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Monetary and Fiscal Policy in an Estimated DSGE Model for Morocco

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Abstract

In this study we estimate a Dynamic Stochastic General Equilibrium (DSGE) model using Bayesian techniques to analyse the effects of monetary and fiscal policy in Morocco.

The results suggest that a positive monetary policy shock generates a diminution of consumption, investment, output and inflation. A positive shock on government expenditures produces an increase in output and wage but generates also a decrease in private consumption and investment due to an increase in inflation and interest rate. Finally, a positive shock on capital tax produces a decrease in investment and thus in output.

In general, the duration of monetary shock is shorter than fiscal shock; the first vanishes in about 10 quarters and the latter is more persistent and lasts more than 15 quarters.

Keywords: DSGE, NKM, bayesian estimation, monetary policy, fiscal policy, impulses responses.

1. Introduction

Macroeconomics has undergone a profound change in modelling since the rational expectations revolution and the introduction of the microeconomic foundations in macroeconomic analysis. This revolution is marked by the abandonment of the Cowles Commission's macro-econometric models, due to theoretical (Lucas 1976) and empirical criticisms (Sims 1981). After the Kydland and Prescott's (1982) seminal paper, Real Business Cycle (RBC) became the core of macroeconomic theory and the main reference framework for the analysis of macroeconomic fluctuations.

The RBC theory uses the dynamic stochastic general equilibrium models as a central tool for macroeconomic analysis and the ad-hoc behavioural equations were replaced by first order conditions of inter-temporal problems facing consumers and firms. The RBC framework is characterized by three fundamental aspects: The efficiency of business cycles, the importance of technology shocks as a source of economic fluctuations and the limited role of monetary factors (Gali 2008). The RBC models were enriched gradually by new Keynesian features to lead to dynamic stochastic general equilibrium models (DSGE) which are currently the state of the art in modelling and studying macroeconomic fluctuations of the economic cycle. The New Keynesian Modelling (NKM) approach combines the DSGE structure of RBC models with assumptions from Keynesian economy.

One of the important features of NKM is monopolistic competition. The prices are set by economic agents in order to maximise their utility unlike in the neoclassical framework where they are supposed to be determined by a Walrasian mechanism. Nominal rigidities are also an important element in DSGE modelling, i.e. firms and workers are constrained in their decisions of price adjustment and wage setting. Finally, as a consequence of the presence of nominal rigidities, monetary policy is not neutral in the short run and changes in short term nominal interest rate leads to variations in real interest rate. In turn, this change in the real interest rate produces changes in consumption, investment and, as a result, in output and employment (Gali 2008).

This paper aims to estimate a DSGE model for the Moroccan economy through the Bayesian approach. Following Smets and Wouters (2003, 2007) and CEE (2001), this model is a generalization of the RBC methodology (Kydland and Prescott, 1982) to an economy characterized by rigidities in prices and wages with the presence of the government and the central bank.

At first we describe the model, then we present its Bayesian estimation and finally, we analyze the impulse response functions generated from the model.

2. The model

In our model we extend the Smets and Wouters (2003) model by integrating the government and taxation as in Iwata (2009) and Chen (2007). The economy is populated by representative households that maximize a utility function on an infinite time horizon. A proportion of them acts as price-maker in the labour market and is supposed to optimally adjust its wage after the reception of some random signal (Calvo 1983). The representative household's utility depends positively in consumption and negatively in labour.

Representative firms are divided into two blocks: intermediate-good firms and final good-firms. The first ones are operating in a monopoly market and therefore they are supposed to be price-maker via a mechanism of price adjustment (Calvo 1983) while the seconds are supposed to be price-taker and operating in a perfect competition market.

The central bank react through a classical Taylor rule and the government follows a fiscal rule equalizing its resources (taxes) and expenditures. In the following we detail the description of the different blocks of the model.

- Households

The economy is populated by a continuum of households living indefinitely indexed by $\tau \in [0,1]$. Each household maximizes a utility function over an infinite horizon:

$$E_0 \sum_{t=0}^{\infty} \beta^t U_t^\tau$$

$$\text{With } U_t^\tau = \varepsilon_t^B \left(\frac{1}{1-\sigma^c} (C_t^\tau - H_t) ^{1-\sigma^c} - \frac{\varepsilon_t^L}{1+\sigma^l} (l_t^\tau)^{1+\sigma^l} \right)$$

The utility depends positively in consumption C_t^τ characterized by habit formation H_t with $H_t = hC_{t-1}$ i.e. the consumption at time t is affected by the consumption patterns in t-1. This mechanism of external habit formation is intended to introduce inertia in household demand (Adjemian and Devulder 2010). The utility depends negatively in labour that provides a disutility because of its painful nature. Parameters σ^c, σ^l represent the inverse of the inter-temporal elasticity of substitution and the inverse of the inter-temporal elasticity of labour with respect to wages respectively.

The utility function also contains two shocks representing the preference shock and the labour supply shock. Both are assumed to follow an AR (1):

$$\varepsilon_t^B = \rho^B \varepsilon_{t-1}^B + \eta_t^B, \varepsilon_t^L = \rho^L \varepsilon_{t-1}^L + \eta_t^L$$

The inter-temporal budget constraint under which the household maximizes its utility is given by:

$$0 = (1 + \tau_t^c) C_t^\tau + I_t^\tau - (1 - \tau_t^n) W_t l_t^\tau - Div_t^\tau + TR_t - (1 - \tau_t^k) (r_t^k z_t^\tau k_{t-1}^\tau - \psi(Z_t^\tau) k_{t-1}^\tau) - \frac{B_{t-1}}{P_t} + b_t \frac{B_t}{P_t}$$

With τ_t^n a tax on labour income, τ_t^c a consumption tax, τ_t^k a tax on capital, TR_t a lump sum tax, B_t the treasury bonds, I_t^τ the investment, W_t the wage, l_t^τ the labor and Div_t^τ are dividends paid by intermediate firms to the households.

z_t^τ is the rate of capital utilization and $\psi(Z_t^\tau)$ the cost of capital utilization. According to CEE (2001) the value of the utilization rate in the steady state is 1 and the cost of capital utilization is 0.

- Labour supply and wage setting

Following Erceg, Henderson and Levin (2000) we assume that wage can be adjusted only if the household receives a random signal. The probability that a household renegotiates its nominal wage is equal to $(1 - \xi_w)$. Thus, the household who receives the signal in period t will set a new salary taking into account the fact that he will not be able to re-optimize it in the near future. For the fraction of households that don't receive a signal, the wage adjusts according to an indexation rule relatively to inflation in the previous period. Formally:

$$W_t^\tau = \left(\frac{P_{t-1}}{P_{t-2}} \right)^{\gamma_w} W_{t-1}^\tau$$

γ_w is the degree of indexation of wage to inflation in the previous period. When there is no indexation ($\gamma_w = 0$) the wage cannot be adjusted and then remain constant. If there is a perfect indexation to past inflation γ_w is equal to 1.

