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MACROECONOMIC VARIABLES IN VARIOUS EXCHANGE RATE REGIMES

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Abstract: *Selecting the exchange rate regimes, results and consequences, is one of the most important international finance issues. Type of exchange rate regimes affect on macroeconomic variables in any country. In this study, macroeconomic performance of Iran's economy in the floating exchange rate regime and managed exchange rate regime has been compared by using dynamics to chastic general equilibrium open economy with the Bayesian approach. The Model includes the households, firms, government-monetary authorities, foreign sector and also domestic, imported goods. Output, consumption, investment, and inflation has been simulated then has been evaluated response of these series to technology, oil revenue and the money supply and nominal exchange rates government spending shocks. The results show that in the floating exchange rate regimes variations of output and inflation in is more than fixed exchange rate regimes. The fluctuations of inflation and output response to oil shock and technology shocks are lower and to exchange rate shocks are higher in the fixed exchange rate regimes.*

Keywords: *Fixed regimes, Floating regimes, Macroeconomic performance, Dynamic Stochastic General Equilibrium*

JEL Classification: F41, E12,E52,C63

1. INTRODUCTION

Economic policies of different channels will impact macroeconomic variables through the exchange rate regime. Selecting the exchange regime, results and consequences, is one of the most important international finance issues (Chia & Cheng (2012)). This issue did not matter before the collapse of the Bretton- Woods system in 1973. Member states could freely choose their exchange rate regime after the collapse of the Bretton-Woods in the early seventies of the nineteenth century and the adoption of an amendment to the Agreement of the IMF. Industrial

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countries have adopted the floating currency regime. How Developing countries should be chosen exchange rate regime (fixed exchange regime, the regime of floating exchange regime managed exchange). In fact, the challenge of how to set the value of money, the money received from other countries. The exchange rate regime of the each country depends on internal situation (inflation, financial market development, output and export structures) and global situation of the country (political, economic openness rate). Therefore, an ideal and common exchange rate regime is not acceptable and appropriate for all countries, changing economic and political conditions may change it over time.

Empirically countries whose exchange rate regime peg to a nominal anchor (inflation or nominal exchange rate) need to maintain macroeconomic stability and the necessity of financial institutions and political development becomes pale. On the other hand, if a country is more exposed to real shocks, adopt floating exchange rate regime. In this case the role of the financial, the political and legal institutions become important. (Monzur Hossain (2009)).

The Iranian central bank is government dependent. Policy making instruments is money volume growth rate. The central bank cannot use Taylor Rule (the most well-known emphasis on reaction that caught on in the 1990s). Following of Tavakolian (2012) and Escude (2012) and assumes managed floating exchange rate policy in the present paper, Policy makers try to control money volume growth and nominal foreign exchange rate. To control money volume growth rate, the rule uses three factors of divergence of inflation from target inflation, divergence of output from stable output government, and divergence of foreign exchange policy from stability. Moreover, it uses these same instruments along with combination of foreign exchange rate and international reserves to control nominal growth of foreign exchange rate. In floating exchange rate regimes central bank uses only one monetary policy (control money growth).

Iran’s economy is an open and small economy, which is influenced by the world’s economy. One may say that main portion of changes in the prices and macro variables of the economy are rooted in changes of inflation. Wide range of shocks to the economy is managed by floating foreign exchange rate from technology shocks on the supply side to monetary and fiscal shocks on the demand side.

The rest of the paper is designed as follows. Section one deals with literature review following by sections two and three illustrate theory, formulation, model linearity models and the indices. Experimental results evaluation is represented in the section four and section five focuses on conclusion.

2. LITERATURE REVIEW

There are several experimental studies - based on DSGE model - on analyzing monetary, oil, and trade business shocks' effect on business cycles including Saez and Puch (2002), Irland (2001), Medona and Soto (2005), Leduch and Sill (2004), Gali (2002), Medona and Soto (2005), Smet and Wouters (2003-2005). Recently Ratto et al (2009) and Aldof et al. (2007) have integrated these models in New-Keynesian open economy models.

Few studies have been carried out on Open dynamic stochastic general equilibrium. Other studies on closed economy have been performed through calibration.

Devereux et al. (2004) compared different monetary policy rules in emerging economy of Asia using DSGE model. Their results showed that stability of non-tradable goods' price is the best policy when exchange rate pass-through is high.

Aldolf et al. (2007) designed and estimated a DSGE model for an open economy for Euro area between 1970 and 2002 using Bayesian method. The results indicated that among the shocks, technology shock had the maximum effect on output and minimum effect on domestic inflation. Technology shock and preferences of the consumers influence on supply of labor and the fluctuations of output. It can be seen that transfer of these fluctuations are because of the high substitution elasticity between imported and domestic consumption goods which is strongly preferable by the data. Ratto et al. (2009) evaluated the impact of monetary and fiscal shocks on the macro variables. Previous studies have mainly focused on monetary shocks, while they added fiscal policies shocks to the study to take into account flexibility of financial market that force the consumers to convert their income and use their wage. Ebrahimi and Tavakolian (2011) investigated the fluctuation of business cycles of Iran's economy. Their results confirmed that technology shocks, oil income shocks had highest effects on real variable of economy and money volume growth, and oil income shocks had highest effect on inflation changes. Bahrami and Ghoreish (2011) concluded that to lead the monetary policies, the policy makers choose either inflation rate or foreign exchange rate control tools. The results indicated that inflation control policy induces smaller fluctuations on non-oil output and inflation rate.

3. THEORY AND FORMULATION

The main framework of DSGE model was taken from Adolf et al. (2007) and Kulikov and Gelain (2009) from households and firms and from Esculde (2012) for the government and central bank sector. Analytical framework of dynamic stochastic general equilibrium models was developed based on economic characteristics of oil export economy.

The model is featured with a household that supply labor service required by the domestic good producers. They consume and invest in baskets consisting of domestic and imported goods. The base model was taken from Dixit and Staiglitz (1997) and Calvo (1983) method was used for price stickiness.

