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The effect of institutional quality on monetary policy in Iran's economy: A DSGE approach

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ABSTRACT

The aim of this study is to investigate the effect of institutional quality on the cyclicality of monetary policies in Iran. For this reason, a Dynamic Stochastic General Equilibrium (DSGE) model is developed for Iran. In this study International Country Risk Guide (ICRG) used as a representative for institutional quality. Considering that this representative is a combined index obtained from twenty-two sub-indices in three groups. It seems that there is sufficient comprehensiveness to provide the country's institutional status. This proxy is improvised in profit function of foreign investors and tax leakage which lead to reduction in government revenue. The results obtained from solving DSGE model shows that an improvement institutional proxy can change the cyclical behavior of monetary policy's behavior and transforms it from a cycle-independent state to a counter-cyclical state.

I. Introduction

Regardless of the different theoretical perspectives on the impact of monetary policy on the economy, nowadays monetary policy is considered as a means to influence the variables and structure of the economy. The main objectives of implementing this category of economic policies such as other policy instruments control adverse economic fluctuation, and relative stability at price levels and the maintenance of production around the optimal path. However, it is clear that after recognizing any adverse economic fluctuation, monetary tools are one of the available alternatives to policy makers to control economic fluctuation. The accepted advice in economic literature is that countries must use counter-cyclical monetary policies. In other words, monetary authorities are advised to cut inflation rates by increasing interest rates and in times that experience the recession, monetary authorities will reduce interest rates in order to stimulate production to return to their sustainable path. This recommendation is attributed to Wicksell (1907) and despite all developments which occurred in the last century in the field of monetary theory, which advice is left without any conflict. This policy is found in Chicago plan to get out of the great 1933 recession as well as the IS and LM models.

Theoretical and empirical studies have shown that institutions are important for economic performance. Rodrik and Subramanian (2009) argued that financial globalization does not promote growth in many developing countries because they have a constraint on investment because of poor institutional environment. Therefore, an expansionary monetary policy in these economies in terms of achieving the goal of improving production can potentially be a failure. It is also possible that a reduction in the central bank discount rates can easily be converted into a failure in the field of promotion as banks are allowed to operate in non-competitive methods and not necessarily transfer interest rates whole economy.

Investigation of the literature shows that in spite of theoretical explicit advice about applying counter cyclical monetary policies, empirical studies show that some countries are not complying with these recommendations. According to these observations, the following questions arose as follows:

- Despite the evidence for the policy ambiguities with theoretical bases, are the selected policies in developing countries were selected correctly? In other words, does the implementation of these policies provide economic stabilization of these countries?
- Why does it occur in developing countries between the theory and the implemented policies?

The answer to the first question is vital for the economy of all developing countries. Because choosing the wrong policy in face of economic fluctuations can increase the depth of economic fluctuation.

Reviewing the reasons presented in different studies made it clear that the main emphasis to explain this conflict between policy theoretical advice and implementing policy can be attributed to institutions and institutional quality. In other words, the studies show that institutional quality can be regarded as the main reason for implementing the proposed pro cyclical monetary policy in some countries.

Present study is trying to investigate the impact of Institutional quality on cyclicality of monetary policy in Iran. In this study International Country Risk Guide is used as the representative of institutional quality which is combined of twenty two sub-indices classified in political, financial and economic risks and seems to be a good proxy for the whole status of institutional quality because of its comprehensiveness. Iran achieved the average point of 59.07 in this index from 1984 to 2019 which place the country in the category of moderate to high risk countries and represent not very well status of institutional quality. In the other hand, Iran's Central Bank statistics reflecting increasing trend of M2 in Iran in the same period with average annual rate of 23.7% which made this country to an approporiate case for investigating the aim of this study.

2. Literature Review

Institutional approach emphasizes the importance of creating a guiding institutional and political environment for the smooth operation of markets and the realization of the benefits of business and entrepreneurship. The works of Douglas North (1990), Peter Bauer (1957 & 1972) and Friedrich Hayek (1945 & 1960) provided the basis for institutional theory. Recent writings by Barro (1996), Barro and Sala-i-Martin (1995), Scully (1988 & 1992), Lands (1998), Knack (1996 & 2003), DeSoto (1989) and Hall and Jones (1999) also play a significant role. They have played a role in the institutionalist perspective (Gwartney & Lawson, 2004).

For economic outcomes, economic institutions are of fundamental importance. Economic institutions such as structure of property rights and existence and perfectness of markets are important because they affect the structure of economic incentives. Without property rights, individuals have no incentive to invest in physical and human capital or to use more efficient technologies. Economic institutions are also important because they help to allocate resources to their most efficient uses, they determine who benefits, who owns the revenue, or who controls. When markets are destroyed or ignored, the benefits of trade remained virgin and resources are misallocated.

Societies which have economic institutions facilitate the accumulation of resources, innovation and the efficient allocation of resources. Acemoglu & et al. (2005) provide a framework of a dynamic system in which the relationship of various institutions to economic performance is described.

Relatively limited studies have been conducted on the relationship between monetary policy and institutional development. Mihal (2009) presents a theoretical model consisting of financial authorities determining the level of taxes, government expenditures and debt, the monetary authority regulating the level of real inflation and the private sector determining the expected inflation.

