

The Dynamic Stochastic General Equilibrium Model for the Monetary Policy Analysis in Tunisia

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Abstract

The paper is aimed to the behaviour analysis of the Tunisian economy with inflation targeting regime represented by a New Keynesian dynamic stochastic general equilibrium model. This model is employed as a macroeconomic method of modelization to analyze this policy estimated with the Bayesian technique in a response to many exogenous shocks. The paper tests the model's proprieties on recent Tunisian data. Moreover, it shows the monetary policy transmission mechanism The model seems to give a satisfactory approximation of the Tunisian economy behaviour. The ultimate goal of the model is to be used in simulation exercises, policy advice and forecasting at the Bank of Tunisia.

Index terms— inflation targeting, monetary policy, dsge, bayesian estimation.

1 I. Introduction

nowadays many events threaten the Tunisian economy and compel the economists to develop the monetary policy. We note for example the growing public debts illustrated by the change in levels of debt/GDP ratio in major industrialized countries from 2007 to 2010. According to the International Monetary Fund(IMF), the budget deficit in Tunisia evolve from 1.1% in 2010 to 3.5% of GDP in 2011 hence the ratio(debt/GDP) increase from 40% of GDP in 2010 to 44.5% of GDP in 2011. Also the inflation rate was 4.9 %in 2008 and becomes 6% in 2014. (Amiri and Talbi, 2013) underlined the evolution of the inflation in Tunisia .. It was under control after a spike in August 2006 to 4.490% due to the rise in international oil prices, the periods of excess of liquidity and the deteriorating of the exchange terms. However in may 2007, it recognizes an important reduction to 2% due to the monetary tightening and the acceleration of the real GDP' s growth to 5% 1 (CPI) was around 4.43% in 2011 and begins to goes up to 5.15% in 2010.. The aim of this study is to highlight the monetary transmission mechanisms (MTM). In this field, (Boughrara, 2007) criticized the limited knowledge of this mechanism in Tunisia considered as an handicap that delays the implementation of Inflation Targeting (IT). This paper also intend to show the main driving forces behind Tunisian business cycle and to understand how the shocks and monetary policy of inflation targeting transmit into the Tunisian economy using the Dynamic Stochastic General Equilibrium model (DSGE) model. In fact DSGE is chosen in this case because it had several attractive advantages for the analysis of the macroeconomic policy compared to VAR, like for example the escapement from the Lucas critique, the fact that they are structural, microfounded. The model is forward looking as it sets the importance of expectations of the agents and the credibility of the Central Bank ??Tetlow, 1999). It also provides an integrated approach to the study of the business cycle and the optimal response of the policy-makers to shocks. It evaluates the success of the adoption of inflation targeting regime. However, issues like the technical capabilities and the Central Bank's autonomy, are most of time lacking in the most emerging market economies, so they are not explicitly considered in our context. The Monetary policy of the Central bank in this case is represented by the generalized Taylor rule. We should remember that the subject of inflation targeting became more important since the vast literature on "the Science of Monetary Policy" concentrates on the industrial countries and the developed emerging markets ??Clarida et al.1999; ??aylor, 1998; ??illarverde, 2009; ??ubik and Shorfheide, 2007). Even so , there is a few literature about the emergent countries implementing targeting we note for instance (Peiris and Saxegaard, 2007

45 ;Benes et al., 2007; Ben Aissa and Rebei, 2009). As far as the objectives of the monetary policy are concerned.
 46 We note for instance stabilizing the prices' level, the economic growth, the financial market and minimizing the
 47 unemployment. In accordance with the Article 33 of the new Law No. 2006-26 concerning the organization of
 48 the BCT (Central Bank of Tunisia), the objective of monetary policy is to maintain the prices stability. To
 49 this end, the issuing institution will use the interest rate as a basic instrument to act on the prices (Chockri
 50 and Frikha,2011). They elucidated that the Tunisian central bank intend to keep the inflation rate to the level
 51 comparable to its partners and competitors 2 (especially the European union). They added that the Tunisian
 52 monetary authority adjust systematically the exchange rate to maintain the inflation differential, and therefore
 53 preserve the external competitiveness. This paper focuses on stabilizing prices via the technique of the inflation
 54 target.Since 1987, the Tunisian monetary authority tried to ensure a policy of economic growth and to control
 55 the inflationary pressure. So it created a financial sector reform in 1988 via the liberalization of the interest rates
 56 and the gradual removal of the volume's control and the composition of the credits. In fact, the monetary policy
 57 in Tunisia recognized a deep mutation. It replaces the direct and discretionary instruments by the intervention in
 58 the monetary market. Also it adopted a device which consist in targeting the currency (M3) whose operational
 59 target is the monetary base. In 2010,the Board of Directors of the Central Bank decided the adoption of a
 60 monetary policy which aimed at controlling the inflation , ensuring an adequate financement of the economy
 61 to maintain unchanged the interest rate .It also monitors the shift in the international conjunctures and its
 62 possible impact on the national economy and the balance of payments in particular (Amiri andTalbi,2013).The
 63 inflation targeting monetary strategy is not a new approach. Indeed, it was first implemented in New Zealand
 64 in 1990, then in the developed economies like Finland, Sweden, Australia, The Czech Republic, Poland, Brazil,
 65 Chile, Colombia, South Africa, Thailand, South Korea, Mexico etc followed this strategy. The success that New
 66 Zealand, Canada or Great Britain is witnessed through an inflation that does not overcome the claimed in flation
 67 target (Ammer and Freeman, 1995). Inflation targeting was adopted only in1999 by the developed countries
 68 (Leiderman and Svensson, 1995; Calum, 1996; Bernanke et al. 1999). Given the benefits of this policy in
 69 terms of credibility and anchor expectations, Tunisia plans to adopt it in the medium run, also it is guided to a
 70 flexible exchange rate. According to (Baccar, 2008), the Tunisian governor of the Central Bank at that time,
 71 IT is closely linked to the capital account liberalization, the total convertibility of the currencies, the flexibility
 72 of the exchange rate, the competitiveness of the country, the unemployment, the independency of the Central
 73 Bank, the depth of the financial market and the banking system's strength.

74 The paper is outlined as follows. Section 2 discusses the modeling strategy of the DSGE model. Section3 briefly
 75 outlines the estimation procedure and describes the estimation results using the Bayesian technique (Smets and
 76 Wouters, 2002) to find the posterior mode, the variance decomposition and the impulse response function of the
 77 macroeconomic variables to different shocks. Section 4 summarizes the main findings of this paper.