3.1. Households

The domestic economy is inhabited by a continuum of households which maximizes utility. The utility function is specified as follows:

$$U_t = E_0 \sum_0^{\infty} \beta^t u(c_t, \frac{M_t}{P_t}, L_t) \tag{1}$$

Where the discount factor satisfies, $0 \leq \beta \leq 1$, E_t expectation condition on information available at time t' C_t is total consumption 'M$_t$ Nominalmoney balances P_t denote consumption price L_t is labor effort:

$$E_t(\sum_{t=0}^{\infty} \beta^t \left[\frac{C_t{}^{1-\sigma}}{1-\sigma} + \frac{\gamma}{1-b_m} m_t{}^{1-b_m} - \varphi \frac{L_t^{1+v}}{1+v}\right] \tag{2}$$

$\sigma \geq 0$, σ is the inverse elasticity of substitution; is the inverse elasticity of labor supply with respect to real wages, $b_m \geq 0$ the inverse elasticity of money demand maximizes utility, subject to a budget constraint:

$$c_t + p_t^i I_t + \frac{B_t}{p_t} + m_t \leq R_t u_t K_{t-1} - \psi(u_t)K_{t-1} + w_t L_t + (1 + r_{t-1})\frac{B_{t-1}}{p_t} + \frac{m_{t-1}}{\pi_t} + \frac{D_t}{p_t} + \frac{TA_t}{p_t} \tag{3}$$

$$\psi(u_t) S. S\acute{\psi}(u_t) > 0 , \psi(1) = 0$$

Physical capital accumulates in accordance to:

$$K_t = (1 - \delta_k)K_{t-1} + \left[1 - S\left(\frac{I_t}{I_{t-1}}\right)\right] I_t \varepsilon_t^i \, S(1) = S'(1) = 0 \ \ , S''(1) < 0 \, \delta_k \in (0,1) \tag{4}$$

w_t, wage earned by the household, R_t is the return on capital, TA_t Taxlump sum payment D_t are dividends from final producers, r_{t-1} interest rate of bonds, K_t Capital stock, δ_kŒ (0و1) is depreciation rate of capital $S\left(\frac{I_t}{I_{t-1}}\right)$ is the investment adjustment cost function.

The stationary investment-specific technology shock common across all households in economy is given by:

$$\log \varepsilon_t^i = \rho_i \log \varepsilon_{t-1}^i + u_t^i u_t^i \sim i.i.d. N(0, \sigma_x^2) \tag{5}$$

Aggregate consumption is given by a CES index of domestic and imported goods according to[1]:

$$C_t = \left[(\alpha_c)^{\frac{1}{\eta_c}}(C_t^d)^{\frac{\eta_c-1}{\eta_c}} + (1-\alpha_c)^{\frac{1}{\eta_c}}(C_t^m)^{\frac{\eta_c-1}{\eta_c}}\right]^{\frac{\eta_c}{\eta_c-1}} \eta_c > 1,\ \alpha_c > 1/2 \tag{6}$$

η_c Is the elasticity of substitution between domestic and imported goods is the share of domestic goods in consumption

The optimal allocated of expenditure between domestic and imported goods are given by:

$$C_t^d = \alpha_c(\frac{P_t^d}{\mathrm{P_t}^{\mathrm{c}}})^{-\eta_c}C_{\mathrm{t}} \qquad C_t^m = (1-\alpha_c)(\frac{P_t^m}{\mathrm{P_t}^{\mathrm{c}}})^{-\eta_c}C_{\mathrm{t}} \tag{7}$$

Where the consumer index P_t^c is given by

$$P_t^c = [\alpha_c(P_t^d)^{1-\eta_c} + (1-\alpha_c)(P_t^m)^{1-\eta_c}]^{\frac{1}{1-\eta_c}} \tag{8}$$

Assume that the basket invested by households is given by

$$I_t = \left[(\alpha_i)^{\frac{1}{\eta_i}}(I_t^d)^{\frac{\eta_i-1}{\eta_i}} + (1-\alpha_i)^{\frac{1}{\eta_i}}(I_t^m)^{\frac{\eta_i-1}{\eta_i}}\right]^{\frac{\eta_i}{\eta_i-1}} \tag{9}$$

Where I_d^t and I_t^m are indexes of investment goods given by CES

Functions,share of domestic investment goods in consumption η_i is the elasticity of substitution between domestic and imported investment goods:

$$I_t^d = (\mathrm{\alpha_i})(\frac{\mathrm{P_t^d}}{\mathrm{P_t}^{\mathrm{i}}})^{-\eta_i}I_t I_t^m = (1-\mathrm{\alpha_i})(\frac{\mathrm{P_t^m}}{\mathrm{P_t}^{\mathrm{i}}})^{-\eta_i}I_t \tag{10}$$

Where the deflator of investment expenditure is given by:

$$P_t^i = \left[\alpha_i {P_t^d}^{1-\eta_i} + (1-\alpha_i\ ){P_t^m}^{1-\eta_i}\right]^{\frac{1}{1-\eta_i}} \tag{11}$$

1 The model combines the use of domestic goods consumption and consumption of imported goods and the investment is mix of investment in domestic goods, investment in imported goods. Household decision making based on the minimization of the cost of their consumption basket demand for domestic goods, demand for foreign goods

3.2. Firms and Price Setting

1. Final good producers

Final good is producer purchases differentiated goods from intermediate firms.

Where the intermediate goods Y_j^t are indexed by j Œ [0,1]

$$\mathrm{Y_t} = \left[\int_0^1 \mathrm{Y_t^j}^{\frac{1}{1+\theta_t^p}} \mathrm{d_j}\right]^{1+\theta_t^p} \quad (12)$$

Where θ_p^t is interpreted as cost push shock in inflation equation and stationary price mark-up shock is following.

$$\mathrm{Log}\,\theta_t^p - \theta^p = \rho_p\left(\log\theta_t^p - \theta^p\right) + u_t^p u_t^p \sim i.i.d.N\left(0, \sigma_p^2\right) \quad (13)$$

The cost minimization condition in the final sector can be written in the form of demand function[2].