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In this model, the government uses taxes and newly issued bonds to finance itself. A parameter of the degree of tax leakage with respect to corruption is presented in the model, which is considered as a measure of institutional quality. This model predicts that increased corruption will lead to higher inflation. This means that the revenue from the multiplier depends on the institutional quality. Another consequence is that for countries with low institutional quality, reducing corruption leads to increased taxes because after reducing corruption, taxes are collected more effectively and, of course, output is reduced. Finally, for countries with moderate to high institutional quality, reducing corruption leads to lower taxes and increased production.

A country's institutional development may change the impact of monetary policy because of its impact on the behavior of macroeconomic actors. These factors are mainly banks and investors, and depending on the constraints imposed by the institutional environment, they respond to the same policy in different ways. Traditional money transfer channels have been described in Boivin, Kiley, and Mishkin (2010). The interest rate channel is the main channel for monetary policy transmission. Interest rates affect the cost of capital and therefore investment costs. The institutional environment may affect this channel because investors' reactions to changes in interest rates depend on the constraints imposed by the institutional environment. Roderick and Subramanian (2009) argue that liberalization of capital accounts and the subsequent reduction in domestic interest rates did not contribute to output growth. Because many economies do not have enough demand for investment. The authors claim that the low investment demand that exists in many countries is the result of low social returns. Poor property rights, poor contract enforcement and fears of expropriation are some of the reasons for private investors' return on investment. As a result, expanding financial resources does not promote increased investment and economic growth.

The bank's lending channel is also subject to institutional quality intervention. Under this mechanism, an expansionary monetary policy increases bank lending, investment costs and returns. The potential impact of the institutional environment on this channel can be found in Mishra et al. (2012). The authors illustrate that imperfect competition in the banking sector can change the effectiveness of this channel. A country's poor institutional quality may be associated with poor quality of regulation, which can lead to poor protection of market competition. As a result of market power, banks tend to limit lending and higher interest rates due to weak institutional environments. The transfer of monetary policy through the bank's lending channel will depend on the institutional environment.

The balance sheet channel arises from the existence of asymmetric information in credit markets. A contractionary monetary policy reduces the net worth of agents, increases unfavorable choices and ethical problems in credit markets. Rising policy rates will be transmitted to the real economy through this channel because lenders will be reluctant to fund, raise interest rates or reduce the supply of loans. As a result, we can say that the balance sheet channel may have different intensities depending on the institutional environment. Porta, Lopez-de-silanes, Shleifer, and Vishney (1998) provide evidence that countries with poor investor protection, due to the nature of legal legislation and the quality of contract enforcement, have smaller capital markets (equity and debt markets) than To countries with stronger investor support. Finally, the authors provide evidence that countries with poor investor protection have smaller capital markets (equity and debt markets) than countries with stronger investor protection due to the nature of the legislation and the quality of contract enforcement

Kaminsky et al. (2004) Claim that their research is the first systematic study in the empirical study of the characteristics of the monetary policy cycle in developing countries. In their research, they have tried to use the data of 104 countries to examine the interactions between monetary and fiscal policies with capital flows and to study the cyclical status of these concepts. In this research, precise quantitative definitions of pro-cyclical and anti-cyclical concepts based on correlation coefficients are presented. The main finding of this study is that monetary policy in emerging economies has exhibited a cyclical behavior. That is, policy rates (short-term interest rates) have fallen in good economic conditions and increased in bad economic conditions.

Calderon et al. (2010) point out that the ability of developing countries to adopt optimal stabilization policies were adjusted due to external borrowing constraints, a fragile financial system and high levels of external debt, and shortcomings in domestic and foreign financial transactions. Also, the lack of financial integration has been adjusted. The authors point out that pro cyclical policies can have political and institutional origins, using data from 115 developing and developed countries (including Iran) for the period 1984 to 2008. They find that institutional quality plays a key role in the ability of countries to implement counter cyclical policies. The results show that macroeconomic policies (both monetary and fiscal) in countries with high levels of institutional quality are counter cyclical and in countries with low levels of institutional quality are pro cyclical.

Duncan (2014) points out that in developing countries, unlike developed countries, monetary policies are counter cyclical and introducing institutional quality as the reason. With this attitude, the author examines the relationship between institutional quality and the cyclical nature of monetary policy and volatility. The results of this analysis indicate that a change in institutional quality can lead to a change in the state of monetary policy against business cycles.

Thornton and Vasilakis (2017) tried to explain why counter-cyclical monetary policies were adopted. In their study, authors examined the relationship between the adoption of an inflation targeting regime and the state of monetary policy cycles in developing and developed countries. The results of this analysis show that the adoption of an inflation targeting regime has a significant effect on the occurrence of counter-cyclical monetary policy. In other words, in this study, different mediating goals have been introduced as the origin of differences in the cyclical behavior of policies in different countries.

Olufemi and Abiodun (2018) examined the state of monetary policy cycles and the relationship of these policies to economic growth and industrial growth in Nigeria. This analysis suggests that monetary policy in Nigeria is counter cyclical. Authors concluded from empirical results that monetary policy in Nigeria has the potential to have a significant impact on the country's economic growth.