2 II. Dsge Model for the Monetary Policy Analyses

79 Actually much research has been conducted to investigate the impact of (IT)on the macroeconomic variables .
 80 For example (Vascek and Musil, 2005) analyzed the behavior of the Czech economy with (IT) regime following
 81 DSGE model. They found that the model seems to give a very satisfactory approximation of the Czech economy
 82 behavior. (Benes et al. 2007) used a DSGE model to support the monetary policy in the emerging market
 83 economies following (IT). They tested the model's properties on recent Turkish data, and show that the main
 84 stylized features relevant for the monetary policy making, are well captured by the model. (Vítola and Ajevskis,
 85 2011) assessed the implications of IT versus the fixed exchange rate regime for seven EU non-euro area countries
 86 with DSGE model. They found that in all the countries the IT monetary rule guarantees more stable inflation
 87 and output than under the other regimes i.e fixed or flexible exchange rate. (Burriel et al,2010) described the
 88 main features of the Spanish economy for the policy analysis using the MEDEA (Modelo de Equilibrio Dinámico
 89 de laEconomía Española) type of DSGE model which is estimated with the Bayesian techniques, and performed
 90 different exercises to illustrate the potential of MEDEA. (Peiris and Saxeegard, 2007) evaluated the monetary
 91 policytradeoffs like the exchange rate peg and the IT in lowincome countries using a (DSGE) model estimated
 92 on Mozambique data taking into account the sources of major exogenous shocks, and the level of the financial
 93 development. The transition to the IT regime needs the comprehension of the monetary transmission mechanism.
 94 To do so, the basic New-Keynesian model (the DSGE) in the spirit of (Villaverde, 2009) is described. In this
 95 model 3 agents are presented. Beginning by the households, the latter represent a continuum so that we can obtain
 96 a whole distribution of wages with each household charging its own differentiated wage. The need of a balanced
 97 growth path implies that the household maximizes the lifetime utility of the form:

98 The utility function depends on the consumption c_t , employment l_t and real money balances m_t/p_t .
 99 In this case E_0 is the conditional expectation operator, p_t is the price level, β is the intertemporal discount
 100 factor representing time preferences. The period utility function is affected by two shocks ϵ_d and ϵ_l which
 101 are normally distributed $N(0,1)$. . The demand shock is an intertemporal preference shock d_t which makes the
 102 agent consume more or less in the current period.

103 The other shock is a shock to labor supply ϵ_l that captures the movements in the observed wedge relating
 104 to the preference between leisure and labor(Hall, 1997).

105 Both shocks follow an autoregressive process of order 1.Their autoregressive coefficient and their standard
 106 deviation are respectively ρ_d , ρ_l and σ_d , σ_l . The household can save on capital k_{t-1} with a depreciation

rate r_t , so that the investment on physical capital x_t satisfies : They can also save on money balances mb_t , or government bonds b_t paying a nominal gross interest rate of R_t . The first order condition (FOC) of the household are: Where λ_t is the lagrangian multiplier associated with the budget constraint.

The equation above is the leisure choice where η is the frish labor supply elasticity and θ the weight on leisure. The pricing kernel is defined by: The final goods' producing firm produces the final domestic goods (y_t) using the intermediate domestic goods (y_t^i) with the following production function:

where σ is the elasticity of substitution between consumption today and tomorrow across the domestic intermediate goods. The final goods' firms maximize profits in a perfectly competitive environment subject to the production function.

As far as the Intermediate goods' producers are concerned ,there is a continuum of intermediate goods' producers in a competitive market who rent the capital and labor .Each one is defined by i producer and has access to technology represented by a production function:

Where α is the elasticity of output to capital, A is a scaling parameter which stands for a neutral technology level, k_{it-1} is the capital rented by the firm, l_{it} is the amount of labour input rented by the firm and z_t is the technology growth rate which follows AR (1) process which is defined by: It is worth stating that the firm has constant returns to the scale, so the output rises by the same proportional change in inputs. The marginal cost does not depend on i , i.e all the firms receive the same technology shocks and all the firms rent inputs at the same price. The marginal cost is given by: Where r_t is the rental price of capital.The intermediate goods' producers consider that they are subject to a Calvo pricing mechanism, so they choose the price that maximizes the discounted real profits. In each period a fraction $1-\theta$ is considered of the firms that can change their prices. It is the probability of reoptimizing prices, while the others keep the previous prices. The firm change their prices to satisfy:

The recursive equation of prices:

The recursive equation for prices 2 :

The recursive condition for prices 3: $g_t = \theta \lambda_t^* y_t + (1-\theta) E_t \lambda_{t+1}^* y_{t+1} + \theta \lambda_t^* y_t + (1-\theta) E_t \lambda_{t+1}^* y_{t+1}$ (15)
 $\lambda_t = \theta \lambda_t^* y_t + (1-\theta) E_t \lambda_{t+1}^* y_{t+1}$ (14)
 $g_t = (\theta + (1-\theta)g_t)$ (13)
 $p_{t-1} = \theta p_{t-1} + (1-\theta) p_t^*$ (12)
 $mc_t = \theta p_{t-1} + (1-\theta) p_t^*$ (11)
 $z_t = \theta z_{t-1} + (1-\theta) z_t$ where $z_t \sim N(0,1)$ (10)
 $y_t = A k_{it}^{\alpha} l_{it}^{1-\alpha}$ (9)
 $y_t = \theta y_t + (1-\theta) y_t$ (8)
 $m_t = \theta m_t + (1-\theta) m_t$ (7)
 $e_t = \theta e_t + (1-\theta) e_t$ (6)
 $d_t = \theta d_t + (1-\theta) d_t$ (5)
 $k_t = (1-\delta)k_{t-1} + x_t$ (4)
 $t = \theta t + (1-\theta) t$ (3)
 $d_t = \theta d_t + (1-\theta) d_t$ (2)
 $E_0 \theta = \theta \log c_t + e_t + \lambda_t + v \log (m b_t p_t)$ (1)

The government is considered as the last agent in the model. The latter decides the nominal interest rates through the open market operations that are financed through lump-sum transfers T_t according to the following Taylor rule as a function of the past interest rates, and the inflation :

In this Taylor rule π^* is the target level of inflation(equal to the inflation in the steady state)and $R = \theta$ is the steady state nominal gross return of capital. ϵ_{mt} is a random shock to the monetary policy normally distributed with an autoregressive coefficient θ_m and a standard deviation σ_m . The implementation of the interest rate can be shown either through the open market operations or through the paying interest on bank reserves. The monetary policy yields either a surplus or a deficit in both cases that is eliminated through lump-sum transfers T_t to the households. The equilibrium of the economy is characterized by the first order conditions of the household, the firms, the taylor rule of the government and the market clearing.