Demand function of j^{th} intermediate good as follows:

$$Y_t^j = \left(\frac{P_t^j}{P_t^d}\right)^{-\frac{1+\theta_t^p}{\theta_t^p}} Y_t \forall j \in [0,1] \quad (14)$$

Zero profit condition for producing the final product will besh own:

$$\mathrm{P_t^d} = \left[\int_0^1 (\mathrm{P_t^j})^{-\frac{1}{\theta_t^p}} \mathrm{d_j}\right]^{-\theta_t^p} \quad (15)$$

2. Intermediate Good Producers

Firms operate in monopolistically competitive market. They hire labour L_t^j and capital K_{t-1}^j from households, paying salary W_t, capital return L_t^k.

Produces L_t^j units differentiated output using the following Cobb-Douglas production technology:

$$Y_t^j = \mathrm{a_t}\left(\widetilde{\mathrm{K}}_{t-1}^j\right)^{\alpha} (\mathrm{kg_{t-1}})^{\chi} \mathrm{L_t^j}^{1-\alpha} - \Phi^j \quad (16)$$

2. $\min \int_0^1 \mathrm{P_t^j} Y_t^j \mathrm{d_j}$ st $\left[\int_0^1 Y_t^{j\frac{1}{1+\theta_t^p}} \mathrm{d_j}\right]^{1+\theta_t^p} > Y_t$

Produce by single intermediate firm jŒ [0,1] that α [0, 1] the share of capital in output F^j is the fixed cost 'Kg$_{t-1}$ Capitalof government 'χ the share of capital of government technology shock.

The stationary technology shock common for all firms.

$$\log(a_t) = \rho_a \log(a_{t-1}) + u_t^a u_t^a \approx i.i.d\ N(0, \sigma_a^2) \tag{17}$$

Firms Equations

The intermediate good producers also face an other type of random friction. In every period a random fraction (1-ξ_p) of firm can optimally set their prices (see Calvo, 1983). Those who cannot re-adjust prices in the current period are assumed to mechanically index them to the past inflation.

$$\mathrm{P}_{t+k}^{j} = \left(\pi_t^d\right)^{\tau_p} \mathrm{P}_t^{j} \tag{18}$$

Where $\pi_t^d := \frac{P_t^d}{P_{t-1}^d}$ 'denotes the domestic inflation rate, and τ_p governs a degree of price indexation where $0 < \tau_p < 1$

The intermediate good producers maximize the expected stream of future discounted profits subject to the demand function of final good producers (14)and the Calvo (1983) price staggering.[3] Where λ_{t+k} is the marginal utility of households' nominal income in period t+k which is exogenous to the firms and mc_{t+s} is the firms nominal marginal cost.

$$E_t \sum_{k=0}^{\infty} (\beta \xi_p)^k \frac{\lambda_{t+k}}{\lambda_t} \left[\prod_{s=1}^{k} \left(\pi_{t+s-1}^d\right)^{\tau_p} \frac{P_t^j}{P_t^d} - mc_{t+s} \right] Y_{t+k}^j \tag{19}$$

Mechanism Solution of this maximization problem leads to an equation describing dynamics of the domestic inflation rate. The inflation dynamics is characterized by the hybrid NewKeynesian Phillips Curve[4]

$$\tilde{\pi}_t^d = \frac{\beta}{1+\beta\tau_p} E_t\{\tilde{\pi}_{t+1}^d\} + \frac{\tau_p}{1+\beta\tau_p} \tilde{\pi}_{t-1}^d + \frac{(1-\xi_p)(1-\xi_p\beta)}{\xi_p(1+\beta\tau_p)} \left(\widetilde{mc}_t + \theta_t^p\right) \tag{20}$$

3 Detailed can be found in Walsh(2003),Aldofson et al (2007)

4 Refer to Gelain and Kulikov (2009) for derivations details

3.3. Government and Central Bank

Iran's Central Bank is dependent on government so it can not be modeled in two separate sections. Keeping balanced budget is government goals and will help the government with maintaining price stability and economic growth.

The government budget is given as follows:

$$p_t^{c_g} C_t^g + p_t^{i_g} I_t^g + \left(1 + r_{t-1}\frac{B_{t-1}}{p_t}\right) + TA_t = T_t + \frac{B_t}{p_t} + \left(\frac{M_t - M_{t-1}}{P_t}\right) + \frac{RCB_t}{P_t} \quad (21)$$

$$K_t^g = I_t^g + \left(1 - \delta_g\right) K_{t-1}^g \delta_g \in (0,1) \quad (22)$$

The basket consumed and invested by the government are given by

$$C_t^g = \left[\alpha_{cg}^{\frac{1}{\eta_{cg}}}((C_t^d)^g)^{\frac{\eta_{cg}-1}{\eta_{cg}}} + (1-\alpha_{cg})^{\frac{1}{\eta_{cg}}}((C_t^m)^g)^{\frac{\eta_{cg}-1}{\eta_{cg}}}\right]^{\frac{\eta_{cg}}{\eta_{cg}-1}} \quad (23)$$

$$(C_t^d)^g = \alpha_{cg}\left(\frac{P_t^d}{P_t^{cg}}\right)^{-\eta_{cg}} C_t^g (C_t^m)^g = (1-\alpha_{cg})\left(\frac{P_t^m}{P_t^{cg}}\right)^{-\eta_{cg}} C_t^g \quad (24)$$

By Placement the Demand functions in C^t_g, the deflator of consumption expenditure is given by

$$P_t^{cg} = \left[\alpha_{cg}(P_t^d)^{1-\eta_{cg}} + \left(1-\alpha_{cg}\right)(P_t^m)^{1-\eta_{cg}}\right]^{\frac{1}{1-\eta_{cg}}} \quad (25)$$

The investment goods are

$$I_t^g = \left[\alpha_{ig}^{\frac{1}{\eta_{ig}}}((I_t^d)^g)^{\frac{\eta_{ig}-1}{\eta_{ig}}} + (1-\alpha_{ig})^{\frac{1}{\eta_{ig}}}((I_t^m)^g)^{\frac{\eta_{ig}-1}{\eta_{ig}}}\right]^{\frac{\eta_{ig}}{\eta_{ig}-1}} \quad (26)$$

$$(I_t^d)^g = \left(\alpha_{ig}\right)\left(\frac{P_t^d}{P_t^{ig}}\right)^{-\eta_{ig}} I_t^g (I_t^m)^g = \left(1-\alpha_{ig}\right)\left(\frac{P_t^m}{P_t^{ig}}\right)^{-\eta_{ig}} I_t^g \quad (27)$$