Nawaz et al. (2018) examined the impact of institutional quality on the status of monetary and fiscal policy cycles in Bangladesh, India, Pakistan and Sri Lanka using data from 1984 to 2015. In this study, different econometric techniques with panel data have been used. The results of this study show that the monetary and fiscal policies implemented in all countries were counter cyclical due to current level of institutional quality.

Review of the above studies shows that in the literature on the subject it is still couldn't reach to a consensus on issues such as the optimality or non-optimality of counter cyclical (and pro-cyclical) policies and even different effectiveness of cyclical behaviors of monetary policy in different countries. So this situation made the cyclical behavior of monetary policy as a dynamic research field in economic literature.

Investigating the studies conducted in Iran shows that a significant number of studies in Iran have examined various aspects of monetary policy. Among these, many studies can be found that have pointed to the inefficiency and failure and even the negative or adverse effects of monetary policy in Iran.

Mojtahed (2009) reviewing the trend of some macroeconomic variables in Iran. Author concluded that the Central Bank of Iran has failed to achieve its goals. He considers the main reasons for this failure to be coercive and external events (such as war and sanctions), the dominance of fiscal policy over monetary policy and the weakness or lack of appropriate monetary instruments in Iran.

Komijani et al. (2010) state that due to structural issues, increasing the amount of liquidity in the Iran's economy (as an indicator of monetary policy) has not been able to affect investment and production. These researchers believe that fluctuations in oil revenues in Iran have effectively taken control of the monetary base out of the hands of the central bank.

The results of Dadgar and Nazari study (2015) also show that monetary policy, despite creating various fluctuations, has not had a significant effect on national production in the short run and has had a negative effect on economic growth in the long run.

Jalali Naeini and Naderian (2016) acknowledged that the design of monetary policy and the choice of an appropriate exchange rate regime largely depend on the economic structure and political economy of each country. Therefore, it is not possible to prescribe appropriate monetary instruments and policies for Iran based on the assumptions of standard economic models and analyzes. They argue that interest rates in economies experiencing low levels of financial development cannot be considered as a good equipment for stabilization.

Kasaeipour and Erfani (2018) in their study without examining the realized behavior of monetary policy cycles in Iran, using a Stochastic Dynamic General Equilibrium model, have concluded that optimal monetary policy in Iran is counter cyclical.

According to the reviewed studies, in the present study, we will try to investigate the effect of institutional quality on cyclical behavior of monetary policy through a Dynamic Stochastic General Equilibrium model for Iran.

3. Methodology

The use of DSGE models as a potential tool for analyzing the policies has played a role in promulgating and expanding these models from academic settings to the policy-making circles. Before entering the symbolic and exact description of the problem of the business entities and consumers' optimization, a simple diagram will be used for clarifying the interactions between the intra-economy functionaries. The thing underlined in this method of exhibition is that although these models offer a highly molded display of the real economy, the DSGE models offer a regular method for thinking about the vista of economy and its interaction with policies.

The model offered is a small model aiming at the construction of a mechanism for transferring the monetary policy that shares the model's main properties with most of DSGE's specificities. Therefore, the model will be only concentrated on the behavior of three substantial macro-level economic variables, namely inflation, GDP growth and short-term interest rate.

3.1. Households and the total demand block

In the center of the substantial demand side in DSGE models, there is a negative relationship between the real interest rate and the optimum expenditures. In the simple model proposed herein, expenses are the only source of consumption. Therefore, there is a negative relationship manifested between the interest rate and demand in the consumption decisions of the households.

This decision is modeled in such a way that it can stem from the optimal decision of a representative big household (this big household can include the whole population of a country). This household maximizes its expected and discounted lifelong optimality since an arbitrary time (t_0) on:

$$\max_{\{B_{t_0+s}, C_{t_0+s}, [H_{t_0+s}(i)]_{i\in[0,1]}\}_{s=0}^{\infty}} E_{t_0}\sum_{s=0}^{\infty}\beta^s\left\{b_{t_0+s}[\log(C_{t_0+s}-\eta C_{t_0+s-1})-\int_0^1 v(H_{t_0+s}(i)di]\right\}$$

Provided that the budget limitations' tail takes the following form:

$$P_tC_t+\frac{B_t}{R_t}\le B_{t-1}+\int_0^1 w_t\,(i)H_t(i)di$$

To solve the above optimization problem, we make a Lagrangian system in the following form:

$$L=E_{t_0}\sum_{s=0}^{\infty}\left\{\beta^s\left[b_{t_0+s}\left(\log(C_{t_0+s}-\eta C_{t_0+s-1})-\int_0^1 v(H_{t_0+s}(i)di\right)\right.\right.$$
$$-\Lambda_{t_0+s}\left(P_{t_0+s}C_{t_0+s}+B_{t_0+s}R_{t_0+s}^{-1}\right)-B_{t_0+s-1}$$
$$\left.\left.-\int_0^1 w_{t_0+s}\,(i)H_{t_0+s}(i)di\right]\right\}$$