3 III. The Bayesian Estimation of the dsge Model

To ensure that the model is not stochastically singular and to reproduce the dynamic in the data, a number of stochastic shocks are incorporated in the model. The shocks that affect the economy in this case are the intertemporal, the productivity,the labor supply and the monetary shock. To estimate the parameters of the DSGE model, the data are quarterly chosen covering the time interval from 1980Q1 to 2011Q4.We use time series for 7 macro-economic variables in Tunisia which are defined by the real gross domestic product(GDP), the consumption, the total investment, the inflation, the real wages, the employment and the nominal interest rate. All the data are supplied by the International Financial Statistics (IFS),the web site of the Central Bank of Tunisia, and the National Statistics Institute of Tunisia web site(INS). The output, consumption, investment, employment were transformed to quarterly data using low to high quadratic-much -sum converter of EViews. The macroeconomic variables were transformed into real per capita. The missing data are filled by K Nearest Neighbor (KNN) of matlab. According to ??Juillard et al. 2004) the time trend in the data are removed on the key macro variables with Hodrick Prescott filter. All the seasonal features of the series are removed using X12 ARIMA FILTER because the theoretical model is not designed to pick up the seasonal fluctuations in the macro -economic data. The seasonally adjusted data are also considered in logarithms except the wage rate. The DSGE model is estimated using the Bayesian techniques. It is worth reminding that this approach which characterizes the posterior distribution of the parameters of the model places a prior distribution $p(\theta)$ on the deep parameters and updates the prior through the likelihood function. ??Geweke, 1998) shows that this is directly related to the predictive performance of the model and it is useful for the policy analysis and forecast. This Bayesian approach enables us to process the model and the uncertainty parameter explicitly and seeks a model with the highest posterior probability. For the calibrated values which are quite standard in the literature, the paper refers to the values of ??Villaverde, 2009) and (Ben Aissa and Rebei, 2009) which are based on the parameterization of

(Backus and Crucini, 2000). The quarterly discount factor β in equation (1) is set equal to 0.98 so that a yearly nominal R interest rate is about 4% at the steady-state. The latter is annualized so that $\beta = \exp[-r/400]$. The steady state rate of inflation π defined in the equation (16) is set to 1.005.

The quarterly depreciation rate of capital $\delta = 0.025$ noted in the equation (4) is chosen like the value calibrated in the low income countries detected by (Peiris and Saxegaard, 2007). The persistence of all the shock ρ , ρ_z , ρ_d presented respectively in equation (3), (10) and (2) is set to 0.8 but their associated standard deviation are different. For example, the standard deviation for the productivity shock determined in equation (10) in our case is very low $\sigma_z = 0.01$ according to (Gali and Monacelli, 2005) and to the average of the international business cycle literature. This is because the new technologies are usually introduced slowly in respect to the quarterly periods. The standard deviation of the monetary shock expressed in equation (16) is very low where $\sigma_m = 0.005$ and the corresponding autoregressive coefficient is set to 0, $\rho_m = 0$. Table ?? exhibits the calibrated parameters that are selected according to the literature and by the theoretical restrictions imposed on some of the parameters while the table 2 displays the steady state result. As for the choice of the prior distribution of the parameters. The Beta distribution is selected for the parameters that lie between 0 and 1 such as the autocorrelation coefficients of the shock processes ρ . The Normal distribution was chosen for the unconstrained parameters while the Inverse Gamma and gamma distribution was selected for the shocks and the parameter values greater than zero i.e real positive value. For the choice of the mean and the standard deviation of the priors, we refer to the model of ??Villaverde, 2009) and ??Smets and Wouters, 2007). The average duration in which a firm can optimize its price are centered around four quarters. According to (Smets and Wouters, 2002), it is two and a half years (2,5). The estimation results are demonstrated in table 3 and 4 inference on the parameters. According to the multivariate and univariate diagnostics, a sample of 100000 draws were sufficient to ensure the convergence of the Metropolis-Hastings sampling algorithm. Especially The MCMC is run with 100000 draws with 2 parallel chains of MH algorithm. In each case of the three figures, dynare reports both within and between the chains' measures. The red line measures the parameter vector within the chains while the blue line measures the parameter vector between the chains. The convergence of the MH method measures computed within and between the chains should converge. An overall convergence is reached after 100000 draws. There are many convergence diagnoses, which enable the determination of the chain convergence. Without convergence verification, the approximation of the posterior distribution is not credible (Grabek et al. 2011). Table 3 reports the mode and the mean as well as 90% per cent confidence interval of the posterior probability which reflects the uncertainty on the structural parameters. The confidence interval reports the 5, and 95 percentile of the standard deviation of the posterior distribution of the parameters obtained through the MH sampling algorithm. The Calvo parameter or the price stickiness parameter of the intermediate good producers for the price adjustment determined in equation (12) presents information about the timing of the price and the wage setting decisions by the domestic firms and the households. The posterior mean of this parameter is found $\theta = 0.4997$ i.e 49% of firms do not reoptimize their price setting implying a price duration of the non optimizing firms of $1/(1-\theta) = 1.99$ quarters. This means that the nominal prices are fixed for 2 quarters approximatively. This parameter is important but it is low compared to the one of the euro area which is nearly 3 quarters for $\theta = 0.9$ see ??Smets and Wouters, 2003; ??dolfson et al. 2005; Gal? and Gerlter, 1999). Knowing that the inflation is negatively correlated to the price stickiness. If there is a high rigidity, there will be a sluggish or gradual response (increase or decrease) of inflation to a monetary shock (Mankiw, 2000; Christiano et al. 2011). This rigidity rationalizes the persistent effect of the monetary shock and brings about a lesser fluctuation of the variable. The posterior mean of the Frish labor supply elasticity η defined in (6) is 1.5128. According to (Burriel et al. 2010), the posterior mean of this elasticity in the Spanish economy accounts for 1.83, which is in line with most estimations for the other countries. As an example, (Smets and Wouters, 2007) estimate a high Frisch elasticity of 1.9. The value found is rather credible once we think about both the intensive and the extensive margin of the labor supply. Also (Hall, 2009) affirmed that the fluctuation in the total hours worked in the economy as the workers involuntarily lose jobs in economic downturns and regain jobs as economic conditions improve, is largely due to the changes in the number of workers who move in and out of unemployment rather than to changes in workers' desired work hours. The elasticity of output to the capital which is the relative shares of the capital in the goods production noticed in equation (??) is set to $\alpha = 0.4102$. According to (Adjemian and Devulder, 2010) this parameter α obtained from the Cobb-Douglas function is situated between [0,1] interval. They think that it is nearly in the neighborhood of 1/3 as the Year 2015

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© 2015 Global Journals Inc. (US) - Year 2015 (E) R t R =? R t?1 R ? ? R ? ? t ? ? ? ? (1?? R) exp(? m m t)(16

5 (E)

conventional settings. In terms of the posterior mean of the elasticity of substitution of consumption given by equation (??) σ , it amounts to 2.7209. This value is not consistent with the log preferences and the findings of (Casares, 2001) for the euro area and the RBC literature which assumes an elasticity of substitution between a half and one. However, in this case it is highly conspicuous that consumers are less responsive than expected to change