Households set their wage in order to maximize their utility function relatively to their budget constraint. Thus, the demand for labor is given by:

$$l_t^\tau = \left(\frac{W_t^\tau}{W_t} \right)^{\frac{1-\lambda_{w,t}}{\lambda_{w,t}}} L_t$$

With L_t the aggregate labour demand and W_t the aggregate nominal wage. They are obtained through the Dixit-Stiglitz aggregation, namely:

$$L_t = \left[\int_0^1 (l_t^\tau)^{\frac{1}{1+\lambda_{w,t}}} d\tau \right]^{1+\lambda_{w,t}}$$

$$W_t = \left[\int_0^1 (W_t^\tau)^{-\frac{1}{\lambda_{w,t}}} d\tau \right]^{-\lambda_{w,t}}$$

The maximization problem results in the equation of mark-up for the proportion of households who re-optimize their wage, it's given by:

$$\frac{\tilde{w}_t}{P_t} E_t \sum_{i=0}^{\infty} \beta^i \xi_w \left(\frac{P_t / P_{t-1}}{P_{t+i} / P_{t+i-1}} \right)^{\gamma_w} \frac{l_{t+i}^\tau U_{t+i}^C}{1 + \lambda_{w,t+i}} = E_t \sum_{i=0}^{\infty} \beta^i \xi_w l_{t+i}^\tau U_{t+i}^l$$

With U_{t+i}^C the marginal utility of consumption and U_{t+i}^l the marginal disutility of labour. Finally, the wage equation is given by:

$$(W_t)^{-\frac{1}{\lambda_{w,t}}} = \xi_w \left(W_{t-1} \left(\frac{P_{t-1}}{P_{t-2}} \right)^{\gamma_w} \right)^{-\frac{1}{\lambda_{w,t}}} + (1 - \xi_w) (\tilde{w}_t)^{-\frac{1}{\lambda_{w,t}}}$$

- Consumption, investment and capital accumulation

Each household maximizes its utility over an infinite horizon under the budget constraint, the Lagrangian can be written as follows:

$$\begin{aligned}
L = & E_0 \sum_{t=0}^{\infty} \beta^t \varepsilon_t^B \left(\frac{1}{1-\sigma^c} (C_t^\tau - H_t)^\tau - \frac{\varepsilon_t^L}{1+\sigma^l} (I_t^\tau)^{1+\sigma_l} \right) \\
& - \lambda_t \beta^t \left[(1+\tau_t^c) C_t^\tau + I_t^\tau - (1-\tau_t^n) W_t I_t^\tau - \text{Div}_t^\tau + TR_t - (1-\tau_t^k) (r_t^k z_t^\tau k_{t-1}^\tau - \psi(Z_t^\tau) k_{t-1}^\tau) - \frac{B_{t-1}}{P_t} + b_t \frac{B_t}{P_t} \right] \\
& - \mu_t \beta^t \left[K_t - K_{t-1} (1-\delta) + (1-S(\varepsilon_t^l I_t / I_{t-1})) I_t \right]
\end{aligned}$$

Deriving the first order conditions, respectively for consumption, capital and investment we have:

$$\begin{aligned}
\lambda_t &= \frac{1}{1-\tau_t^c} (C_t^\tau - H_t)^{-\sigma^c} \varepsilon_t^B \\
Q_t &= E_t \left[\beta \frac{\lambda_{t+1}}{\lambda_t} \left[(1-\delta) Q_{t+1} + (1-\tau_t^k) (r_{t+1}^k Z_{t+1}^\tau - \psi(Z_{t+1}^\tau)) \right] \right]
\end{aligned}$$

With

$$\begin{aligned}
Q_t &= \frac{\mu_t}{\lambda_t} \\
1 &= E_t \left[Q_t - Q_t \left[S\left(\frac{\varepsilon_t^l I_t}{I_{t-1}}\right) + S'\left(\frac{\varepsilon_t^l I_t}{I_{t-1}}\right) \left(\frac{\varepsilon_t^l I_t}{I_{t-1}}\right) \right] + \beta Q_{t+1} \frac{\lambda_{t+1}}{\lambda_t} S'\left(\frac{\varepsilon_{t+1}^l I_{t+1}}{I_t}\right) \left(\frac{\varepsilon_{t+1}^l I_{t+1}}{I_t}\right) \right]
\end{aligned}$$

Households own the capital that they rent to firms with a rate of remuneration r_t^k . They can increase the supply of capital through an additional investment I_t which becomes operational at the end of the second period. They can also increase the supply of capital by increasing the utilization rate (z_t) of production capacity already installed. Households choose the capital stock, investment and utilization of production capacities in order to maximize their utility function under the constraint given by the equation of capital accumulation:

$$K_t = K_{t-1} (1-\delta) + (1-S(\varepsilon_t^l I_t / I_{t-1})) I_t$$

With δ the rate of capital depreciation and $S(\cdot)$ an adjustment cost function of capital (CEE 2001).

$\varepsilon_t^l = \rho_l \varepsilon_{t-1}^l + \eta_t$ is an investment shock.

The first order condition with respect to the rate of capital utilization leads to the following equation:

$$r_t^k = \Psi'(z_t)$$

- Final-good sector

The final good is produced using the intermediate good as input through the following aggregation function:

$$Y_t = \left[\int_0^1 (y_t^j)^{\frac{1}{1+\lambda_{p,t}}} dj \right]^{1+\lambda_{p,t}}$$

y_t^j is the intermediate good j used in the production of the final good. $\lambda_{p,t}$ is a mark-up parameter assumed to follow an AR(1) process.

From the first order conditions of cost minimization, we derive the demand function for the intermediate good y_t^j :

$$y_t^j = \left(\frac{P_t^j}{P_t} \right)^{\frac{1-\lambda_{p,t}}{\lambda_{p,t}}} Y_t$$

P_t^j is the price of intermediate good j and P_t the price of the final good given by the aggregation of intermediate goods prices:

$$P_t = \left[\int_0^1 (P_t^j)^{-\frac{1}{\lambda_{p,t}}} dj \right]^{-\lambda_{p,t}}$$

- Intermediate-good sector

Each firm produces a differentiated good j according to a Cobb-Douglas production function:

$$y_t^j = \varepsilon_t^a \tilde{K}_{j,t}^\alpha L_{j,t}^{1-\alpha} - \Phi$$

With ε_t^a a productivity shock assumed to follow an AR (1) process and $\tilde{K}_{j,t}^\alpha$ is the capital stock actually used ($\tilde{K}_{j,t} = z_t K_{t-1}$). $L_{j,t}$ and Φ are respectively the labour factor and the fixed cost of production.

Cost minimization implies that:

$$\frac{W_t L_{j,t}}{r_t^k \tilde{K}_{j,t}} = \frac{1-\alpha}{\alpha}$$

Marginal cost is given by:

$$CM_t = \frac{W_t^{1-\alpha} (r_t^k)^\alpha [\alpha^{-\alpha} (1-\alpha)^{-(1-\alpha)}]}{\varepsilon_t^a}$$

The last two equations imply that the demand for input and the marginal cost are the same for all the firms.

The profit of firm j is given by:

$$\pi_t^j = (p_t^j - CM_t) \left(\frac{p_t^j}{P_t} \right)^{\frac{1+\lambda_{p,t}}{\lambda_{p,t}}} (Y_t) - CM_t \Phi$$

Operating in a monopolistic market, the producers of the intermediate good are price makers. As well as households on the labour market, firms are supposed to change their prices once they receive signals (Calvo 1983). The probability that a price is re-optimized is constant and is given by $(1 - \xi_p)$. Firms not receiving signal adjust their prices on inflation in the previous period:

$$P_t = \left(\frac{P_{t-1}}{P_{t-2}} \right)^{\gamma_p} \pi_t P_{t-1}$$

The first order condition of the maximisation problem of re-optimizing firms leads the following equation:

$$E_t \sum_{i=0}^{\infty} \beta^i \xi_p^i \lambda_{t+i} y_{t+i}^j \left[\frac{p_t^j}{P_t} \left(\frac{P_{t-1+i} / P_{t-1}}{P_{t+i} / P_t} \right)^{\gamma_p} - (1 + \lambda_{p,t+i}) CM_{t+i} \right] = 0$$

This implies that the price of firm j is dependent on future marginal costs. If we were in a situation where prices are flexible, the mark-up is simply given by $1 + \lambda_{p,t+i}$.