With preliminary conditions in the following form:

$$\frac{\partial L}{\partial B_t}:\Lambda_t=\beta E_t[\Lambda_{t+1}]R_t$$

$$\frac{\partial L}{\partial C_t}:\frac{\Lambda_t}{b_t}P_t=\frac{1}{C_t-\eta C_{t-1}}-\eta E_t\left[\frac{\beta b_{t+1}/b_t}{C_t-\eta C_{t-1}}\right]$$

for $t=t_0, t_{0+1}, \dots, \infty$, and:

$$\frac{\partial L}{\partial H_t(i)}:\frac{v'(H_t(i))}{\Lambda_t/b_t}=W_t(i)$$

Combining the two equations, we will have:

$$\frac{1}{C_t}=E_t\left[\frac{\beta b_{t+1}}{b_t}\frac{1}{C_{t+1}}\frac{R_t}{P_{t+1}/P_t}\right]$$

A linear logarithmic approximation of Euler equation following a little displacement gives the following relation:

$$y_t=E_ty_{t+1}-(i_t-E_t\pi_{t+1})-\delta_t$$

In more precise terms, this equation creates a relationship between a current output and the total expected future path of the real interest rates in such a way that solving of the equation for future (forward) gives the following relation:

$$y_t=-E_t\sum_{s=0}^{\infty}(i_{t+s}-\pi_{t+s+1}-\delta_{t+s}$$

Through this path, the prospective monetary policy expectations directly influence the current economic conditions. As it was explained in the discussion about the role of the policy expectations, this equation actually shows that the prospective interest rates are important for the determination of today's outputs to the extent of the current level of the short-term interest rate.

3.2. Business entities and total supply block

The supply block of a DSGE model deals with the issue as to how the business entities determine their prices as a function of the demand level at hand. The intermediate business entity i hires a number of ($H_t(i)$) units from the workforce of the type i from the completely competitive market so as to produce ($Y_t(i)$) unit of the intermediate goods i with the following technology:

$$Y_t(i)=A_tH_t(i)$$

Where, (A_t) denotes the general efficiency of the production process. It is mostly assumed that (A_t) follows an exogenous stochastic process the random fluctuations of which embrace the unpredicted productivity variations (that are often experienced by the modern economies) in the course of time; business entities determine the prices on the condition of this requirement that they satisfy the demand for their goods. Such a demand is placed by the business entity f and it is in the following form:

$$Y_t(i)=Y_t\left(\frac{P_t(i)}{P_t}\right)^{-\theta_t}$$

Let us call ($\Omega\subset[0,1]$) a subsystem of the business entities that are capable of determining an optimal price at time t; they maximize the discounted flow of the expected future profits through considering the idea that there is this probability (α^s) that they might be obliged to keep on for s periods with the price they have determined in the current period. The objective function for each of these business entities takes the following form:

$$\max_{P_t(i)}E_t\sum_{s=0}^{\infty}\alpha^s\frac{\beta^s\Lambda_{t+s}}{\Lambda_t}\{P_t(i)Y_{t+s}(i)-W_{t+s}(i)H_{t+s}(i)\}$$

For all $i\in\Omega_t$ and conditioned to the production function and also under the condition of this extra limitation that they must satisfy the demand for their products at any point of time, that is to say:

$$Y_{t+s}(i)=Y_{t+s}\left(\frac{P_t(i)}{P_{t+s}}\right)^{-\theta_{t+s}}$$

The first order condition of this optimization problem takes the following form:

$$E_t\sum_{s=0}^{\infty}(\alpha\beta)^s\Lambda_{t+s}Y_{t+s}P_{t+s}^{\theta_{t+s}-1}\left[P_t^*(i)-\mu_{t+s}\frac{W_{t+s}(i)}{A_{t+s}}\right]=0$$

The final cost of a business entity that is still obliged to keep its price equal to $P_t(i)$ at time t+s can be rewritten in the following form:

$$S_{t+s}(i)\equiv\frac{W_{t+s}(i)}{A_{t+s}}=\frac{v'[H_{t+s}(i)]}{\Lambda_{t+s}/b_{t+s}}\frac{1}{A_{t+s}}=\frac{v'\left(\frac{Y_{t+s}}{A_{t+s}}\left(\frac{P_t(i)}{P_{t+s}}\right)^{-\theta_{t+s}}\right)}{A_{t+s}\Lambda_{t+s}/b_{t+s}}$$

An approximation of the New-Keynesian Phillips curve (a relationship between the current inflation, expected future inflation and the real final cost) is resulted in the following form:

$$\pi_t=\xi s_t+\beta E_t\pi_{t+1}+\mu_t$$

Therefore, like before, the previous equation can be repeated forwardly (towards future) and obtain the following expression:

$$\pi_t=E_t\sum_{s=0}^{\infty}\beta^s\,(\xi s_{t+s}+\mu_{t+s})$$

3.3. Monetary policy

It is assumed in the discussed model that the interest rates are determined based on the policy rule:

Foreign Investors:

In this model, the foreign investors have a preferences function in the form shown below:

$$E_0 \sum_{t=0}^{\infty} \beta^t U^*(C_{ft}^*)$$

They also have an optimality function in the following form:

$$U^*(C_{ft}^*) = \frac{(C_{ft}^*)^{1-\chi_f}}{1-\chi_f}$$

The foreign investment can be per se made in the following two forms:

- Direct investment in the production activities (k_f) and
- İnvestment in financial market (D_f^f). Output (R_f) is the weighted average of the investment output in the forms of (k_f) and (D_f^f).

