations; data are extracted from the Reports of the Central Bank of Iran (1977 to 2019), database: https://www.cbi.ir*

Figure 1. *DSGE Model Forecast and Actual*

The main objective is to estimate a complete set of certain parameters to evaluate the model. The estimation uses Bayesian techniques, as it is now common in the literature. Figure 1 shows the time series path of empirical and simulated data. In terms of model fitting, the model does a good job of matching the business cycle moments of the data. Comparison of real data moments and software-derived moments suggest that the research model has been able to simulate the periodic behavior and fluctuations of variables well.

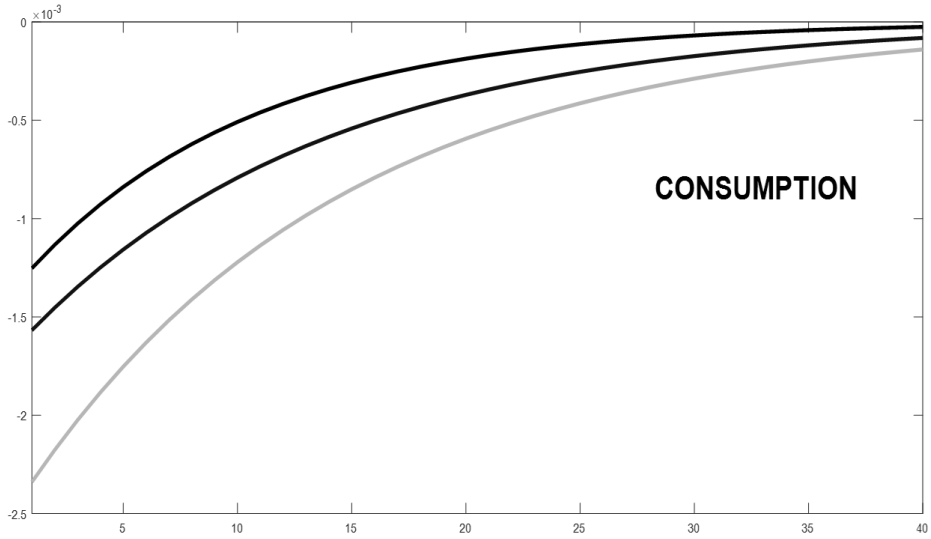
Considering the assumptions of the model, the effects of the productivity shock on the economy with financial sanctions are examined. The total factor productivity (TFP) is investigated as a shock on the economy of a model without sanctions, a model with low intensity of sanctions, a model with high intensity of sanctions, and then compared to the behavior of variables in all models.

Evaluation of Figure 2 shows that due to increased productivity, the output can be expected to rise sharply in the country. It should be noted that the decrease in the output of the country aftershock occurs in three models, but for the model with financial sanctions, output has dramatic fluctuations.



Note. *black line: model without sanctions, blue line: model with low intensity of sanctions, green line: model with high intensity of sanctions.*
Source: *Research calculations; Data are extracted from the Reports of the Central Bank of Iran (1977 to 2019), database: https://www.cbi.ir.*

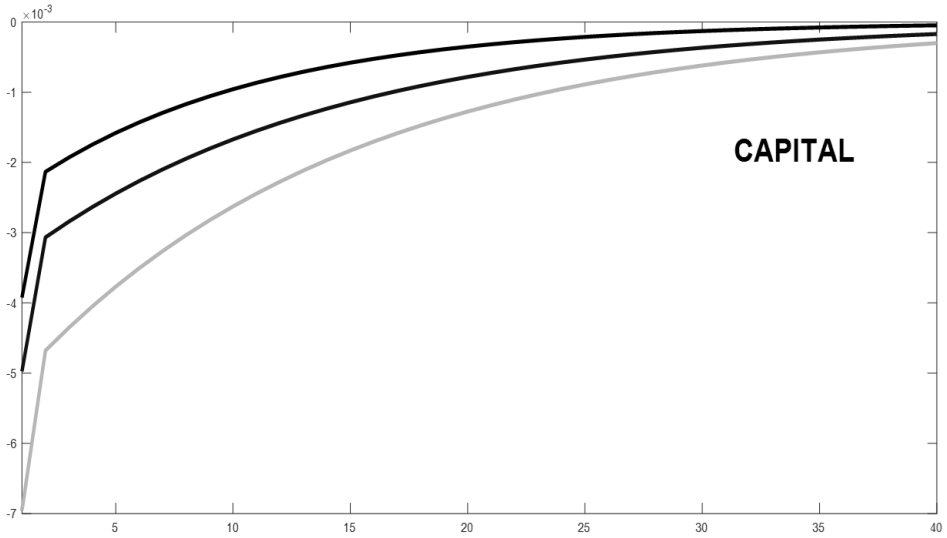
Figure 2. Impulse Response to a Unit Technology Shock on Output Variable