The deflator of investment expenditure is given by

$$P_t^{ig} = \left[\alpha_{ig}(P_t^d)^{1-\eta_{ig}} + \left(1-\alpha_{ig}\right)(P_t^m)^{1-\eta_{ig}}\right]^{\frac{1}{1-\eta_{ig}}} \quad (28)$$

$$\log G_t - \log G = \rho_g (\log G_{t-1} - \log G) + u_t^g u_t^g \approx i.i.d\ N(0, \sigma_g^2 \tag{29}$$

$$G_t = CG_t + IG_t \tag{30}$$

The balance sheet of the central bank's monetary base.

$$M_t = DC_t + S_t FR_t \tag{31}$$

$$M_t\text{-}M_{t-1} = DC_t - DC_{t-1} + S_t\, FR_t - S_{t-1}\, FR_{t-1} - RCB_t \tag{32}$$

DC_t is domestic credit S_t nominal exchange rate, FR_t net foreign reserve

RCB_t Changing the foreign reserves due to exchange rate changes. The international reserves are defined as:

$$S_t FR_t = S_t FR_{t-1} + \omega Xo_t + Xno_t - IM_t \qquad \omega < 1 \tag{33}$$

In this regard, the Government ωŒ(0,1) percent of its oil revenues directly sells to the central bank and (1- ω) kept deposits at the National Development Fund.

$$NOF_t = NOF_{t-1} + (1 - \omega)\, Xo_t \tag{34}$$

The collection of oil and non oil export is total export.

$$X_t = Xo_t + Xno_t \tag{35}$$

3.4. Monetary Policy

In fixed exchange rate regime, central bank can achieve its goals through legal instruments to Intervene exchange market. In general, replacing monetary policies, classified in two general types, are defined based on nominal anchor and operation goals and response in two general types. The government the exchange market assuming that the central bank follows a long-term operational goal for international reserves. The central bank does not enforce a fixed exchange rate but rather to intervene the market by selling and purchasing of the international reserves in the market. Inflation nominal anchor is the goal in this case.

$$\frac{d\dot{c}_t}{dc} = \left(\frac{d\dot{c}_{t-1}}{dc}\right)^{h_0} \left(\frac{\pi_t}{\pi^T}\right)^{h_1} \left(\frac{Y_t}{Y}\right)^{h_2} \left(\frac{e_t}{e}\right)^{h_3} \tag{36}$$

$$d_t = \frac{S_t}{S_{t-1}}$$

$$\frac{d_t}{d} = \left(\frac{d_{t-1}}{d}\right)^{K_0} \left(\frac{\pi_t}{\pi^T}\right)^{K_1} \left(\frac{Y_t}{Y}\right)^{K_2} \left(\frac{e_t}{e}\right)^{K_3} \left(\frac{e_t fr_t / Y_t}{\gamma^{FR}}\right)^{K_4} \tag{37}$$

Under managed float exchange rate regime, the central bank seeks its goals through systematic and legal manipulation of exchange rate as an instrument. The central bank reacts to divergence of inflation rate from target inflation, divergence of GDP from the balance rate, and divergence of real exchange rate from balanced rate. In the managed model central bank uses two instruments. In the floating exchange rate regimes central bank uses only (36) and (37) delete from model.

3.5. Foreign Economy

Foreign output and foreign price are given by:

$$\tilde{\pi}_t^* = \rho_{\pi^*}\tilde{\pi}_{t-1}^* + u_t^{\pi^*} u_t^{\pi^*} \approx i.i.d\ N\left(0, \sigma_{\pi^*}^2\right) \tag{38}$$

$$\tilde{y}_t^* = \rho_{y^*}\tilde{y}_{t-1}^* + u_t^{y^*} u_t^{y^*} \approx i.i.d\ N(0, \sigma_{y^*}^2) \tag{39}$$

All shocks follow a first-order auto regressive process

$$\log \pi_t^* - \log \pi^* = \rho_{\pi^*}(\log \pi_{t-1}^* - \log \pi^*) + u_t^{\pi^*} u_t^{\pi^*} \approx i.i.d\ N(0, \sigma_{\pi^*}^2) \tag{40}$$

$$\log y_t^* - \log y^* = \rho_{y^*}(\log y_{t-1}^* - \log y^*) + u_t^{y^*} u_t^{y^*} \approx i.i.d\ N(0, \sigma_{y^*}^2) \tag{41}$$

3.6. Aggregation

Market Clearing Conditions

$$c_t + p_t^i I_t + \frac{B_t}{p_t} + \frac{M_t - M_{t-1}}{p_t} + p_t^{c_g} C_t^g + p_t^{i_g} I_t^g + \left(1 + i_{t-1}^b \frac{B_{t-1}}{p_t}\right) + \frac{TA_t}{p_t} + T_t = R_t u_t K_{t-1} - \psi(u_t) K_{t-1} + w_t L_t + \left(1 + i_{t-1}^b\right)\frac{B_{t-1}}{p_t} + \frac{D_t}{p_t} + \frac{TA_t}{p_t} + T_t + \frac{B_t}{p_t} + \left(\frac{M_t - M_{t-1}}{P_t}\right) \tag{42}$$

$$c_t + p_t^i I_t + p_t^{c_g} C_t^g + p_t^{i_g} I_t^g = R_t u_t K_{t-1} - \psi(u_t) K_{t-1} + w_t L_t + \frac{D_t}{P_t} \tag{43}$$

$$Y_t = C_t + I_t + G_t + \psi(u_t) K_{t-1} + X_t - IM_t \tag{44}$$

$$Y_t = C_t + I_t + G_t + X_t - IM_t \tag{45}$$

$$IM_t \cong C_t^m + I_t^m + (C_t^m)^g + (I_t^m)^g \tag{46}$$

$$Xno_t = \left(\frac{P_t^x}{P_t^*}\right)^{-\eta_*} Y_t^* \tag{47}$$

$$Y_t = \alpha_c\left(\frac{P_t^c}{P_t^d}\right)^{-\eta_c} C_t + I_t + G_t + \psi(u_t)K_{t-1} + \left(\frac{P_t^x}{P_t^*}\right)^{-\eta_*} Y_t^* + Xo_t \tag{48}$$