It is worth mentioning that the main variables of this section are based on an intermediate goods produced by a business entity owned by the foreigners with its global price (P_I^*) being fixed and normalized to unity. Therefore, the foreign investment's wealth has been allocated to consumption and investment in the current period:

$$\Omega_{ft} = p_c^* C_{ft}^* + B_{wt} + B_{ft}$$

Where, (p_c^*) is an exogenous relative price defined as $p_c^* \equiv P_f^*/P_I^*$ with the price of the foreign goods being based on the intermediate goods. In order to induce a standing balance, the portfolio's moderation cost is taken into account in the model. Resultantly, the wealth of the foreign investors will take the following form in the next period:

$$\Omega_{ft+1} = R_w B_{wt} + R_{ft+1} B_{ft} - \psi_w(B_{wt}) - \psi_f(B_{ft})$$

Where, (ψ_w) and (ψ_f) are functions that impose a cost for moderating the investment into the investor as explained below:

$$\psi_w(B_{wt}) = \frac{\psi_w}{2}(B_{wt} - \bar{B}_w)^2$$

$$\psi_f(B_{ft}) = \frac{\psi_f}{2}(B_{ft} - \bar{B}_f)^2$$

Where, (ψ_w), (ψ_f), $(\bar{B}_w)$ and $(\bar{B}_f)$ are the fixed and positive parameters.
The first order foreign investment optimization conditions express that:

$$(C_{ft}^*)^{-\chi_f} = \beta E_t (C_{ft+1}^*)^{-\chi_f} [R_w - \psi_w(B_{wt} - \bar{B}_w)]$$

$$(C_{ft}^*)^{-\chi_f} = \beta E_t (C_{ft+1}^*)^{-\chi_f} [R_{ft+1} - \psi_f(B_{ft} - \bar{B}_f)]$$

Considering the certainty of R_w and R_f, the four recent equations determine the optimal choices of $C_{ft}^*, \Omega_{ft}, B_w$ and B_f for foreign investment.

It is assumed in this model that the foreign investors are also active in other economies, as well, and invest an amount of physical capital (K_f) and hire workforce (L_f) services to produce an intermediate goods (Y_f). The business entities owned domestically only need workforce for making productions.

The total size of the portfolio the foreign investor applied in an economy in the form of physical and financial investment is equal to:

$$B_{ft} = K_{ft} + D_{ft}^f$$

It has to be highlighted that it is assumed in the model that the foreign investors make investments in the assets that are based on the intermediate goods and promulgated by the internal households.

When doing business in an open small economy, the foreign investors encounter a thing we call institutional risk which has been defined as the risk including the institutional quality within the format of the costs related to the weak protection of the proprietary rights, weak enforcement of the contracts and inefficient or corrupted judicial system.

The foreign investor is faced with two situations in the presence of this risk:

- A situation wherein the institutional quality is high; under such conditions, there is an exogenous probability $(q \epsilon [0,1])$ that no loss may occur and they can continue their activities normally.
- A situation wherein the institutional quality is low; under such conditions, one part of the output $(1 - \emptyset)$ might be lost with the probability of $(1 - q)$.

In this structure, q represents the level of the institutional quality in the model. Before offering more details for every state, several definitions should be given. Let (δ), (I_f) and (FCF_f) denote the depreciation rate, physical investment and the assets' cash flow in the form of foreign currency, respectively. These two last variables are defined in the following form:

$$I_{ft} = K_{ft} - (1-\delta)K_{ft-1}$$

$$FCF_{ft} = D_{ft}^f - (1+r_d)D_{ft-1}^f$$

In the high institutional quality state, the dividends of the foreign investor would be equal to:

$$\pi_{ft}^H = Y_{ft} - \frac{w_t}{s_t} L_{ft} - I_{ft} - FCF_{ft}$$

Where, W denotes the real wage (which is based on the domestic goods as introduced in the forthcoming sections) and S designates the real foreign currency exchange rate (nominal exchange rate divided by the price of the domestic goods).

If the foreign investor decides to make direct investment inside a country, the production function will be in the following form:

$$Y_{ft} = A_{ft} K_{ft-1}^{\alpha_k} L_{ft}^{\alpha_l}$$

Where, $0 < \alpha_k + \alpha_l < 1$ and L_f are workforce hired from the internal households and (K_f) is the capital directly applied with foreign ownership in the domestic production process and (A_{ft}) is the productivity term that follows a random process as explained below:

$$A_{ft} = (A_{ft-1})^{\rho_{af}} e^{\xi_{ft}}$$

Where, $(\rho_{af} \epsilon (0,1))$ and $\xi_{ft} \sim N(0, \sigma_{ft}^2)$.

In the state that the institutional quality is low, it is assumed that the business entities owned by the foreigners lose one part $(1 - \emptyset)$ of the output (Y_f). In other words, there is a possibility equal to (1-q) for the foreign investors to lose part of their output as a result of low institutional quality. In such a situation, the dividends will be equal to:

$$\pi_{ft}^L = \emptyset Y_{ft} - \frac{w_t}{s_t} L_{ft} - I_{ft} - FCF_{ft}$$

Using the above-presented materials, the expected dividends expressed based on foreign currency can be written in the following form:

$$\pi_{ft} = q\pi_{ft}^H + (1-q)\pi_{ft}^L$$

$$\pi_{ft} = Q A_{ft} K_{ft-1}^{\alpha_k} L_{ft}^{\alpha_l} - \frac{w_t}{s_t} L_{ft} - I_{ft} - FCF_{ft}$$

Where, $Q = q + (1-q)\emptyset$ and we consider it as the institutional quality index. Since the productions made by the foreign investors will be exported, they are faced with a demand with an unlimited elasticity for their goods that are offered with an exogenous price P_I^*. For simplicity, it has been assumed that (P_I^*) and (r_d) are fixed for every period and has been normalized to unity.