Thus, the equation of the market price of the intermediate good is given by:

$$(P_t)^{-\frac{1}{\lambda_{p,t}}} = \xi_p \left(P_{t-1} \left(\frac{P_{t-1}}{P_{t-2}} \right)^{\lambda_p} \right)^{-\frac{1}{\lambda_{p,t}}} + (1 - \xi_p) (\tilde{p}_t^j)^{-\frac{1}{\lambda_{p,t}}}$$

- The central bank:

The behaviour of the central bank is modelled by a Taylor rule given by:

$$R_t = \rho R_{t-1} + (1 - \rho) \left\{ \bar{\pi}_t - r_\pi (\hat{\pi}_{t-1} - \bar{\pi}_t) + r_y (\hat{y}_{t-1} - \bar{y}_t^p) \right\} + r_{\Delta\pi} (\hat{\pi}_t - \hat{\pi}_{t-1}) + r_{\Delta y} [(\hat{y}_t - \hat{y}_t^p) - (\hat{y}_{t-1} - \hat{y}_{t-1}^p)] + \eta_t^R$$

Thus, the monetary authorities are supposed to change the interest rate according to the changes occurring at the level of inflation and output.

- Government

The government is supposed to follow a fiscal rule equalizing its resources that come from different types of taxes with its expenditures.

This is given by:

$$G_t = C_t \tau_t^c + L_t \tau_t^n + K_t \tau_t^k + TR_t$$

-The equilibrium conditions:

The goods market is in equilibrium when aggregate output is equal to the sum of consumption, investment and the government expenditure:

$$Y_t = C_t + G_t + I_t + \Psi(z_t) K_{t-1}$$

The equilibrium of the public sector is achieved when the taxes equalize the sum of transfers and spending, we have:

$$G_t = \tau_t^c C_t + \tau_t^k (r_t^k Z_t K_{t-1} - \psi(Z_t) K_{t-1}) + \tau_t^n W_t L_t - F_t$$

The equilibrium in the capital market is reached when the demand for intermediate firms is equal to the supply of household and labour market equilibrium is achieved when the labour demand is equal to the labour supply for a given wage level.

- Log-linearization of the model:

In order to estimate the model, we proceed first by its linearization around the steady state. In its log-linear form, the model is given by the following linear equations:

The equation of the marginal utility of consumption

$$\hat{\lambda}_t = \hat{\varepsilon}_t^B - \frac{1}{1-h} \sigma_c [\hat{C}_t - h \hat{C}_{t-1}] + \hat{\tau}_t^c$$

The rate of capital utilization equation

$$\hat{Z}_t = \psi \hat{r}_t^k$$

The consumption equation

$$\hat{C}_t = \frac{h}{1+h} \hat{C}_{t-1} + \frac{1}{1+h} \hat{C}_{t+1} - \frac{1-h}{(1+h)\sigma_c} (\hat{R}_t - \hat{\pi}_{t+1} + \hat{\varepsilon}_t^B - \hat{\varepsilon}_{t+1}^B + \hat{\tau}_t^c - \hat{\tau}_{t+1}^c)$$

The Q equation

$$\hat{Q}_t = -(\hat{R}_t - \hat{\pi}_{t+1}) + \frac{1-\delta}{1-\delta-\bar{r}^k} \hat{Q}_{t+1} + \frac{\bar{r}^k}{1-\delta-\bar{r}^k} \hat{r}_{t+1}^k + \eta_t^Q - (1-\beta+\beta\delta) \hat{\tau}_t^k$$

The investment equation

$$\hat{I}_t = \frac{1}{1+\beta} \hat{I}_{t-1} + \frac{\beta}{1+\beta} \hat{I}_{t+1} + \frac{\varphi}{1+\beta} \hat{Q}_t + \hat{\varepsilon}_t^I$$

The capital accumulation equation

$$\hat{K}_t = (1 - \delta)\hat{K}_{t-1} - \delta\hat{I}_{t-1}$$

The equalization of the marginal cost of labour and capital allows us to obtain the function of labour demand

$$\hat{L}_t = -\hat{\varsigma}_t + (1 + \psi)\hat{r}_t^k + \hat{K}_{t-1}, \quad \hat{\varsigma}_t = \hat{W}_t - \hat{P}_t \text{ is the real wage}$$

The market equilibrium condition

$$Y_t = \phi\epsilon_t^a + \phi\alpha\psi\hat{r}_t^k + \phi\alpha\hat{K}_{t-1} + \phi(1 - \alpha)\hat{L}_t$$

$$Y_t = \frac{\bar{C}}{\bar{Y}}\hat{C}_t + G_t + \frac{\bar{I}}{\bar{Y}}\hat{I}_t$$

The government rule

$$\hat{G}_t = \overline{YC}\tau_t^c + \overline{YWL}\tau_t^n + \overline{YKR}^k\tau_t^k + \overline{YTR}\hat{R}_t$$

The inflation equation

$$\hat{\pi} = \frac{\beta}{1 + \beta\gamma_p}\hat{\pi}_{t+1} + \frac{\gamma_p}{1 + \beta\gamma_p}\hat{\pi}_{t-1} + \frac{\beta}{1 + \beta\gamma_p} \frac{(1 - \beta\xi_p)(1 - \xi_p)}{\xi_p} [\alpha\hat{r}_t^k + (1 - \alpha)\hat{w}_t - \hat{\epsilon}_t^a + \eta_t^p]$$

The real wage equation

$$\begin{aligned} \hat{w}_t = & \frac{\beta}{1 + \beta}\hat{w}_{t+1} + \frac{1}{1 + \beta}\hat{w}_{t-1} + \frac{\beta}{1 + \beta}\hat{\pi}_{t+1} - \frac{1 + \beta\gamma_w}{1 + \beta}\hat{\pi}_t + \frac{\gamma_w}{1 + \beta}\pi_{t-1} \\ & + \frac{1}{1 + \beta} \frac{(1 - \beta\xi_w)(1 - \xi_w)}{\left(1 + \frac{(1 + \lambda_w)\sigma_L}{\lambda_w}\right)\xi_w} \left[-\hat{w}_t - \sigma_L\hat{L}_t + \frac{\sigma_c}{1 - h}(\hat{C}_t - h\hat{C}_{t-1}) + \hat{\epsilon}_t^L + \hat{\tau}_t^n + \eta_t^w \right] \end{aligned}$$

The monetary policy rule of the central bank

$$R_t = \rho R_{t-1} + (1 - \rho) \left\{ \bar{\pi}_t - r_\pi(\hat{\pi}_{t-1} - \bar{\pi}_t) + r_y(\hat{y}_{t-1} - \bar{y}_t^p) \right\} + r_{\Delta\pi}(\hat{\pi}_t - \hat{\pi}_{t-1}) + r_{\Delta y}[(\hat{y}_t - \hat{y}_t^p) - (\hat{y}_{t-1} - \hat{y}_{t-1}^p)] + \eta_t^R$$

3. Bayesian estimation and impulse responses analysis

3.1 Bayesian estimation

Bayesian econometrics is an alternative to the traditional econometrics since it allows to overcome the lack of sufficient historical data and allows integrating the "beliefs" or expert's opinions in the estimation exercise. It combines the beliefs, represented using a joint probability density of the model parameters *a priori*, with historical data when estimating parameters.