4. CALIBRATION AND ESTIMATION

The proposed model is comprised of 56 equations and 56 variables with households, producers of downstream and mid products, government, monetary authorities, market liquidity condition, relative prices, performance shocks, mark up, oil income, money volume. The extracted models from the first order condition then optimization are taken from linear Uhlig method (1990). Thus, the proposed equation models encompass the equations (see in Appendix(1))

Some key parameters such as (β, σ, δ_k, ω, ξ_p) calibrated based on previous studies, and others according to the recommendations Plasser (1989) for maximum compatibility simulated data with real data is evaluated. As for the auto regressive coefficients in the shock processes, we have assumed a high degree of persistence for technology,no persistence for the remaining shocks.

4.1. Calibrated Parameters

We impose dogmatic priors these are presented in the Table (1) likelihood method and calibration. (Hamilton, 1994)

Table 1
Key Parameters

Parameters	*Explanation*	*Value*	*Resource*
β	Discount factor	0.96	Tavakolian (2012)
σ	Unverse elasticity of substitution	1.5	Bhattacharjee & Thoenissen (2005)
δ_k	Depreciation rate of capital	0.041	Ebrahimi (2011)
ω	Percentage of selling oil to central bank	0.7	Tavakolian (2012)
ξ_p	Random friction of producer can't re-adjusting price	0.5	Gelain and Kulikov (2009)

For the empirical analysis of linear equations used Dynare software. The parameters that have been calibrated in this section are based on authors 'calculation for some values we take sample period averages.

$$\frac{\bar{C}}{\bar{y}} = 0.52, \frac{\bar{I}}{\bar{y}} = 0.11, \frac{\overline{\imath mt}}{\bar{y}} = 0.18, \frac{\bar{x}}{\bar{y}} = 0.23, \frac{\bar{C}^g}{\bar{y}} = 0.15, \frac{\bar{I}^g}{\bar{y}} = 0.3, \frac{\bar{C}^g}{\bar{g}} = 0.7, \frac{\bar{I}^g}{\bar{g}} = 0.3,$$

$$\frac{\overline{xo}}{\bar{x}} = 0.83, \frac{\overline{xno}}{\bar{x}} = 0.16 =, \frac{\overline{xo}}{\overline{nof}} = 4, \frac{\overline{xo}}{\overline{fr}} = 1.7, \frac{\overline{xno}}{\overline{fr}} = 0.3, \frac{\overline{\imath mt}}{\overline{fr}} = 1.5, \frac{\overline{\mathrm{efr}}}{\overline{\mathrm{m}}} = 0.59 , \frac{\overline{\mathrm{dc}}}{\overline{\mathrm{m}}} = 0.41$$

First, the distribution of the mean and standard deviation prior to setting the parameters considered. Given the initial values for the mean and standard deviation can be estimated using Bayesian indicators related indicators presented in Appendix (2). After assessment, the next step is using these parameters in the model and simulation model for Iran economy.

4.2. Impulse Response Functions (IRF)

As indicated in Figure (1)in appendix, positive technology shock, the supply function shifts to right; output, consumption and investment, money volume, and credit response positively; and domestic inflation and consumer inflation based on nominal exchange rate response negatively. One may say that during the first five quarters, the real variables follow ascending trend and nominal variables follow descending trend before starting a different trends. Technology leads to increase of investment and production volume and consequently consumption increase due to increase of production, reduced inflation, and expanding monetary policies following by increase of credit. This shock, thereby, has an important effect on economic growth. See that in floating exchange rate regime variation of variables except inflation are higher than managed exchange rate regime.

Figure (2) indicated that in the case of positive oil shock, increase of exchange reserves leads to decrease of nominal exchange rate and by gradual infusion of foreign currency to the market, exchange rate, money volume and credit follow ascending trend. At first, output experiences a growing trend and then follows descending trend due to the inflation and distrust in performance of output section. Moreover, consumption follows ascending trend due to increase of money volume. As can be seen the domestic inflation in floating regime is more than managed regime.

A mount of real variable (y,c,i) in managed are more than floating regime.

Figure (3) pictures impulse response function relative to money growth shock. The shock increase expecting inflation and reduced money balances. As a result of increase of money volume, demand increase and leads to increase the output; although its trend is descending. In this shock results are the same as pervious but in managed output achieve stability sooner than floating regime.

Positive shock of exchange rate, as pictured in figure (4), this policy exists in managed floating regime but does not in a floating regime. Positive shock of exchange rate increases cost of imported products and decrease demand of imported products. It also leads to increase of export and realization of available capacity, which means increase of output, decrease of money volume and credits. However, with decrease of nominal exchange rate, inflation it grows.

5. CONCLUSION

Iran's economy was simulated by using DSGE open economy. We compare response of the macroeconomic variables such as consumption, investment, money volume, output and inflation in particular which were key variables of macro economy in floating and managed exchange rate regimes. These variables were assessed under technology, oil, money growth, shocks. As the results showed, oil shock and money volume growth were the main shocks. Response of output, consumption, and money volume to technology shock was ascending with growing rate. Technology shock decreased inflation while oil shocks increased inflation. Money growth increased nominal variables while oil shock increased inflation through monetary channels. The results show that in floating exchange rate regimes variations of output and inflation in technology shock and oil shock are more than managed regime. The above results are consistent with experimental results, which mean the open New Keynesian by dynamic stochastic general equilibrium model is a good theoretical tool to assess performance of macro economy. Evaluating the prior and posterior parameters indicate the fitness of the model.