229 their current consumption decisions in response to the interest rate shocks. This value is not very far compared
 230 to the inverse of the intertemporal elasticity of the consumption substitution perceived by ??Gelain and Kulikov,
 231 2009) which is centered around 1.85. It is higher than the value 1.39 reported by ??Smets and Wouters, 2003) for
 232 the euro area. When it comes to the estimates of the autoregressive coefficients of the stochastic processes, we can
 233 see that they are high as they reflect a high degree of persistence found in the data. Based on the posterior mean,
 234 the estimates of the smoothing degree of the preference shock noted in equation (2) is $\beta = 0.6855$ considered
 235 important. So it has an effect on the permanent change in the preference. The other estimated coefficients imply a
 236 higher persistence for the labor supply shock $\beta = 0.9554$ detected in equation (3). This persistence, coming from
 237 the labor disturbance, is sufficient to describe the observed dynamics of the Tunisian time series. The persistence
 238 for the productivity shock noticed in (10), is $\beta = 0.9999$ which seems to be in line with the literature as well as
 239 with the benchmark studies for the euro area ??Smets and Wouters, 2003) and ??Adolfson et al, 2005). In this
 240 context (Burriel et al. 2010) observed that the estimation of the autoregressive parameters 's shock processes
 241 show that the domestic shocks are very persistent, especially those related to demand, public consumption, and
 242 preferences. The next set of the parameters reported in Table 4 is related to the standard deviation of the shock.
 243 Beginning with the labor supply shock β defined in equation (3) ,it is estimated to 0.0574 so they are not very
 244 important in explaining the business cycle fluctuation. Henceforth, the deviation of the preference shock observed
 245 in (2) is $\beta = 0.0566$. The monetary shock is larger with a mean of $\beta = 0.0725$. Finally the productivity
 246 shock presented in (10) has the value of $\beta = 0.5357$ which is the most volatile. It is crucial to refer to the
 247 previous studies in the Tunisian economy with DSGE. For the instance ,the research carried out by (Ben Aissa
 248 and Rebei, 2009) who detected the standard deviation of the technology shock both for the subsidized and the
 249 non subsidized intermediate goods which amounts to 0.00925 on average .It is more volatile than the monetary
 250 shock set to 0.001 on average, and that of (Jouini and Rebei, 2013) In fact, in the long run, the reduction in
 251 the money supply via the interest rate reduces proportionally the inflation. As stated by Friedman "inflation
 252 has a monetary origin". Therefore, the currency has no effect on the production and the nominal interest rate
 253 in the long run. In absence of the money effect in the long run, we can conclude that it is neutral. 4 plots the
 254 intertemporal preference shock or the discount factor shock. The latter is a demand shock which make the agent
 255 prefer to consume more or less in the current period. The consumption choices can be affected by the deep habit
 256 that it not mentioned in this case. Our result is different from the one of (Smets and Wouters, 2002) focusing on
 257 the effect of a positive preference shock, that is an increase in the interest in consumption, and to the temporary
 258 shock of (Vasicek and Musil, 2005) in terms of inflation, output and interest rates. It is also different from
 259 (Grabek et al. 2011) with the positive preference shock, in terms of consumption, output, employment ,domestic
 260 prices and interest rate. On the other hand, we find that labor supply (l) as well as the real wage(w) reveal a
 261 downward trend. This is justified by the decreasing demand in consumption that puts pressure on the real wage
 262 which will drop making the marginal cost (mc) defined in (11) and the inflation(ppi) fall. (Smets and Wouters,
 263 2004) claimed that the downturn in the US economy is mostly driven by a negative preference and an investment
 264 shock.

265 Year 2015 (E) The technology or the productivity shock is represented in Figure 5. When there is a high
 266 productivity, the representative intermediate goods producing firms are able to produce more goods at a lower
 267 price. Therefore we can deduce like (Adnen and Frikha, 2011) and (Daboussi et al. 2013), that in the short term,
 268 a supply shock has a positive effect on production which is rising (around 10 -2). According to the conventional
 269 theory, a rise in the productivity and an improvement in the production technology leads to an increase in the
 270 output(y) and the consumption(c). In this context,(Jouini and Rebei, 2013) highlighted that the increasing
 271 production shock in the goods' sector raises demand throughout the Tunisian economy and hikes the aggregate
 272 outputs as well. For more information, we can refer to the results of ??Gelain and Kulikov, 2009; ??Mkrtchyan
 273 et al. 2009; Smets and Wouters, 2002; Huseynov, 2010). This shock makes the price level or the inflation(ppi)
 274 decline in the short term because the monetary policy cannot offset the decline in the marginal cost (Peiris and
 275 Saxegaard, 2007). According to (Mkrtchyan et al. 2009), the inflation decreases owing to the reduction of the
 276 production cost and the higher labor productivity. Also (Huseynov, 2010) ascertains that more production and
 277 more distribution networks imply a decrease in the domestic price which leads to a drop in the domestic inflation.
 278 The interest rate(r) dips in the short run. (Mkrtchyan et al. 2009) and (Benes et al. 2005) claimed that the
 279 monetary authority responds to deflation by lowering interest rates. Furthermore, (Grabek et al. 2011) added that
 280 lower inflation implies a reduction of the interest rate. This result is similar to the one of ??Smets and Wouters,
 281 2003; ??Gelain and Kulikov, 2009). In the medium term, it is important to remember the finding of (Chockri and
 282 Frikha, 2011; Daboussi et al. 2013) who revealed that this positive effect of the supply shock on output(y), the
 283 nominal interest rate (R n) and the price level are more likely to decline and vanish. Therefore this shock effect
 284 becomes negligible and tends to be absorbed in the long run. Concerning the investment(x), it declines as the
 285 result found by (Jouini and Rebei, 2013) in Tunisia because of the depreciation of the real exchange rate according
 286 to them. Employment(l) declines as a result of the interaction between the sticky prices and the technological
 287 shift pointed out by ??Gali, 1999; ??Smets and Wouters, 2002; Peiris and Saxegaard, 2007 ; Grabek et al. 2011).
 288 (Peiris and Saxegaard, 2007) explained that the reason that makes the firms reduce employment is the decrease
 289 of the aggregate price level and the rise of the aggregate demand less than the growth of productivity. (Peiris and
 290 Saxegaard, 2007) and (Grabek et al. 2011), discovered that the marginal cost (mc) of the domestic production
 291 falls across all the firms due to the rise in productivity (Smets and wouters, 2002). The latter enables them to

lower the prices of the domestic goods (Mkrtchyan et al. 2009). Finally, following this positive productivity shock, the real wage (w) gradually rises in the medium term which is consistent with the result of Gelain and Kulikov, 2009) and (Smets and Wouters, 2002). Eventually, there is another interesting shock which is the labor-shock interpreted by a rise in the labor supply. This shock is displayed in the figure 6. Since the end-nineties, there have been significant shifts in the Tunisian economy, mainly due to the increase in the labor force participation, the large immigration flows and the integration of the women and the young manpower in the labor market. It is noticeable that the nominal interest rate (R_n) has increased then leveled off. There is also a wage reduction (w). In this context, Gelain and Kulikov, 2009) puts forward that when working-hours increase, wages drop which imply a reduction in the domestic inflation (ppi) in the long run via the effect of the reduction of the marginal cost (mc). Indeed, (Smets and Wouters, 2002) showed that the fall in real wages leads to a fall in the marginal cost as well as a decrease in the inflation. To further elucidate the trend of these two variables, one can refer to (Grabek et al. 2011) who confirms that the marginal costs of domestic production as well as the inflation rise in the short term then will slightly decrease in the medium term. He also justified that an increase in the price of labour services makes the inflation important. The Dynamic Stochastic General Equilibrium Model for the Monetary Policy Analysis in Tunisia