Formally, let θ_M a vector of parameters associated with the parametric model M , $\theta_M \equiv (\theta_1^M, \dots, \theta_k^M)$, the priors associated with this vector can be written as follows:

$$p_0(\theta_M / M)$$

This joint density defines a prior uncertainty about the parameters θ_M without taking into account the information contained in the data.

As we have observations from a vector $\{y_t\}_{t=1}^T$ for variables of interest, the likelihood is the density of the sample conditionally to the model parameters:

$$\ell(\theta_M, y_t, M) = P(y_t / \theta_M, M)$$

In other words, the maximum likelihood estimator of the parameters θ_M of the model M is the value of the parameters that make the more likely the occurrence of the sample $\{y_t\}_{t=1}^T$.

Thus, as we have density that characterize the priors beliefs $p_0(\theta_M / M)$ and density $P(y_t / \theta_M, M)$ that characterizes the information contained in the historical data, it is possible to combine these two

sources of information using Bayes theorem to obtain the density of the vector of parameters θ_M given the data $\{y_t\}_{t=1}^T$:

$$P_1(y_t / \theta_M, M) = \left(\frac{P_0(\theta_M / M) P(y_t / \theta_M, M)}{P(y_t / M)} \right)$$

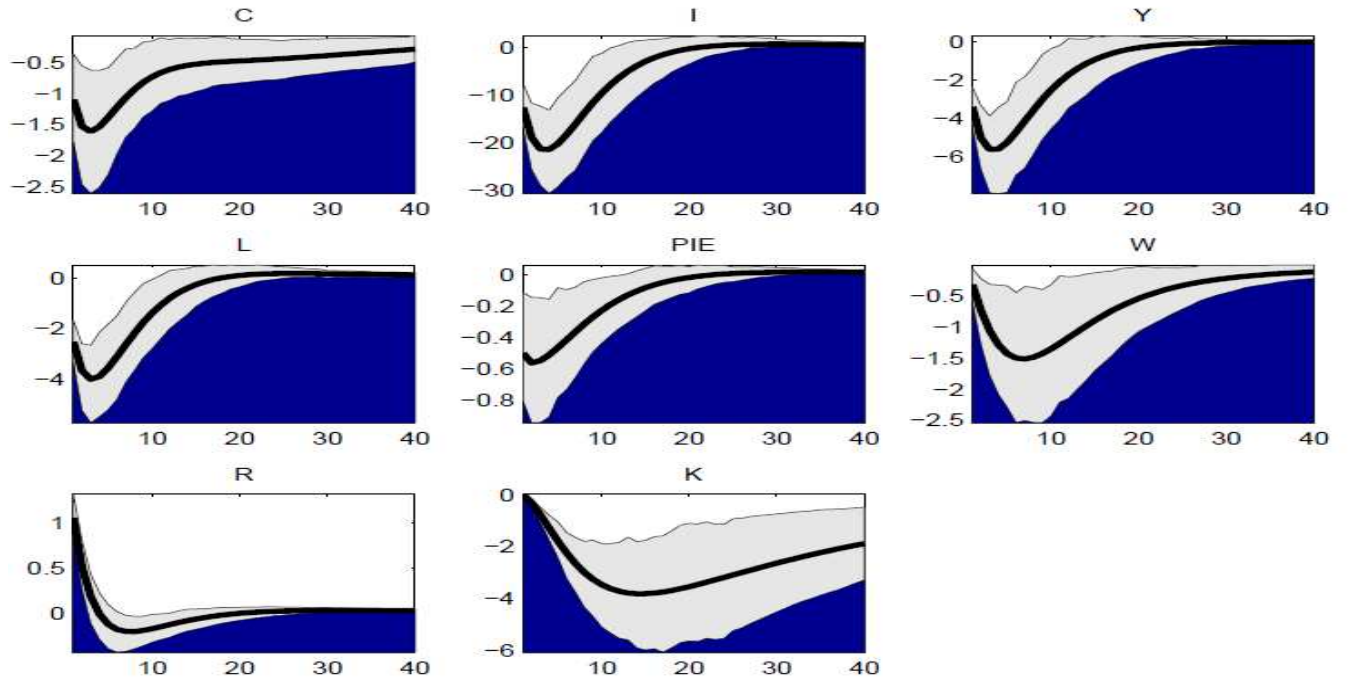
With $P(y_t / M) = \int_{\theta_M} P_0(\theta_M / M) P(y_t / \theta_M, M) d\theta_M$ the marginal density.

the data used to estimate the model are the interbank interest rate, real GDP, inflation and the ordinary expenses of treasure from 1997-Q1 to 2012-Q2. Series have been seasonally adjusted, expressed in logarithms and filtered using HP filter except the interest rate and inflation which are taken in level. The priors of the Bayesian estimation were mainly taken from Semts and Wouters (2003), Iwata (2009) and Chen (2007).

3.2 Impulse response functions analysis

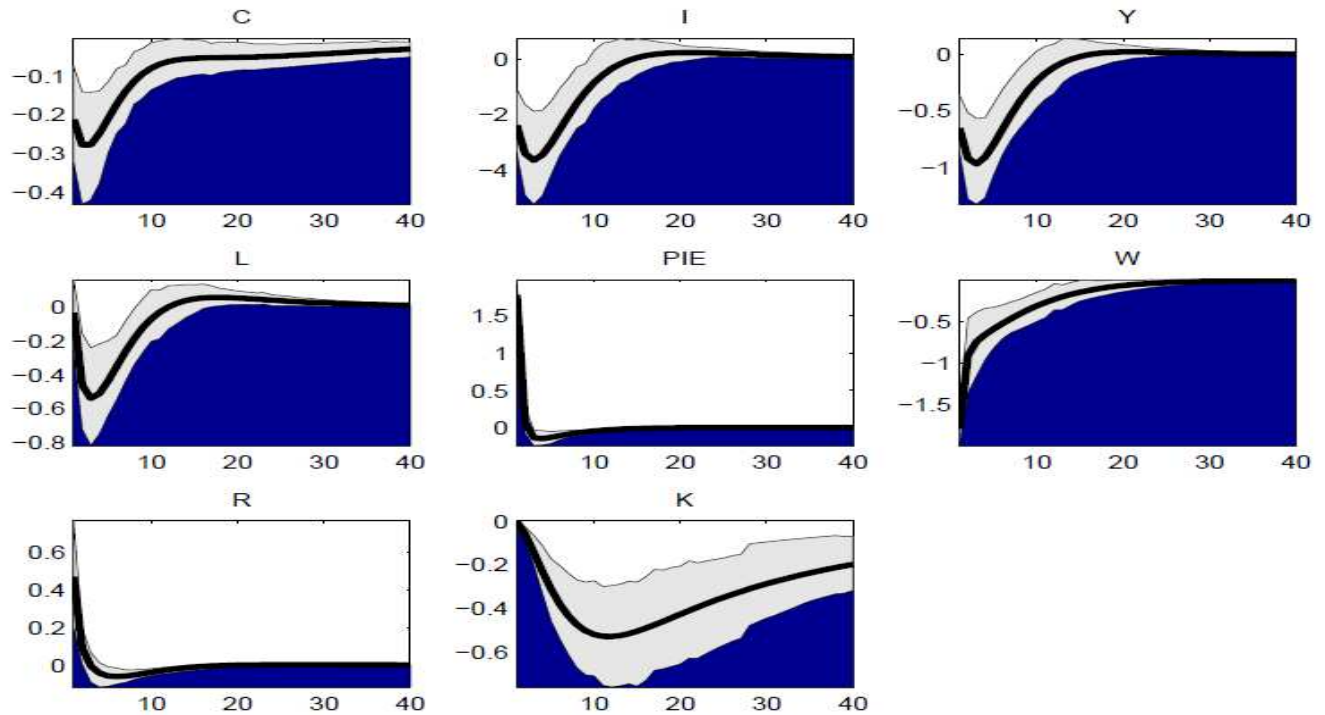
In the following we present the Bayesian impulse responses generated from the model to analyse the effect of various monetary and fiscal shocks on the main macroeconomic aggregates.