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APPENDIX (1)

Linear Equations in the Model

$\tilde{C}_t^d = -\eta_c(\tilde{\gamma}_t^{d}) + \tilde{C}_t$(Domestic consumption)

$\tilde{C}_t^m = -\eta_c(\tilde{\gamma}_t^{m}) + \tilde{C}_t$(Imported consumption)

$\tilde{\pi}_t^c = \alpha_c(\bar{\gamma}^d)^{1-\eta_c}\tilde{\pi}_t^d + (1-\alpha_c)(\bar{\gamma}^m)^{1-\eta_c}\tilde{\pi}_t^m$(Consumption Inflation)

$\tilde{C}_t = \frac{1}{\sigma}E_t(\sigma\tilde{C}_{t+1} + \tilde{\pi}_{t+1}^c) - \frac{1}{\sigma}\tilde{r}_t$(Consumption Euler equation)

$\tilde{I}_t^d = -\eta_i\tilde{\gamma}_t^{I^d} + \tilde{I}_t$(Domestic investment)

$\tilde{I}_t^m = -\eta_i\tilde{\gamma}_t^{I^m} + \tilde{I}_t$(Imported investment)

$\tilde{\pi}_t^i = \alpha_i\left(\bar{\gamma}^{I^d}\right)^{1-\eta_i}\tilde{\pi}_t^d + (1-\alpha_i)\left(\bar{\gamma}^{I^m}\right)^{1-\eta_i}\tilde{\pi}_t^m$(Imported Inflation)

$\tilde{w}_t = v\,\tilde{l}_t + \sigma\tilde{C}_t$ (Supply labor)

$\tilde{l}_t = \tilde{R}_t - \tilde{w}_t + \tilde{\tilde{\tilde{K}}}_{t-1}$ (Demand labor)

$\tilde{y}_t = \chi\widetilde{Kg}_{t-1} + \alpha\tilde{\tilde{\tilde{K}}}_{t-1} + (1-\alpha)\tilde{l}_t + \tilde{a}_t$(Output)

$\tilde{\pi}_t^d = \frac{\beta}{1+\beta\tau_p}E_t\{\tilde{\pi}_{t+1}^d\} + \frac{\tau_p}{1+\beta\tau_p}\tilde{\pi}_{t-1}^d + \frac{(1-\xi_p)(1-\xi_p\beta)}{\xi_p(1+\beta\tau_p)}(\widetilde{mc}_t + \theta_t^P)$ (Domestic Inflation dynamics)

$\tilde{k}_t = \delta_k(\tilde{\imath}_t + \tilde{\varepsilon}_t^i) + (1-\delta_k)\tilde{k}_{t-1}$ (Capital accumulation)

$\widetilde{mc}_t = \alpha\tilde{R}_t + (1-\alpha)\tilde{w}_t - \chi\widetilde{Kg}_{t-1} - \tilde{a}_t$(Marginal Cost)

$\tilde{k}_t^g = \delta_g\tilde{\imath}^g + (1-\delta_g)(\tilde{k}_{t-1}^g)$ (Government effective capital stock)

$$\tilde{\imath}_t = \frac{1}{1+\beta}\tilde{\imath}_{t-1} + \frac{\beta}{1+\beta}E_t\tilde{\imath}_{t+1} - \frac{1}{1+\beta}\tilde{\gamma}_t^{i^d} + \frac{1}{1+\beta}\frac{1}{\varphi}\tilde{q}_t + \varepsilon_t^i$$

$$p_t^m = \frac{P_t^m}{\mathrm{p_t^c}} = \frac{s_t P_t^*}{\mathrm{p_t^c}} = e_t$$

$$\frac{e_t}{e_{t-1}} = \frac{S_t}{S_{t-1}} \cdot \frac{P_t^*}{P_{t-1}^*} \cdot \frac{1}{\frac{P_t^c}{P_{t-1}^c}} = d_t \cdot \frac{\pi_t^*}{\tilde{\pi}_t^c}$$

$\tilde{e}_t = \tilde{d}_t + \tilde{\pi}_t^* - \tilde{\pi}_t^c - \tilde{e}_{t-1}$(Real exchange rate)

$\tilde{q}_t = -\tilde{r}_t + \frac{1-\delta}{1-\delta+R} E_t \tilde{q}_{t+1} + \frac{R}{1-\delta+R} E_t \tilde{R}_{t+1}$(Price of capital dynamics)

$(\tilde{C}_t^d)^g = -\eta_{cg}\left(\tilde{\gamma}_t^{\mathrm{cg^d}}\right) + \tilde{C}_{\mathrm{t}}^{\ \mathrm{g}}$(Domestic consumption)

$(\tilde{\mathrm{C}}_{\mathrm{t}}^{\mathrm{m}})^{\mathrm{g}} = -\eta_{cg}\left(\tilde{\gamma}_t^{\mathrm{cg^m}}\right) + \tilde{C}_{\mathrm{t}}^{\ \mathrm{g}}$(Imported consumption)

$$\tilde{\pi}_t^{cg} = \alpha_{cg}\left(\bar{\gamma}^{\mathrm{cg^d}}\right)^{1-\eta_{cg}} \tilde{\pi}_t^d + \left(1-\alpha_{cg}\right)\left(\bar{\gamma}^{\mathrm{cg^m}}\right)^{1-\eta_{cg}} \tilde{\pi}_t^m$$

$(\tilde{\mathrm{I}}_{\mathrm{t}}^{\mathrm{d}})^g = -\eta_{\mathrm{ig}}\tilde{\gamma}_t^{\mathrm{ig^d}} + \tilde{\mathrm{I}}_{\mathrm{t}}^{\ \mathrm{g}}$(Government Domestic consumption)

$(\tilde{\mathrm{I}}_{\mathrm{t}}^{\mathrm{m}})^{\mathrm{g}} = -\eta_{\mathrm{ig}}\tilde{\gamma}_{\mathrm{t}}^{\mathrm{igm}} + \tilde{\mathrm{I}}_{\mathrm{t}}^{\ \mathrm{g}}$ (Government Imported consumption)