Now, considering $\Lambda_{ft} \equiv \beta^t U_C^*(C_{ft}^*)$ as the random discount factor, the foreign investment optimization problem will include the choices of (D_f^f) and (k_f) in an economy for maximizing the current discounted values of the expected dividends, that is to say:

$$E_0 \sum_{t=0}^{\infty} \Lambda_{ft} \pi_{ft}$$

Considering the wealth constraints and the initial values of (D_{f-1}^f) and (k_{f-1}), the optimization of the above expression entails establishment of the two following conditions:

$$E_t \frac{\Lambda_{ft+1}}{\Lambda_{ft}} \left[\alpha_k Q A_{ft} K_{ft-1}^{\alpha_k - 1} L_{ft}^{\alpha_l} - (r_d + \delta)\right] = 0$$

$$\alpha_l Q A_{ft} K_{ft-1}^{\alpha_k} L_{ft}^{\alpha_l - 1} = \frac{w_t}{s_t}$$

3.4. Internal households

In the model used in the present study, the internal households have similar preferences in the following form:

$$E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, L_t)$$

The households' optimality function takes the following form:

$$U(C_t, L_t) = \frac{{C_t}^{1-\chi_h}}{1-\chi_h} - v_0 \frac{L_t^v}{v}$$

Where, (L_t) points to the workforce and (C_t) is a combination of the consumption of the domestic and foreign goods. The combination process is carried out using the following function:

$$C_t = \zeta C_{ht}^{\gamma} C_{ft}^{1-\gamma}$$

Where, $\zeta \equiv \left[\gamma^{\gamma}(1-\gamma)^{1-\gamma}\right]^{-1}$ is a fixed amount and γ denotes the relative preferences for the domestic goods and C_h is a basket of various goods produced internally. This variable has been summed-up using the following function:

$$C_{ht} = \left[\int_0^1 (C_{ht}(j))^{\frac{\vartheta-1}{\vartheta}} dj\right]^{\frac{\vartheta}{\vartheta-1}}$$

Where, $\vartheta > 1$ is the substitution elasticity of various types of goods, assuming that the unit price rule is governing and also presuming that the price of the foreign goods is fixed and normalized to unity ($P_f^* = 1$), the consumption price index (or the minimum cost of a summed consumption unit), P, is defined as shown below:

$$P_t = (P_{ht})^{\gamma}(S_t)^{1-\gamma}$$

With a cumulative function in the following form:

$$P_{ht} = \left[\int_0^1 (P_{ht}(j))^{1-\vartheta} dj\right]^{\frac{1}{1-\vartheta}}$$

Where, (S_t) is the nominal currency exchange rate and (P_{ht}) is the local price of the domestic goods.

Considering the certainty of the prices and interest rate, households have the following budget limitation:

$$P_t C_t + T_t + (1+r_{t-1}) D_{ht-1}^{Nh} + (1+r_d) S_t D_{ht-1}^{f} = W_t L_t + \Pi_{ht} + D_{ht}^{Nh} + S_t D_{ht}^{f}$$

The household chooses the consumption levels, workforce and keeping bonds for maximizing the expected optimality in respect to the budget limitation, the initial values of (D_{h-1}^{f}) and (D_{h-1}^{h}) and the appropriate transversality conditions. Under such circumstances, the optimization necessitates that:

$$v_0 {C_t}^{\chi_h} L_{t-1}^{v} = \frac{W_t}{P_t}$$

$$E_t \frac{\Lambda_{ht+1}}{\Lambda_{ht}} \left[(1+r_t) - (1+r_d)\frac{S_{t+1}}{S_t}\right] = 0$$

The first order conditions express that:

$$C_{ht} = \gamma \frac{P_t C_t}{P_{ht}}$$

$$C_{ft} = (1-\gamma)\frac{P_t C_t}{S_t}$$

3.5. Internally possessed business entities

In this model, the domestic production is carried out by means of a range of the exclusive competitors. The business entity (j), with $(j \epsilon [0,1])$, applies the following linear technology:

$$Y_{ht}(j) = A_{ht} L_{ht}(j)$$

Where, $(Y_h(j))$ denotes the internal output of the type (j) and (A_h) is the productivity expression the behavior of which follows the following random process:

$$A_{ht} = (A_{ht-1})^{\rho_{ah}} e^{\xi_{ht}}$$

Where, $(\rho_{ah} \epsilon (0,1))$ and $\xi_{ft} \sim N(0, \sigma_{ht}^2)$.