- Monetary policy shock



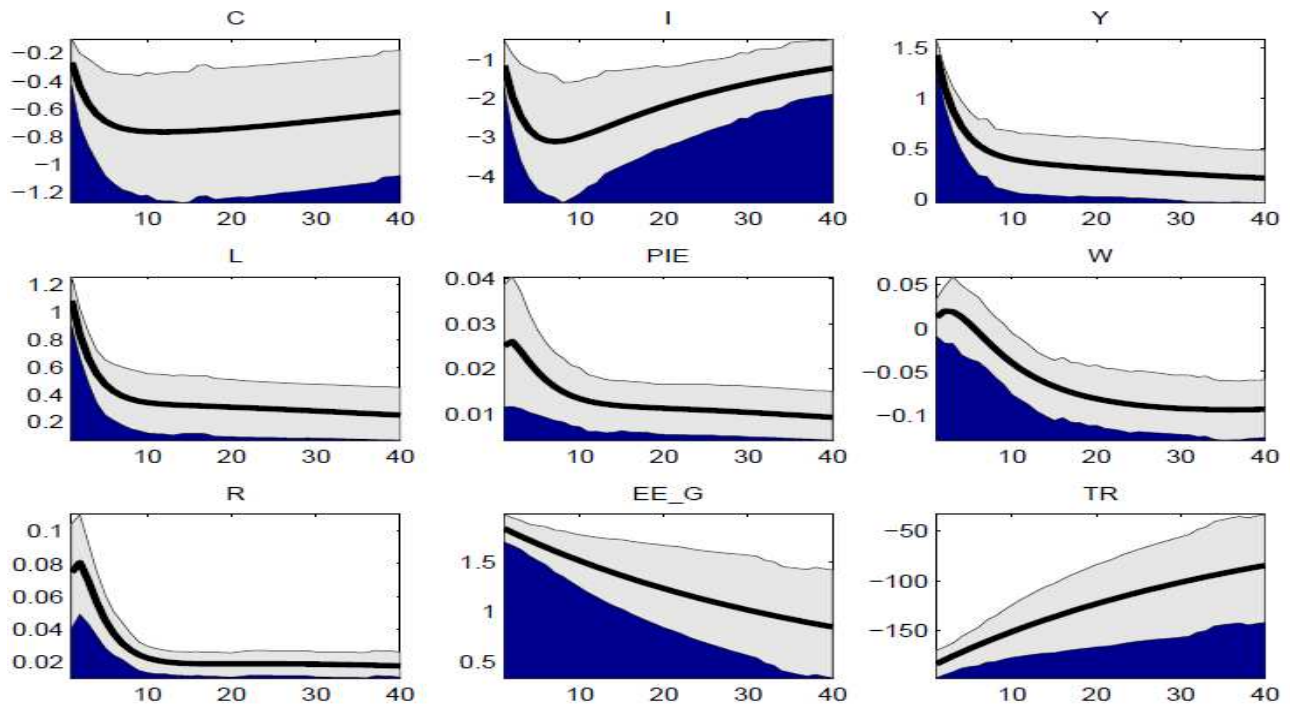
A positive shock on monetary policy, i.e. an increase in interest rate (R), generates reactions that are in line with macroeconomic theory i.e. a diminution of consumption (C), investment (I), output (Y) inflation (PIE), labour (L) and Wage (W). The effects vanish in about 10 quarters.

- Inflation shock



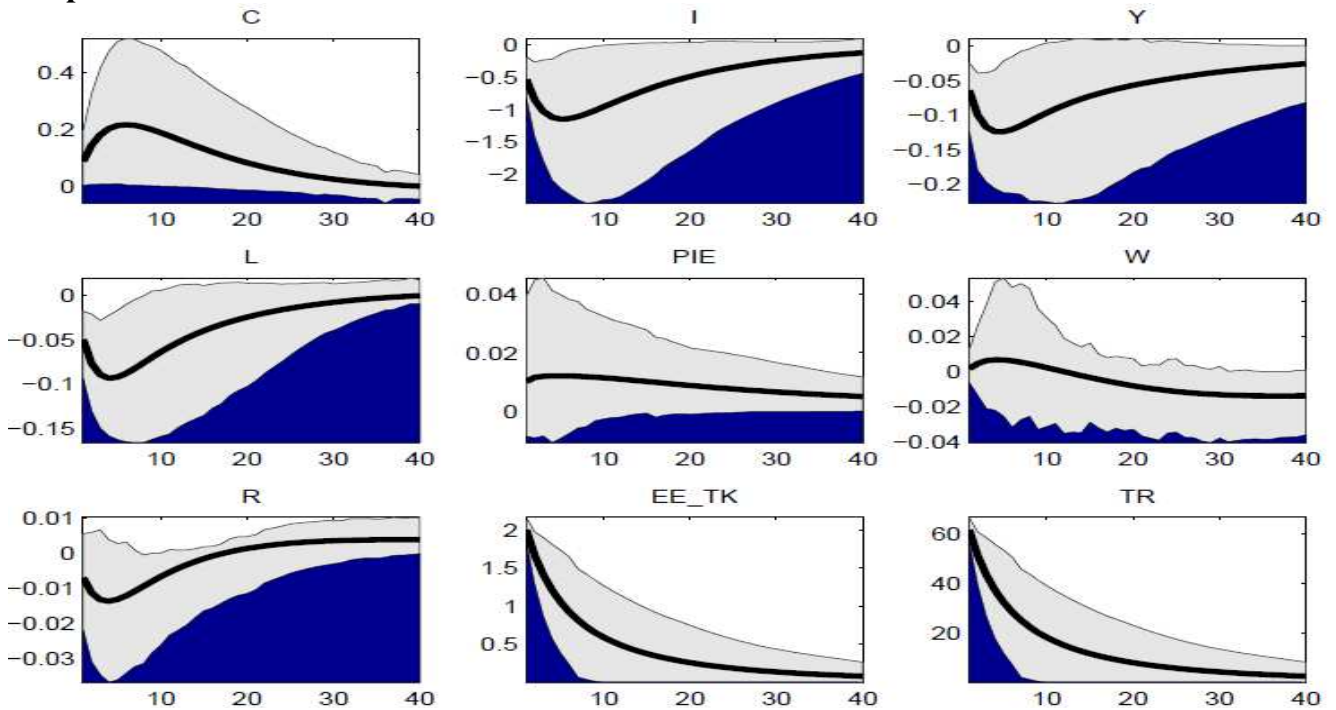
A positive inflation shock on Moroccan economy produces a decrease in consumption, investment, output and wage. The monetary authority reacts with an increase in the interest rate. The duration of the shock is about 10 quarters.