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In our case, the output as well as the consumption insignificantly drop in the beginning of the period but will recover very shortly. This reduction in the output is explained by a large negative demand shock, when the labor supply was negative (Burriel et al. 2010). However, in the medium and the long run there is a stimulation of consumption (c) which in turn boosts the output (y) and the investment (x) because of the fall of the inflation (Gelain and Kulikov, 2009). The Employment (l) rises in line with the rise in the output (y) like the findings of (Smets and Wouters, 2002) due to the fall in the leisure. The investment is improved due to the augmentation of the consumption and the reduction of the leisure. The result related to output, consumption and investment the one of (Grabek et al. 2011) in analyzing the increase in the importance of the leisure. According to them, an improvement of the leisure leads to the reduction in the investment, the GDP, the employment and the consumption.

7 b) Variance decomposition

The importance of the structural shock which contributes to the dynamics of the state variable in the DSGE model is measured by the share of the total variation that a shock explains for each variable of the model (Gelain and Kulikov, 2009). Table 5 presents the variance decomposition result for the Tunisian economy. The most important shock is the monetary shock ϵ_m which accounts for 50% of the state variables. The second shock is the intertemporal shock ϵ_d defined in (2). It accounts for approximately 45% of the variance of the variables. The other shocks have a marginal contribution to the overall variability of the model notably the labor shock. Concerning the output variation, like the results of (Smets and Wouters, 2002), they are driven primarily by the monetary shock $\epsilon_m = 55.81\%$ and the intertemporal shock $\epsilon_d = 20.04\%$, but the labour and the productivity shocks contribute successively with 4.96% and 19.20% of the error variance. Moreover, it is noted that the most striking shock that contributes to the inflation variability is the monetary shock with $\epsilon_m = 74.35\%$. As (Daboussi et al. 2013), we find the prevalence of the monetary shock over the inflation rate. So an anti-inflation policy is deemed necessary. This is contrary to the result of (Smets and Wouters, 2002) who noticed that the monetary shock account little for the variation of the inflation. Besides, there is the productivity shock with $\epsilon_z = 12.51\%$. The contribution of the preference shock ϵ_d is not negligible with 10.97%. In some research previously carried out, there are other shocks like the wage mark up and the price mark up shock that are very crucial in the contribution of the inflation variability. Unfortunately they are not available in this paper. For the interest rate, the most visible shock is also the monetary shock which contributes with $\epsilon_m = 77.16\%$ to the variation of the latter. Then, follows the productivity shock with $\epsilon_z = 10.58\%$ and the preference shock with the contribution of $\epsilon_d = 10.34\%$ of the variability of the interest rate. For the employment, the most striking shock is again the monetary shock ϵ_m with 64.22%; then occurs the preference ϵ_d with 22.30% and finally the labor shock that accounts for $\epsilon_l = 5.50\%$ of the employment variability. To conclude for the real wage variable, it is necessary to mention that in the study of (Smets and Wouters, 2002) the wage mark up shock is the most conspicuous in the variation of the real wage, but in this case, the monetary shock occurs at the top with a part of $\epsilon_m = 79.77\%$ and the productivity ϵ_z shock comes after with a contribution of 14.49% of the real wage variability.

8 IV. Conclusion

This paper provides a simple neoknesian model of (Villaverde, 2009) represented by DSGE to evaluate the transmission of the monetary policy in Tunisia and to see the effect of applying the IT policies. To do so, the Central Bank must stabilize the prices according to the Taylor rule to adjust the interest rate. This model is estimated with the Bayesian techniques with the nominal rigidities using seven macroeconomic variables and 4 shocks. The empirical properties of the model is examined by studying its impulse-response functions and its variance decomposition. The estimated DSGE turned out to have economically plausible properties in terms of

351 the propagation of the key economic shocks into the Tunisian economy and their contribution to the business cycle
352 fluctuations. It seems to show a suitable approximation of the behavior of the Tunisian economy with respect to
353 the results. The findings reveal that the monetary shock bears a significant influence on inflation. The graphics
354 and estimations show the importance of the interest rate channel to stimulate the output and the consumption..
355 In addition, it is worth noticing that there are some conditions to be met before choosing this regime policy.
356 According to ??Mishkin, 2000; ??atini and Laxton, 2005), these conditions are the independency of the Central
357 Bank, the advanced infrastructure techniques for a reliable forecasting, the solid financial system, also having a
358 low inflation because of the difficulty of forecasting inflation and hitting an inflation target in the conditions of
359 high and volatile inflation (Hammond, 2012). (Pétursson, 2000) pointed out that there are other factors beyond
360 the control of the Central Bank that have short-term effects on inflation making IT difficult to implement like
361 the fiscal dominance and the labor market conditions. Concerning the limits of this study, (Kvasnicka, 2001)
362 and (Mizen,1998) affirmed that the examples of success achieved by many countries do not mean that IT is the
363 best conduction driven by the monetary policy. Until now researchers don't know whether this regime is more
364 suitable for the developed countries ??Masson et al. 1997) or for the emerging countries. They cannot take
365 general conclusions for this policy because the period of implementation it is too short (Jonas and ??ishkin,
366 2003). (Hammond, 2012) added that IT is not the optimal monetary policy regime for curbing inflation but it
367 proved to be effective at anchoring inflation expectation around the target and maintaining inflation stable. Many
368 other features are tremendously essential to capture the persistence and the covariance in the data, to ameliorate
369 the fit of the model and to delay the response of the economy to shocks, are missed in this paper. For example the
370 habit persistence in consumption, the adjustment cost of investment and changing the utilization rate ,the labor
371 market frictions that will enrich the study. In this paper, we put forward a closed small model of the Tunisian
372 economy. In the further research, the open economy model as well as IT with a floating exchange rate as a new
373 monetary policy framework of choice will take our interest , because of the failure of money targeting in the
mid1980 and the collapse of the fixed exchange rate pegs in the early 1990 (Hammond, 2012).^{1 2}



Figure 1:

374

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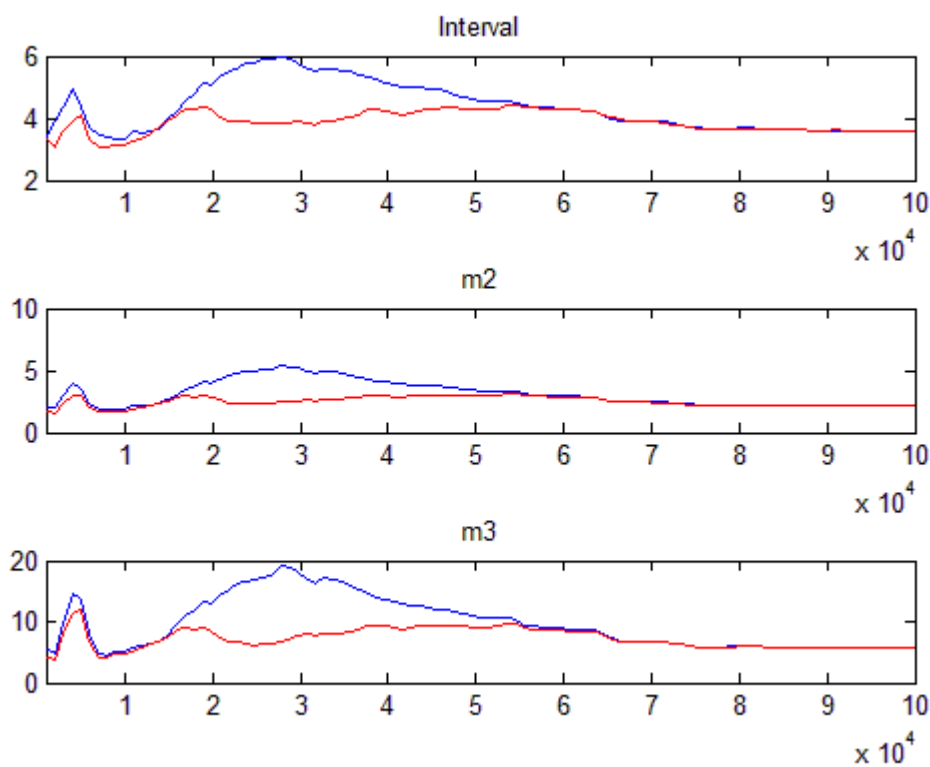


Figure 2:

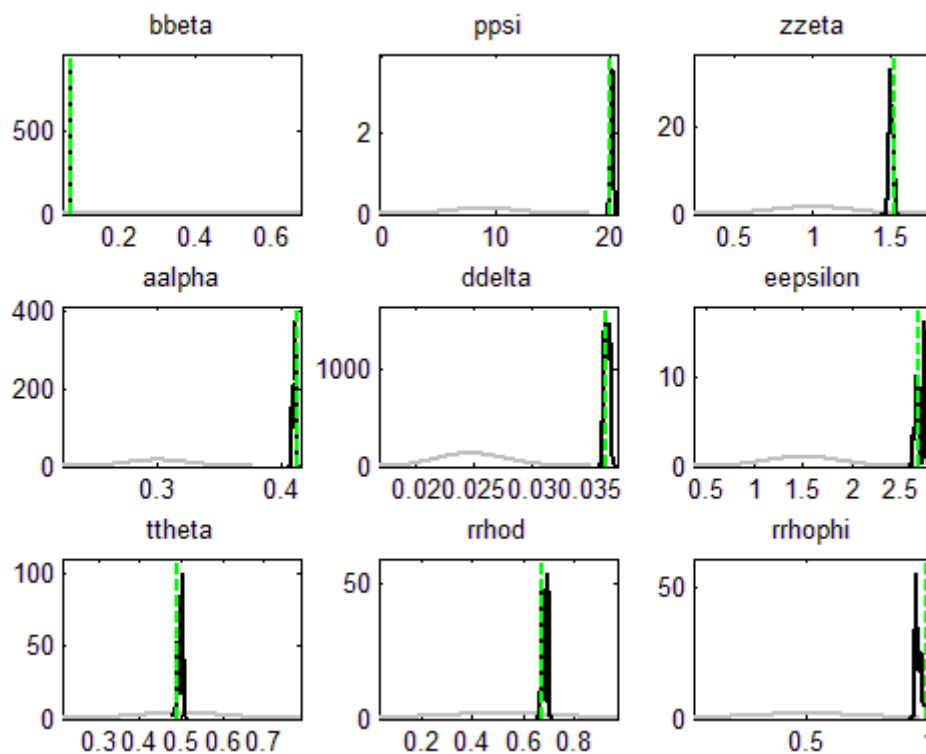


Figure 3: Figure 1 :

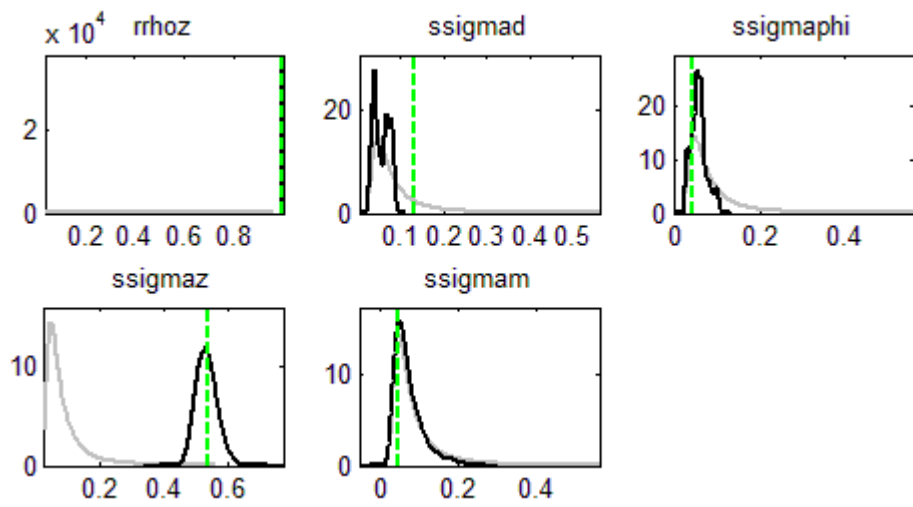


Figure 4:

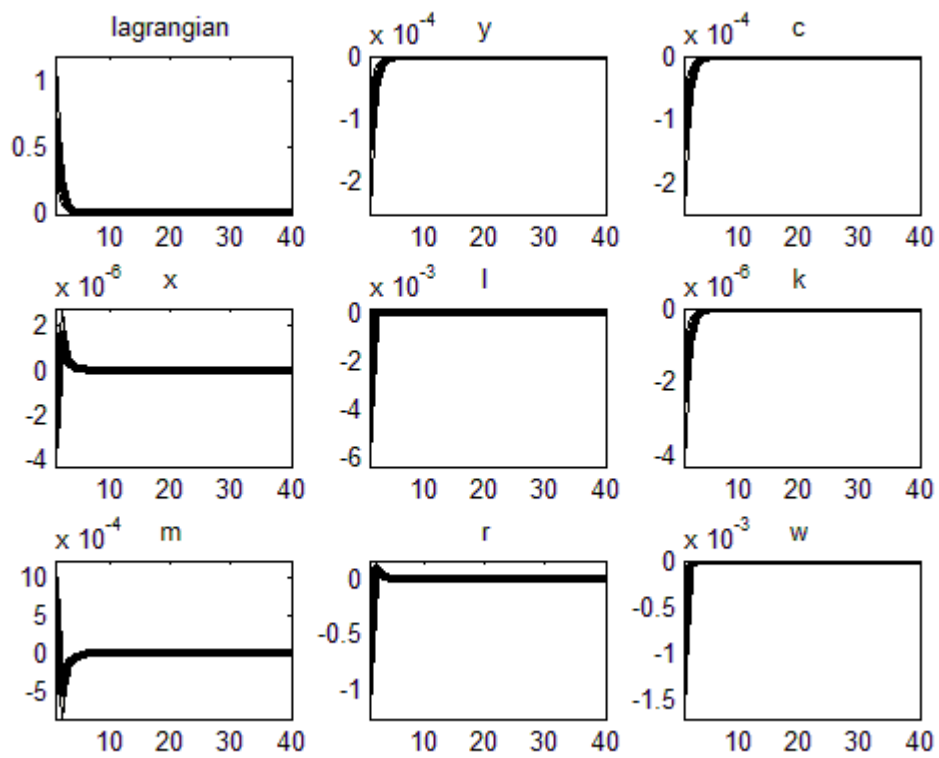
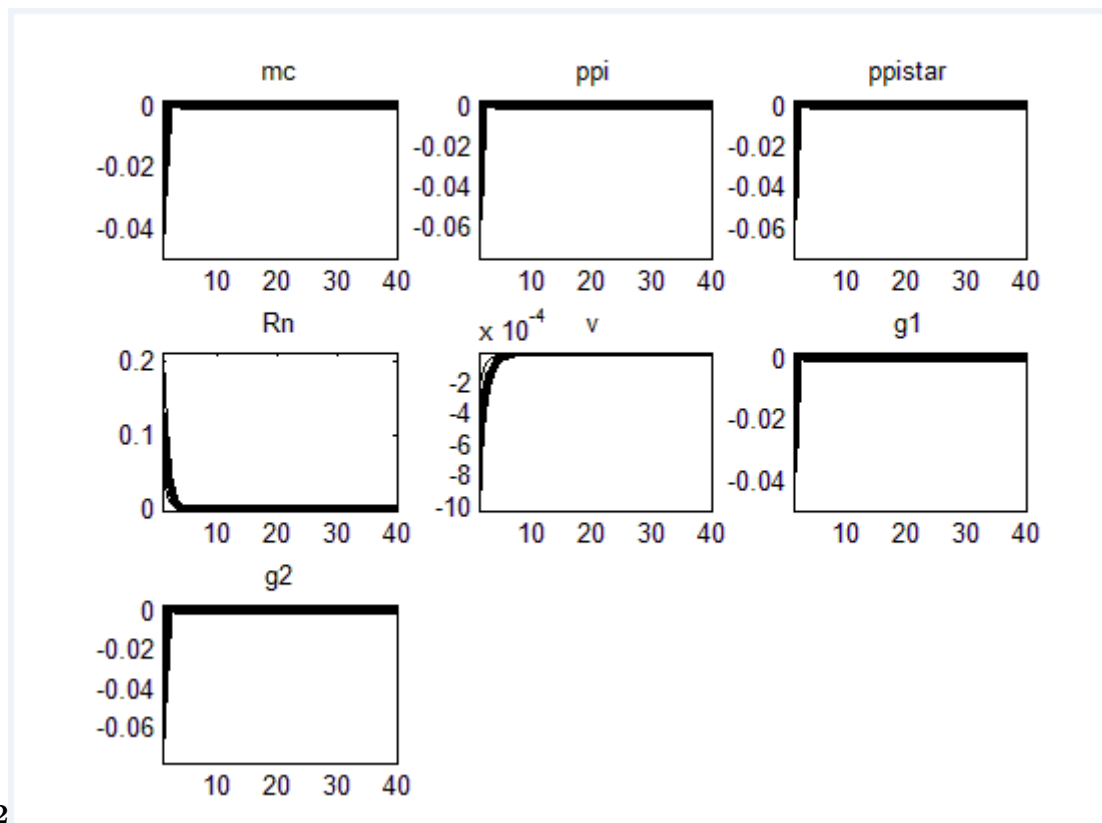
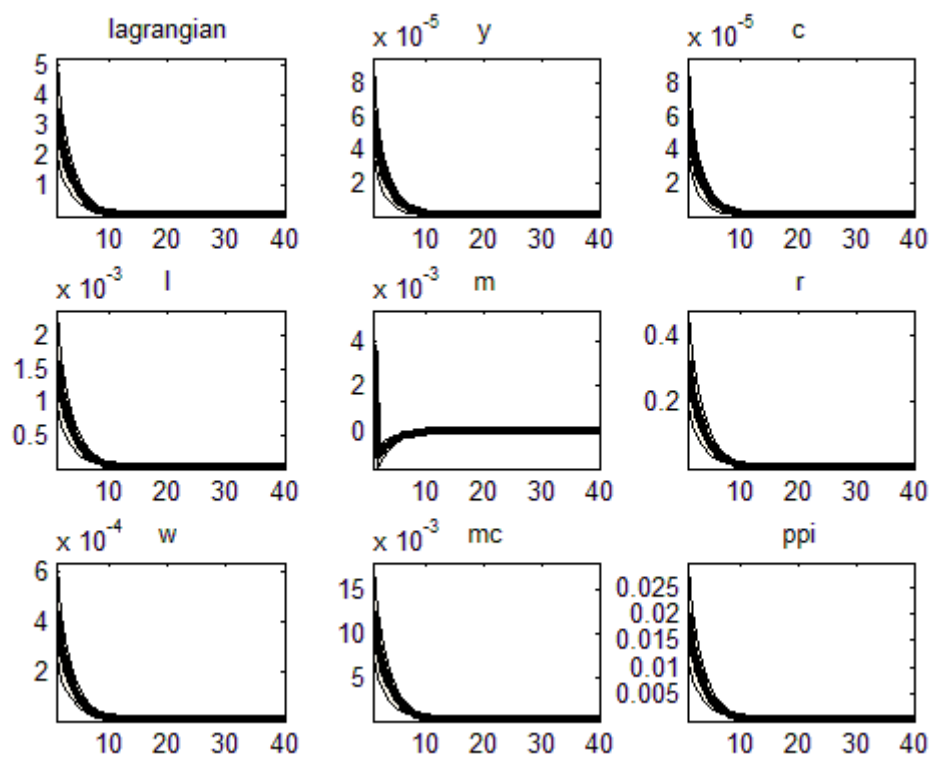


Figure 5:



2

Figure 6: Figure 2 :



3

Figure 7: Figure 3 :