The dividends of the internally owned business entities will be in the form below:

$$\pi_{ht}(j) = P_{ht}(j) Y_{ht}(j) - W_t L_{ht}(j)$$

If (mc_t) is considered as referring to the final (real) cost of the business entity, the cost minimization would be indicative of the idea that:

$$\frac{W_t}{P_{ht(j)}} = mc_t(j) \frac{Y_{ht}(j)}{L_{ht}(j)}$$

Again, (Λ_{ht}) is considered as the random discount factor and the business entity is expected to maximize the following function:

$$E_t \sum_{\tau=0}^{\infty} \theta^{\tau} \left[\frac{\Lambda_{ht+\tau}}{\Lambda_{ht}} \left(\tilde{P}_{ht} Y_{h,t+\tau|t} - TC_{T+\tau}(Y_{h,t+\tau|t})\right)\right]$$

Provided that the demand for the domestic goods be in the following form:

$$Y_{h,t+\tau|t} = \left[\frac{\tilde{P}_{ht}}{\tilde{P}_{ht+\tau}}\right]^{-\vartheta} Y_{h,t+\tau}^{d}$$

In this case, the first order condition takes the following form:

$$E_t \sum_{\tau=0}^{\infty} \theta^{\tau} \left[\frac{\Lambda_{ht+\tau}}{\Lambda_{ht}} Y_{h,t+\tau|t} \left(\tilde{P}_{ht} - \bar{\vartheta} MC_{t+\tau|t}\right)\right] = 0$$

Since P_{ht} is the domestic goods' price index, the previous assumption about the determination of the price related to this index takes the following form:

$$P_{ht} = [\theta (P_{ht-1})^{1-\vartheta} + (1-\theta)(\tilde{P}_{ht})^{1-\vartheta}]^{\frac{1}{1-\vartheta}}$$

3.6. Foreign demand for the domestic goods

The foreigners' consumption of the domestic goods features a unit elasticity as explained below:

$$X_{ht} = \frac{S_t X_t}{P_{ht}}$$

Where, (X_t) follows an exogenous random process as explained beneath:

$$X_t = (\bar{X})^{1-\rho_x} (X_{t-1})^{\rho_x} e^{\xi_{xt}}$$

With a stable amount of $\bar{X} > 0, \rho_x \epsilon (0,1)$ and $\xi_{xt} \sim N(0, \sigma_x^2$.

Monetary and Financial Authority:

The monetary financial authority balances its own budget:

$$QT_t = P_{ht} G_{ht}$$

The monetary authority controls the interest rate to minimize the loss function which is directly dependent on the inflation and the output gap. The loss function corrected in this study is in the following form:

$$(1/2) E_t \sum_{\tau=0}^{\infty} \beta^{\tau} \left[\pi_{ht+\tau}^2 + \psi_y \hat{Y}_{t+\tau}^2 + \psi_s (\Delta s_{t+\tau})^2\right]$$

The central bank follows its goal by controlling R for minimizing the loss function.

Market Liquidation Conditions:

The market liquidation conditions can be written in the following form in this model:

$$D_{ft}^{f} = D_{ht}^{f}$$

$$D_{ht}^{h} = 0$$

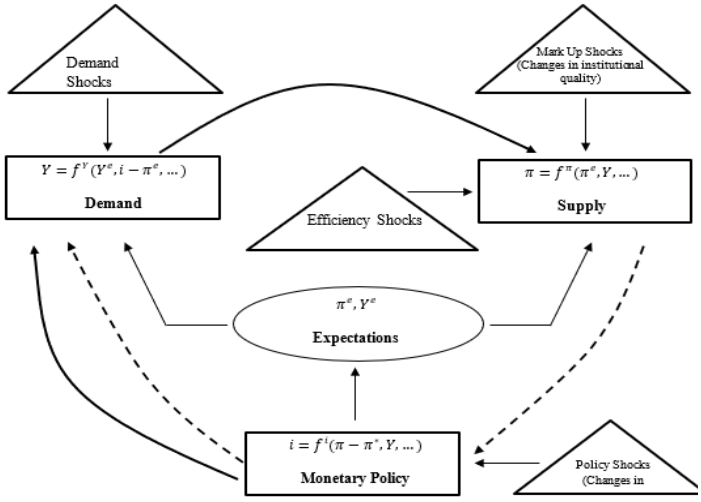
$$Y_{ht} = C_{ht} + G_h + X_{ht}$$

$$L_t = \int_0^1 L_{ht}(j)dj + L_{ft}$$

$$s_t\left(D_{ft} - D_{ft-1}\right) - r_d s_t D_{ft-1}^{f} + \left(W_t L_{ft} + X_{ht} - s_t C_{ft}\right) = 0$$

The last equation points to the balancing of the economy payments based on the domestic goods.

For summarization of the model, a graphic chart which is developed by Sbordone & et al, 2010, with a little changes due to the aim of this study is represented below:



3.7. Important variables

A review of various studies shows that different variables have been used to represent monetary policy. It is clear that the tools of monetary policy in different countries can vary depending on the prevailing economic environment. A review of studies conducted in Iran shows that money supply and interest rates (profit rate) are the most widely used variables to represent monetary policy in the country.