Note. *black line: model without sanctions, blue line: model with low intensity of sanctions, green line: model with high intensity of sanctions.*
Source: *Research calculations; data are extracted from the Reports of the Central Bank of Iran (1977 to 2019), database: https://www.cbi.ir*

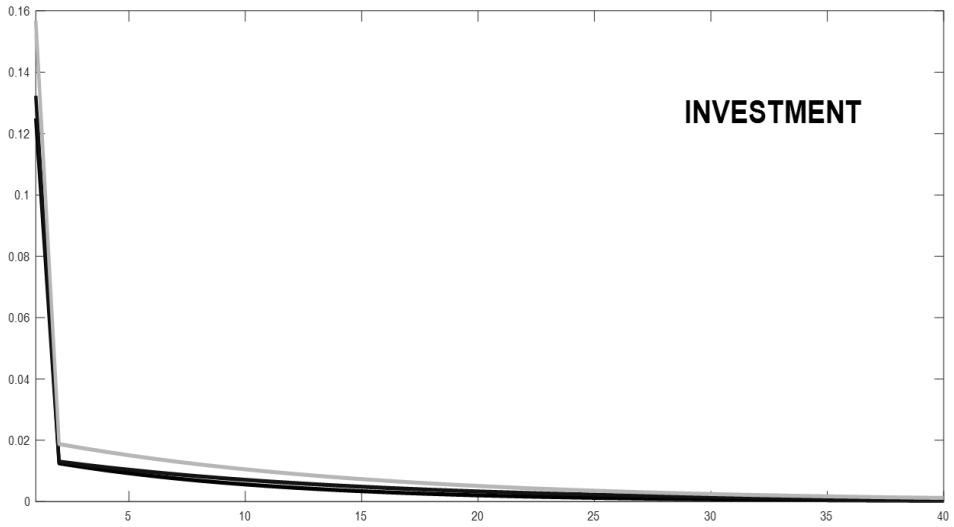
Figure 3. Impulse Response to a Unit Technology Shock on Consumption Variable

Evaluation of Figure 3 related to the response functions shows that due to the increased productivity shock, the amount of consumption in the country decreases. As a matter of fact, as expected, in the period of productivity, the existence of financial sanctions has reduced the consumption, and the degree of intensity of financial sanctions shows the intensity of consumption reduction.



Note. *black line: model without sanctions, blue line: model with low intensity of sanctions, green line: model with high intensity of sanctions.*
Source: *Research calculations; data are extracted from the Reports of the Central Bank of Iran (1977 to 2019), database: https://www.cbi.ir*