$\tilde{\pi}_t^{ig} = \alpha_{ig}\left(\bar{\gamma}^{\mathrm{ig^d}}\right)^{1-\eta_{ig}} \tilde{\pi}_t^d + \left(1-\alpha_{ig}\right)\left(\bar{\gamma}^{\mathrm{ig^m}}\right)^{1-\eta_{ig}} \tilde{\pi}_t^m$ (Government Consumption Inflation)

$\tilde{g}_t = \frac{\bar{C}^g}{\bar{g}} \tilde{C}_t^g + \frac{\bar{I}^g}{\bar{g}} \tilde{I}_t^g$(Government expenditure)

$$\widetilde{nof}_t = \widetilde{nof}_{t-1} - \tilde{\pi}_t + (1-\omega)\frac{\overline{xo}}{\overline{nof}}\tilde{x}_{ot}$$

$\widetilde{\mathrm{fr}}_{\mathrm{t}} = \widetilde{\mathrm{fr}}_{\mathrm{t-1}} - \tilde{\pi}_t + (\omega)\frac{\overline{xo}}{\overline{fr}}\tilde{x}_{ot} + \frac{\overline{xno}}{\overline{fr}}\tilde{x}_{not} - \frac{\overline{\imath mt}}{\overline{fr}}\widetilde{\imath m}_t$(Foreign reserves)

$\widetilde{m}_{\mathrm{t}} = \frac{\overline{\mathrm{dc}}}{\bar{\mathrm{m}}}\widetilde{\mathrm{dc}}_{\mathrm{t}} + \frac{\overline{\mathrm{efr}}}{\bar{\mathrm{m}}}(\tilde{\mathrm{e}}_{\mathrm{t}} + \widetilde{\mathrm{fr}}_{\mathrm{t}})$ (Money Supply)

$\widetilde{m}_{\mathrm{t}} = \frac{\sigma}{bm}\tilde{\mathrm{C}}_{\mathrm{t}} - \frac{1}{\bar{r}}\tilde{r}_t$ (Money demand)

$\widetilde{\widetilde{m}}_t = m_t - m_{t-1} + \tilde{\pi}_t^c$(Money growth)

$\widetilde{\widetilde{m}}_t = h_0\widetilde{\widetilde{m}}_{t-1} + h_1(\tilde{\pi}_t^c - \tilde{\pi}_t^T) + h_2\tilde{y}_t + h_3\tilde{e}_t + \vartheta_t^{dc}$(Monetary policy)

$\tilde{\pi}_t^m = \tilde{d}_t + \tilde{\pi}_t^*$(Imported consumption inflation)

$\tilde{d}_t = K_0\tilde{d}_{t-1} + K_1({\tilde{\pi}_t}^c - \tilde{\pi}_t^T) + K_2\tilde{Y}_t + K_3\tilde{e}_t + K_4\left[\tilde{e}_t + \widetilde{fr}_t - \tilde{y}_t\right] + \vartheta_t^d$(Monetary policy)

$$\tilde{y}_t = \frac{\bar{c}^m}{\bar{y}}\tilde{c}_t^m + \frac{\bar{\mathrm{I}}^m}{\bar{y}}\tilde{\mathrm{I}}_t^m + \frac{\bar{c}^d}{\bar{y}}\tilde{c}_t^d + \frac{\bar{\mathrm{I}}^d}{\bar{y}}\tilde{\mathrm{I}}_t^d + \frac{(\bar{c}^m)^g}{\bar{y}}(\tilde{c}_t^m)^g + \frac{(\bar{\mathrm{I}}^m)^g}{\bar{y}}(\tilde{\mathrm{I}}_t^m)^g + \frac{(\bar{c}^d)^g}{\bar{y}}(\tilde{c}_t^d)^g + \frac{(\bar{\mathrm{I}}^d)^g}{\bar{y}}(\tilde{\mathrm{I}}_t^d)^g + \frac{\bar{x}}{\bar{y}}\tilde{x}_t - \frac{\overline{\iota mt}}{\bar{y}}\widetilde{\iota m}_t$$

$\widetilde{\iota m}_t = \frac{\bar{c}^m}{\overline{\iota mt}}c_t^m + \frac{\bar{\mathrm{I}}^m}{\overline{\iota mt}}i_t^m + \frac{(\bar{c}^m)^g}{\overline{\iota mt}}(c_t^m)^g + \frac{(\bar{\mathrm{I}}^m)^g}{\overline{\iota mt}}(i_t^m)^g$(Import)

$\tilde{x}_{not} = -\eta_*\tilde{\gamma}_t^e + \tilde{y}_t^*$(Non oil export)

$\tilde{x}_t = \frac{\overline{xo}}{\bar{x}}\tilde{x}_{ot} + \frac{\overline{xno}}{\bar{x}}\tilde{x}_{not}$(Export)

Relative Price

$\gamma_t^d = \frac{P_t^d}{P_t^c}$, $\gamma_t^m = \frac{P_t^m}{P_t^d}$, $\gamma_t^e = \frac{P_t^e}{P_t^*}$, $\gamma_t^{I^d} = \frac{P_t^d}{P_t^I}$

, $(\gamma_t^{i_g})^m = \frac{P_t^m}{P_t^{i_g}}$, $\gamma_t^{I^m} = \frac{P_t^m}{P_t^I}$, $\left(\gamma_t^{i_g}\right)^d = \frac{P_t^d}{P_t^{i_g}}$, $(\gamma_t^{c_g})^d = \frac{P_t^d}{P_t^{c_g}}$

,$(\gamma_t^{i_g})^m = \frac{P_t^m}{P_t^{i_g}}$,$(\gamma_t^{c_g})^m = \frac{P_t^m}{P_t^{c_g}}$

Shocks

Technology	$\tilde{a}_t = \rho_a\tilde{a}_{t-1} + u_t^a u_t^a \approx i.i.dN(0,\sigma_a^2)$
Price mark-up	$\tilde{\theta}_t^p - \theta^p = \rho_p(\tilde{\theta}_{t-1}^p - \theta^p) + u_t^p u_t^p \sim i.i.d.N(0,\sigma_p^2)$
Monetary policy	$\tilde{\upsilon}_t^{dc} = \rho_{dc}\tilde{\upsilon}_{t-1}^{dc} + u_t^{dc}u_t^{dc} \sim i.i.d.N(0,\sigma_{dc}^2)$