Studies such as Mojtahed (2009), Komijani et al. (2010) and Dadgar and Nazari (2015) have acknowledged that the conversion of oil foreign exchange earnings into Rial (Iranian Currency) and the inability of the Central Bank to neutralize the effect of this fiscal policy, increase the money base and ultimately the growth of liquidity. It is clear that the emergence of this practice challenges the interpretation of money supply as a representative variable of monetary policy. So with considering the aforementioned points and taking into consideration that implementing money supply in DSGE models took monetary policy countercyclical as an assumption, in this study interest rate is used as the proxy of monetary policy. But, it must considered that interest rate in conventional definition is prohibited in Iran's banking system and some forms of Islamic contracts were used instead. For this reason in this study average interest rates (profit rate) on loans granted to different economic sectors is used as monetary policy proxy. International Country Risk Guide (ICRG) index is used as institutional quality proxy improvised in this model.

3.8. Calibration

As it was observed in the DSGE model constructed above, such models usually incorporate a large number of parameters and random processes. The amounts of the used parameters have been summarized in Table (1).

4. Findings and discussion

In line with this, if the coefficient of correlation between the output and the interest rate ($\rho_{r,y}$) is considered as the index of the monetary policy's cyclic behavior, the index's reaction to the changes in the institutional quality (Q) can provide us with the answer to the study question.

Table 1: Amounts of Parameters Used in the Model

Parameter	Explanation	Amount	Method of Value Assignment
χ_h, χ_f	Risk-aversion coefficient	2.5	Tavakkolian and Sarem (2017)
β	Subjective discount factor	0.962	Tavakkolian and Sarem (2017)
$\bar{B}_f$	Cost of (internal) portfolio moderation	7.00	Calibration
$\bar{B}_w$	Cost of (external) portfolio moderation	0.08	Duncan (2014)
$\psi_w, (\psi_f)$	Portfolio moderation cost	0.001	Duncan (2014)
α_k	Capital's share of production	0.35	Devereux et al (2006)
α_l	Workforce's share of production	0.55	Devereux et al
δ	Depreciation rate	0.025	Devereux et al
R_w	Interest rate without global risk	0.01	Duncan (2014)
r_d	Interest rate of the foreign capital	0.11	Study estimations
$1 - \emptyset$	Amount of lost production under unfavorable institutional conditions	0.5	Duncan (2014)
$\rho_{ah}, \rho_{ah}, \rho_x$	Stability of the productivity shock	0.6	Tovar (2005) and Galí and Monacelli (2005)
σ_{af}, σ_{ah}	Turbulence of the productivity shocks	0.005	Duncan (2014)
θ	Degree of price stickiness	0.6	Duncan (2014)
ϑ	Substitution elasticity between the types	6	Galí and Monacelli (2005
v	Work non-optimality curve	2	Duncan (2014)
v_0	Work non-optimality	1	Duncan (2014)
γ	Preferences' inclinations towards domestic goods	0.75	Duncan (2014)
σ_x	Turbulence caused by the foreign demand shocks	0.037	Duncan (2014)
ψ_y	The weight of the output gap in loss function	0.5	Tavakkolian and Sarem (2017)
ψ_s	Currency exchange rate's decline weight in loss function	0.06	Duncan (2014)

As for the institutional quality index, it is necessary to say that since there is no specific subordinate relationship between our experimental representative of the institutional quality (ICRG index) and our theoretical representative of the institutional quality ($Q = q + \emptyset(1-q)$), we have defined the initial value of Q simply in a one-to-one form between Q and ICRG index in percentage. Since the range of the ICRG index's values is above 50% (up to about 0.90%), we have set equal to 0.5 and allowed q change between zero and unity. This results in the generation of Qs with values above 0.5 in unity domain. Next and after preliminary solving of the model, the values of the institutional quality index are increased by 0.1 and the amount of the correlation coefficient for the relationship between the output and the interest rate ($\rho_{r,y}$) is obtained. The investigation of the change process in these two variables in respect to one another leads us to the answer to the study question. The results of this analysis have been reported in Table (2).

The results presented in table (2) are reflecting the idea that the increase in the institutional quality brings about an increase in the coefficient of correlation between the output and interest rate. In more precise terms, the results obtained from several times of solving the Dynamic Stochastic General Equilibrium model show that the increase in the institutional quality makes monetary policies more counter-cyclic. It has to be noted that the higher the coefficient of the correlation between the output and the interest rate, the more the counter-cyclic behavior of the monetary policy will be corroborated.

Table 2: Results of Improving the Institutional Quality on the Cyclic Behavior of the Monetary Policies

Amount of Institutional Quality Index (Q)	0.5	0.6	0.7	0.8	0.9
Coefficient of Correlation between the Output and Interest Rate ($\rho_{r,y}$)	0.002	0.052	0.083	0.132	0.173

5. Conclusion

How does the institutional quality influence the monetary policy's cyclic behavior in Iran's economic environment? To find an answer to this question, use was made of a Dynamic Stochastic General Equilibrium (DSGE) model wherein the studies performed by Duncan (2014) and Kasa'eipour and Erfani (2018) were applied for contriving the institutional quality. The results obtained from solving the DSGE model indicated that the increase in the institutional quality will lead to the improvement of the timing for the implementation of the counter-cyclic monetary policies. In other words, it can be stated in an answer to the study question that the improvement of the institutional quality can change the monetary policy's cyclic behavior in Iran and transform it from a cyclical to a counter-cyclical state corruption.

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