Figure 4. Impulse Response to a Unit Technology Shock on Capital Variable

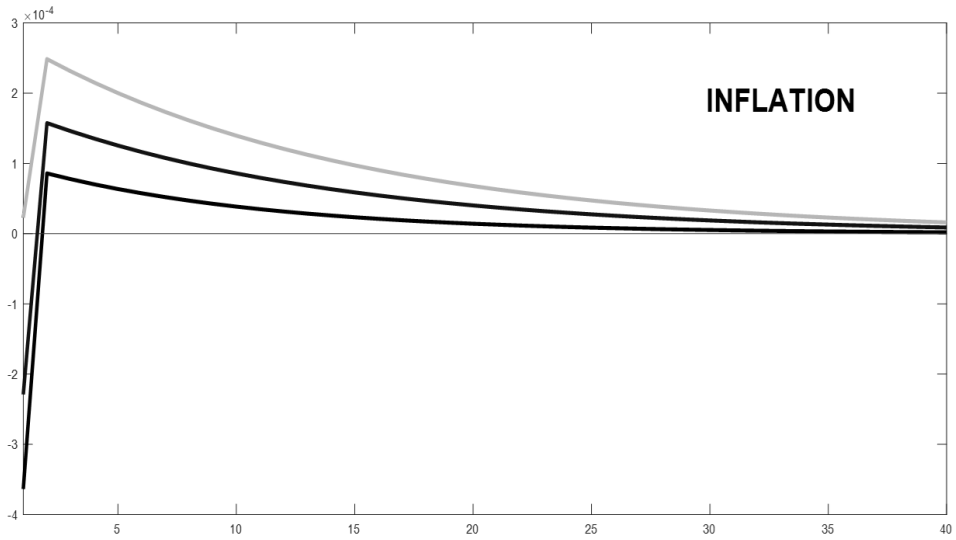


Note. black line: model without sanctions, blue line: model with low intensity of sanctions, green line: model with high intensity of sanctions.
Source: *Research calculations; data are extracted from the Reports of the Central Bank of Iran (1977 to 2019), database: https://www.cbi.ir*

Figure 5. Impulse Response to a Unit Technology Shock on Investment Variable

Evaluation of Figure 4 related to the response functions of the increased productivity shock effect shows that the country has faced a significant decrease in capital accumulation, which can be said to be caused by the sanction of capital and lack of financing foreign capital.

The evaluation of Figure 5 shows that sanctions cause decreases in the country's investment due to



Note. *black line: model without sanctions, blue line: model with low intensity of sanctions, green line: model with high intensity of sanctions.*
Source: *Research calculations, data are extracted from the Reports of the Central Bank of Iran (1977 to 2019), database: https://www.cbi.ir*

Figure 6. Impulse Response to a Unit Technology Shock on Inflation Variable

declined capital. Therefore, the capital productivity is decreased, which brings about a decline in production. As a result, the investment market in the country has lost its attractiveness; therefore, it will be decreased at the same time as the capital outflows.

In the following, considering the assumptions of the model, the evaluation of Figure 6 shows that financial sanctions can increase the cost of production, and the decline in production leads to rising inflation.

In total, considering the assumptions of the model, the results of the effects of sanctions are investigated. The effect of TFP on the economy is examined as a shock. Evaluation of graphs related to instantaneous response functions of the simulated variables of the model in response to the shock shows positive productivity. The shock importing into the technology factor as many as a standard deviation will reduce capital accumulation and consumption. In the case of consumption, it can also be interpreted economically that the decrease in consumption is due to a decrease in net income, and capital accumulation is reduced to some extent. Thus, capital accumulation will decrease investment in the country and the movement of capital flows.

Due to the decreased capital accumulation and investment in the country, an increase in inflation also occurs, which leads to a rise in labor wages and ultimately leads to lower gross domestic income. However, with the transfer of capital from one country to another country, Gross Domestic Production (GDP) decreases. However, inflation will increase.

Conclusions

Given the importance of the role of financial sanctions in which uniformity changes the direction of variables, this work presented three models with differences in the components of each one. The results of the models showed that private consumption decreases, whereas (due to the positive shock in productivity) domestic production leads to reduce the wage of the labor forces. Also, in this economy, because of the decreased capital accumulation and capital transfer, the domestic inflation rate will rise. In addition, following the decreased attractiveness of the financial market because of the reduction of economic power resulting from declined productivity, the portfolio will be transferred from the country, and consequently, the debts will increase.

Finally, the presence of a financial sanctions mechanism in our model significantly amplifies and propagates the impact of demand-side shocks—monetary policy, money demand, preference shocks on investment, and the price of capital. However, the financial sanctions as accelerator mechanism dampens (pushes down) the decrees of investment following positive supply-side shocks—technology and investment-efficiency shocks. The role of the financial accelerator in investment fluctuations, therefore, depends on the nature of the shock and the degree of sanctions intensity.

Note

[1] It is important to assume S(FS) defined the financial sanction cost as a function.

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