- Public expenditures shock



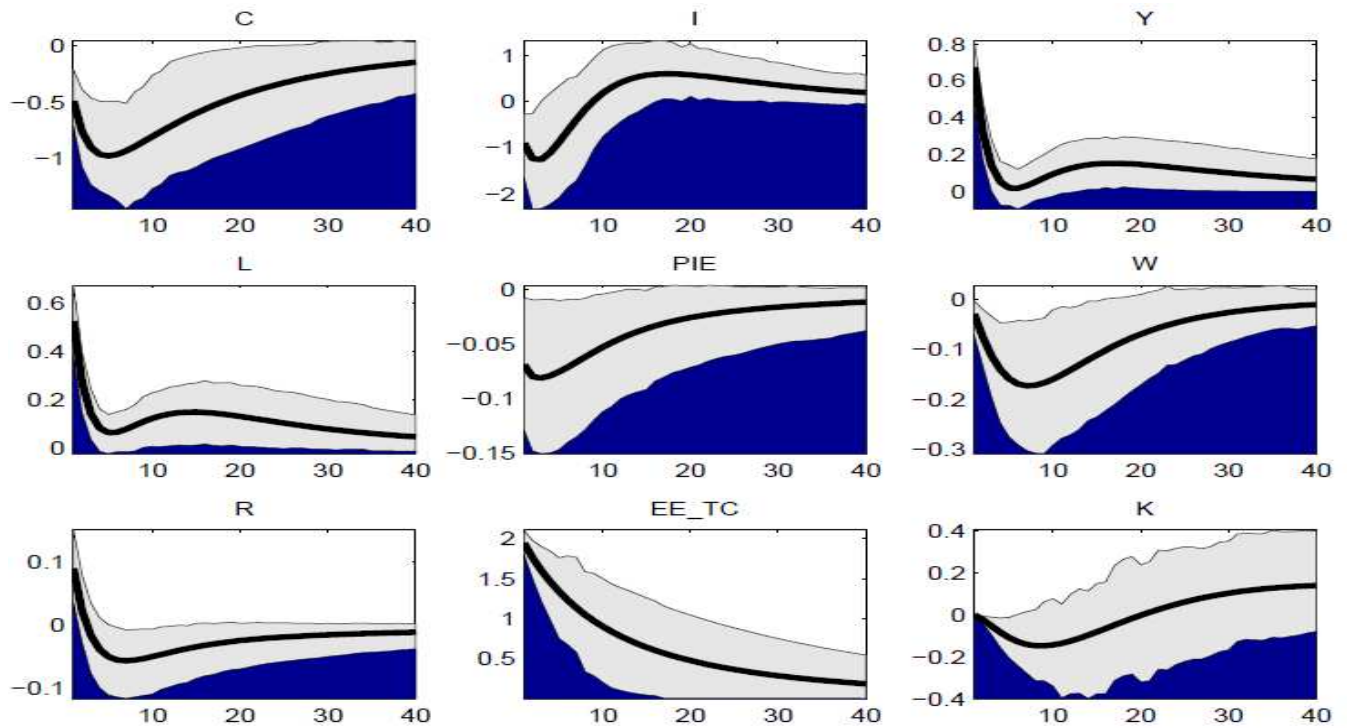
A shock on government expenditure produces an increase in output and wage but generates also a decrease in private consumption and investment due to an increase in inflation and interest rate.

- Capital tax shock



An increase in capital tax causes a decrease in investment and thus in output. Consumption is stimulated because of the trade-off that the households operate between consumption and investment.

- Consumption taxes shock



Finally, an increase in consumption tax generate a decrease in consumption, investment, Wage and inflation. In general the duration of the fiscal shocks is about 15 quarters.

4. Summary and conclusion

Contributing to the comprehension of the effects of monetary and fiscal in Morocco, this work proposes an estimated Dynamic Stochastic Equilibrium Model (DSGE) for the Moroccan economy. Many frictions were taken in consideration such as rigidities in prices and wages with the presence of government and central bank. The model is estimated using Bayesian techniques. The used data are the interbank interest rate, real GDP, inflation and the ordinary expenses of treasure.

The results indicate that a positive shock on monetary policy generates a diminution of consumption, investment, output and inflation. A shock on government expenditure produces an increase in output and wages but generates also a decrease in private consumption and investment due to an increase of inflation and interest rate. Finally, a positive shock on capital tax produces a decrease in investment and thus in output. In general, the duration of monetary shocks is shorter than fiscal shocks; the first vanish in about 10 quarters and the last in about 15 quarters.