Government expenditure	$\tilde{g}_t = \rho_g \tilde{g}_{t-1} + u_t^g u_t^g \sim i.i.dN(0, \sigma_g^2)$
Oil revenue shock	$\widetilde{xo}_t = \rho_{xo} \widetilde{xo}_{t-1} + u_t^{xo} u_t^{xo} \sim i.i.dN(0, \sigma_{xo}^2)$
Exchange rate shock	$\tilde{e}_t = \rho_e \tilde{e}_{t-1} + u_t^e u_t^e \sim i.i.dN(0, \sigma_e^2)$
Foreign output	$\tilde{y}_t^* = \rho_{y^*} \tilde{y}_{t-1}^* + u_t^{y^*} u_t^{y^*} \approx i.i.dN(0, \sigma_{y^*}^2)$

APPENDIX (2)

Figure 1: Impulse responses to a technology shock

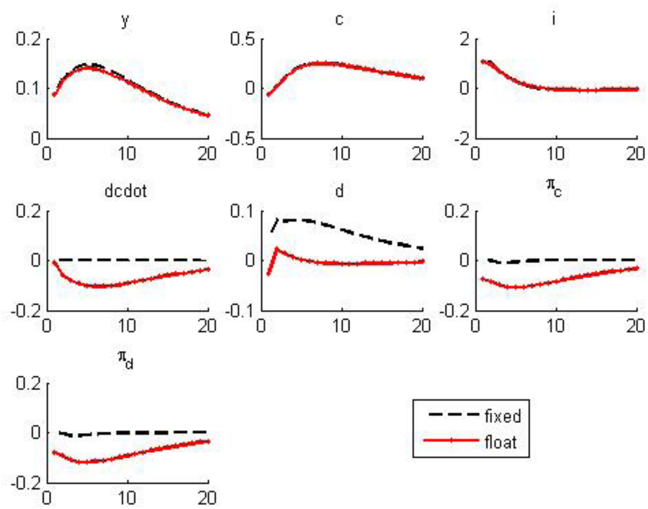


Figure 2: Impulse responses to an oil shock

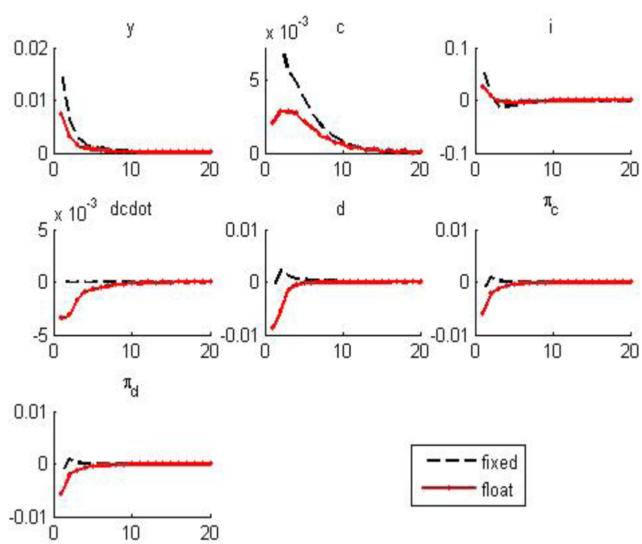


Figure 3: Impulse responses to a money growth shock

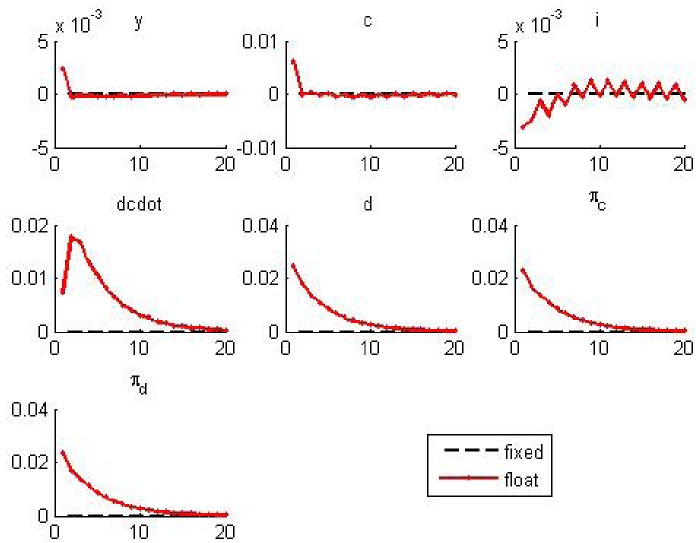
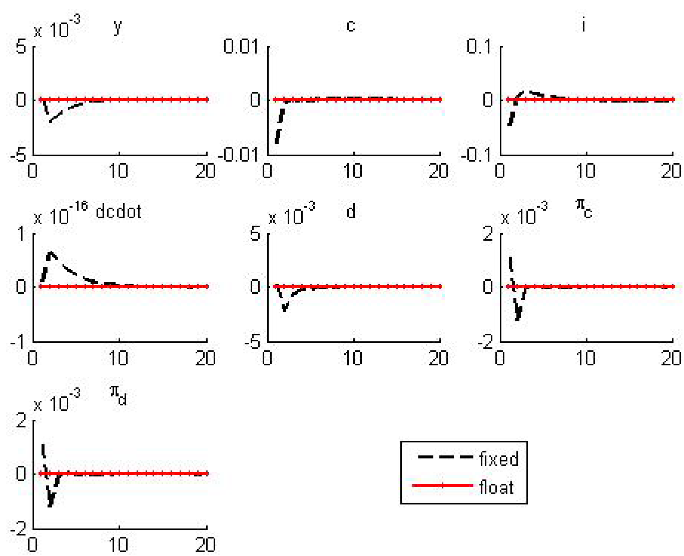


Figure 4: Impulse responses to an exchange rate shock



Prior and Posterior Figure