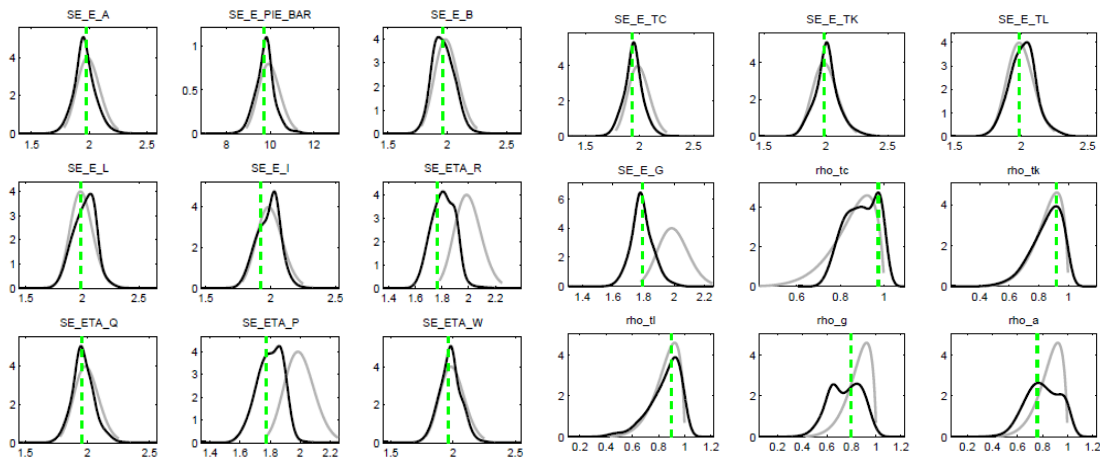
References

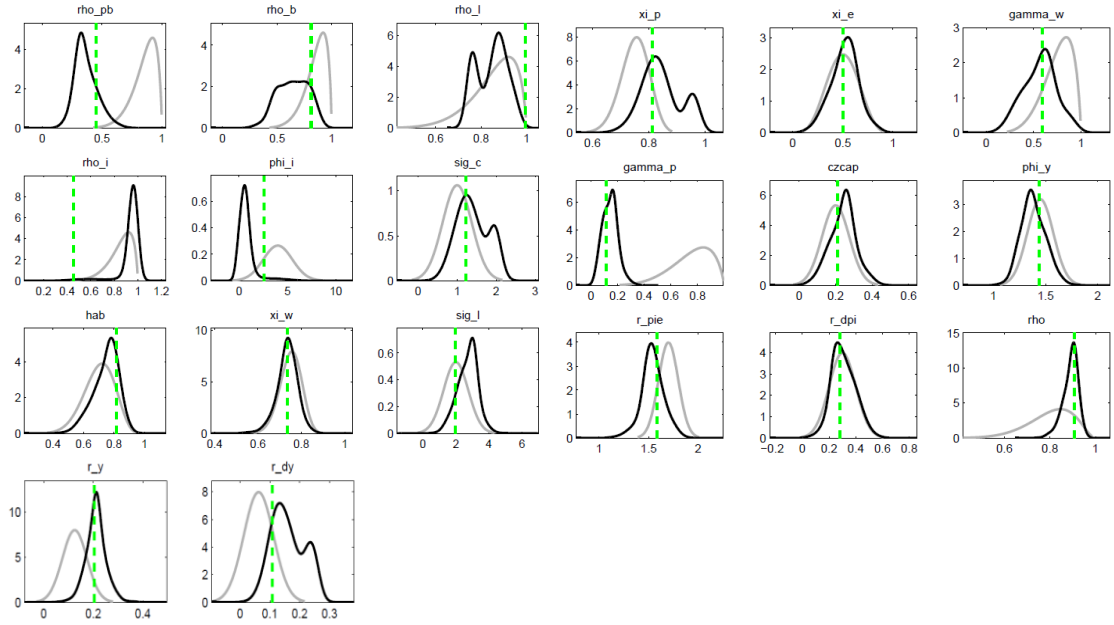
- Abraham-Frois, G.**, « La macroéconomie en l'an 2000 », *Revue économique*, 2001, Volume 52, Numéro3, p. 481 – 493
- Bernanke, B., and Gertler, M.**, Inside the Black Box: The Credit Channel of Monetary Policy Transmission, *Journal of Economic Perspectives*, Vol. 9, 1995, p 24-48.
- Blanchard, O., et Khan, C. M.**, The solution of linear difference models under rational expectation , *Econometrica*, vol. 48 (5) (July), 1980, pp. 1305-11.
- Calvo, G.**, “Staggered prices in a utility maximising framework”, *Journal of Monetary Economics*, 1983.
- Christiano, L. , Eichenbaum M., et Evans C.**, Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy," *Journal of Political Economy*, 2005, 113, 1-45.
- Clarida, R., Gali, J., et Gertler, M.**, The science of monetary policy: a new Keynesian Perspective , *Journal of Economic Literature*, 37:4, 1999, p. 1661-1707.
- Collard, F., et Juillard, M.**, Perturbation Methods for Rational Expectations Models, Manuscript, CEPREMAP, 2001.
- Canova, F.**, *Methods for Applied Macroeconomic Research*, Princeton University Press, 2005.
- Dib, A., Gammoudi, M. et Moran, K.**, Forecasting Canadian Time Series with the New Keynesian Model, Bank of Canada, Working Paper 05-27, 2006.
- Gali, J.**, *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework*, Princeton University Press, 2008.
- Gali, J., et Rabanal, P.**, Technology Shocks and Aggregate Fluctuations: How Well Does the RBC Model Fit Postwar U.S. Data, *NBER Macroeconomics Annual*, 2004, MIT Press, Cambridge, MA.
- Goodfriend, M., et King, R.**, The new neoclassical synthesis and the role of monetary policy , Bernanke, B. and J. Rotemberg (eds), *NBER Macroeconomics Annual*, 1997, 231-283.
- Hansen, G.**, Indivisible Labor and the Business Cycle, *Journal of Monetary Economics*, 1985, 309-328.
- Ireland, P.**, Technology Shocks in the New Keynesian Model, *The Review of Economics and Statistics*, 2004, p 923-936.
- Iwata, I.**, Fiscal Policy in an Estimated DSGE Model of the Japanese Economy: Do Non-Ricardian Households Explain All?, *ESRI Discussion Paper Series No.216*, 2009.
- Judd, K.**, *Numerical Methods in Economics*, Cambridge, MA: MIT Press, 1998.
- Juillard M.**, Dynare: A Program for the Resolution and Simulation of Dynamic Models with Forward Variables through the Use of a Relaxation Algorithm, *CEPREMAP Working Paper 9602*, CEPREMAP Paris, 1996.

- Kamran, D.**, The evolution of macroeconomic theory and policy, Springer, 2009.
- King, R., Plosser, C., et Rebelo, S.**, Production, Growth and Business Cycles: the Basic Neoclassical Model, *Journal of Monetary Economics*, 1988, 195- 232.
- King, R., et Rebelo S.**, Resuscitating real business cycles , NBER Working Paper Series, 2000.
- Kydland, F. et Prescott E.**, Time to Build and Aggregate Fluctuations, *Econometrica*, 1982, p. 1345-1369.
- Kydland, F. et Prescott, E.**, Business Cycles: Real Facts and a Monetary Myth, Federal Reserve Bank of Minneapolis Quarterly Review, 1990.
- Lucas, R.**, Econometric policy evaluation: A critique, Carnegie-Rochester Conference Series on Public Policy, Vol. 6, 1976, pages 19-46.
- Miranda, M. J. et Fackler P. L.**, Applied Computational Economics and Finance, Cambridge MA: MIT Press, 2002.
- Sargent, T. J.**, Dynamic Macroeconomic Theory, Cambridge, Mass.: Harvard University Press, 1987.
- Smets, F. et Wouters, R.**, An estimated dynamic stochastic general equilibrium model of the euro area, *Journal of the European Economic Association*, 2003, p.1123-75.
- Zanetti, F.**, Prototype micro-founded DSGE models in Scilab, Bank of England, CCBS, Technical Handbook No. 3, 2010.
- Wickens M.**, Macroeconomic theory: a dynamic general equilibrium approach, Princeton University Press, 2009.
- Woodford, M.**, Interest and Prices: Foundations of a Theory of Monetary Policy, Princeton University Press, 2003.
- [30] **Woodford, M.**, The Taylor Rule and Optimal Monetary Policy, *American Economic Review*, 2001, p 232-237.

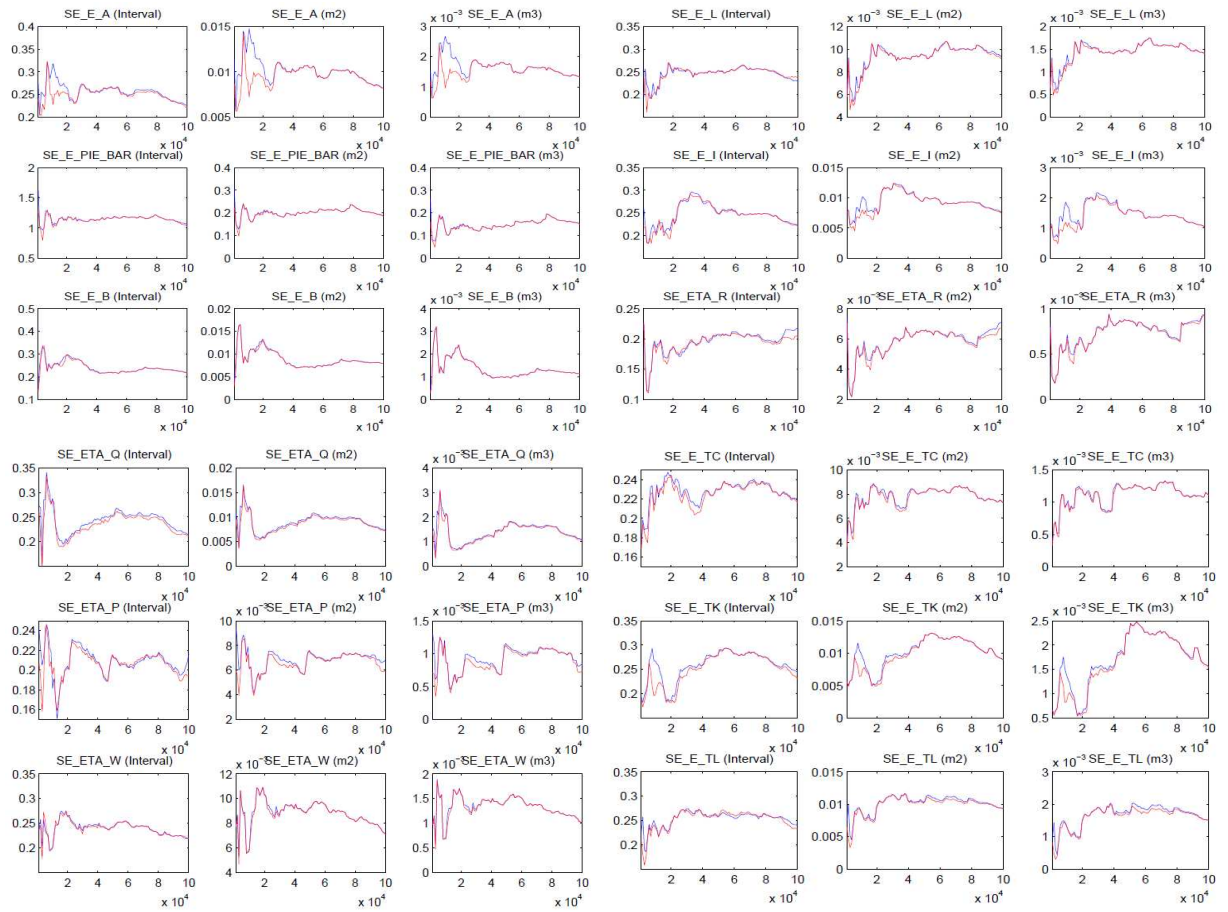
Appendices

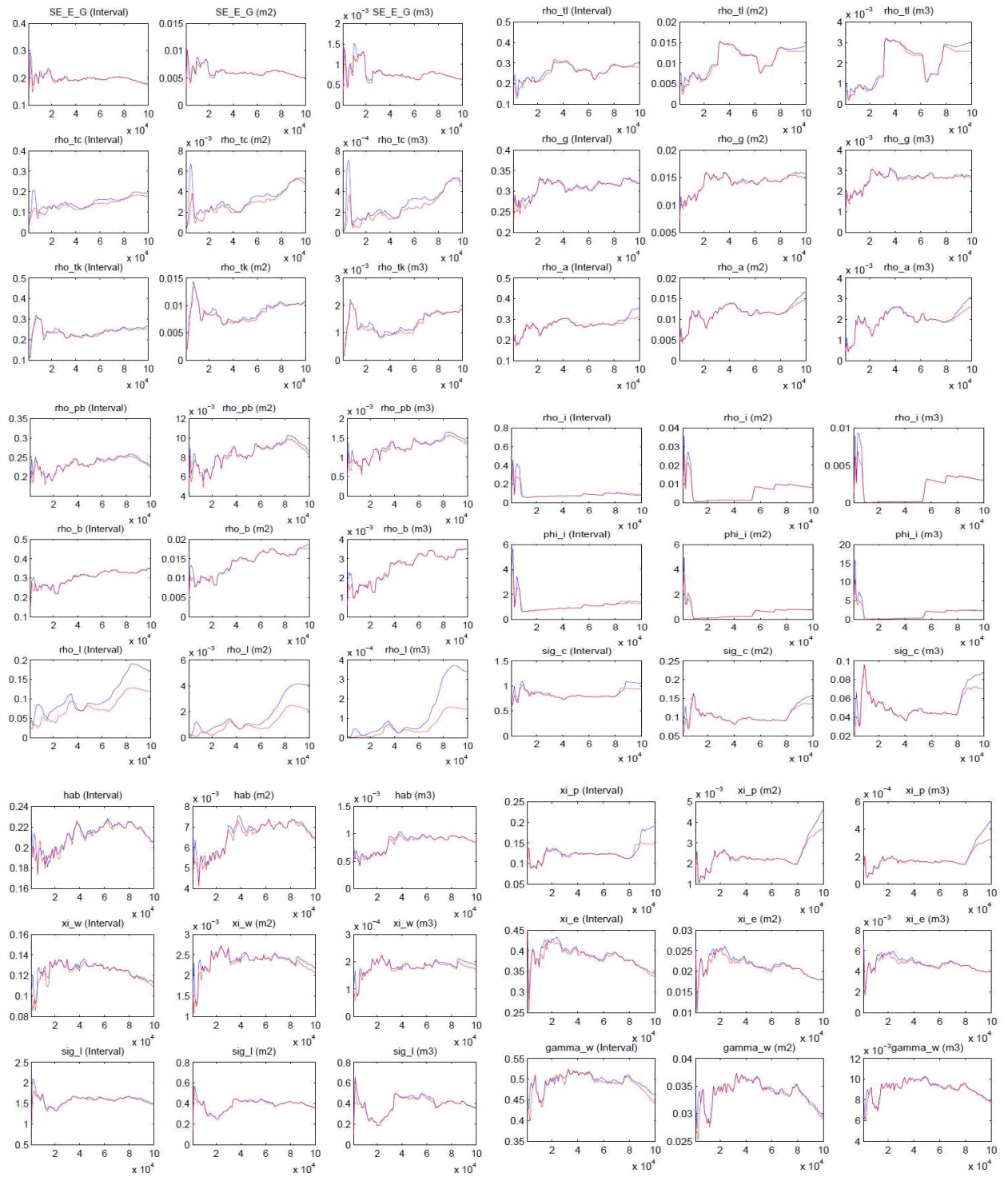
Priors and posteriors distribution of the estimated parameters

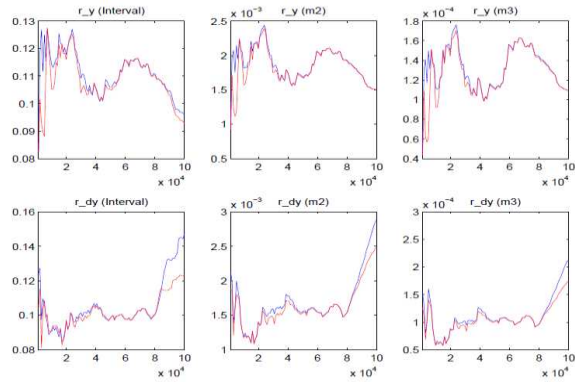
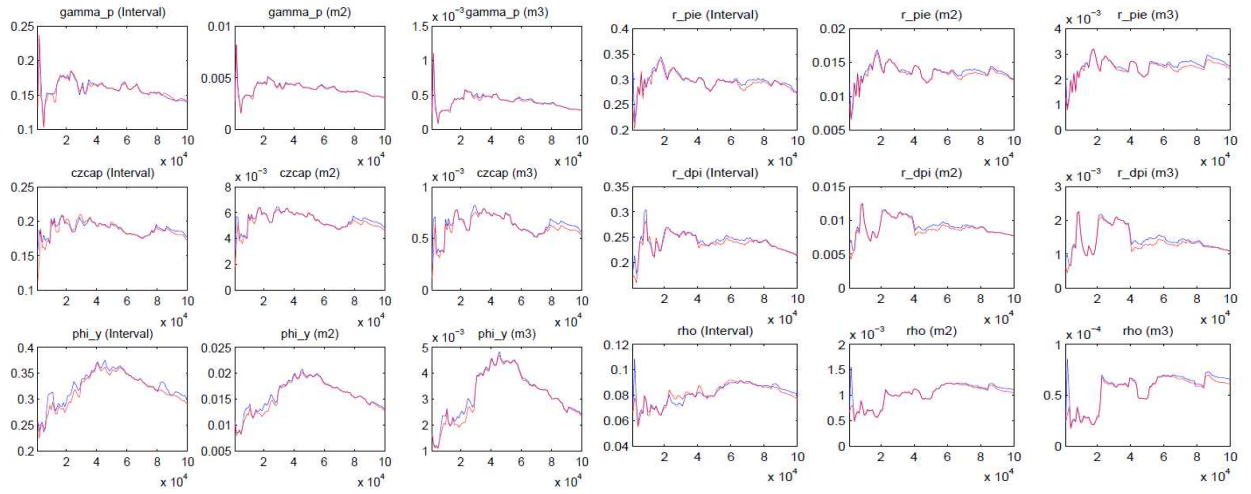




Univariate convergence diagnostic, Brooks and Gelman (1998)







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