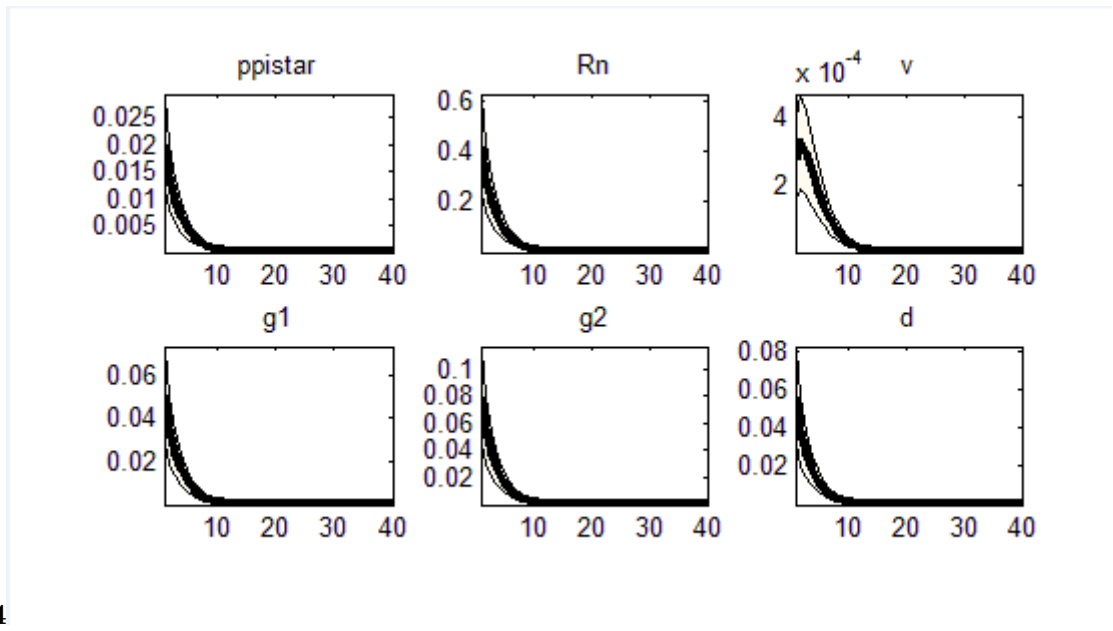


Figure 8: Figure 4 :

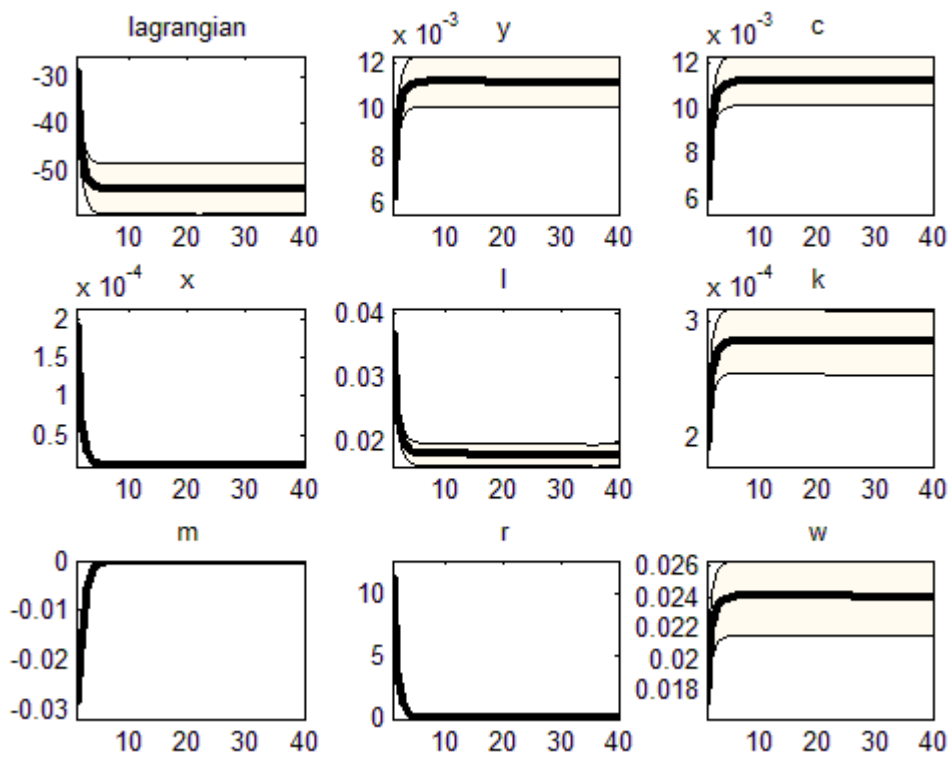
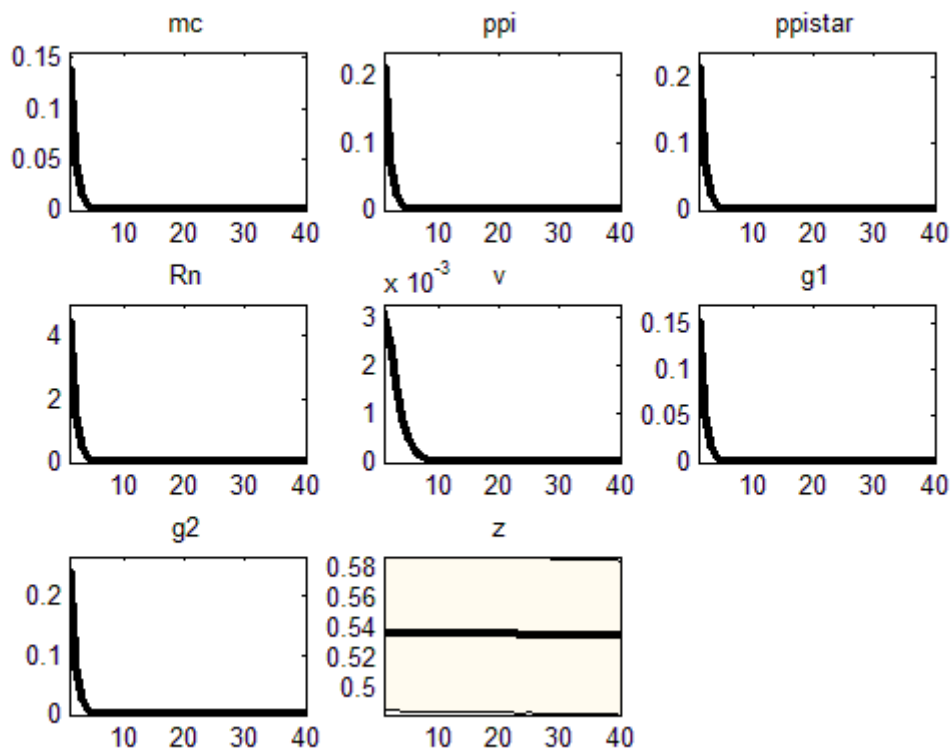
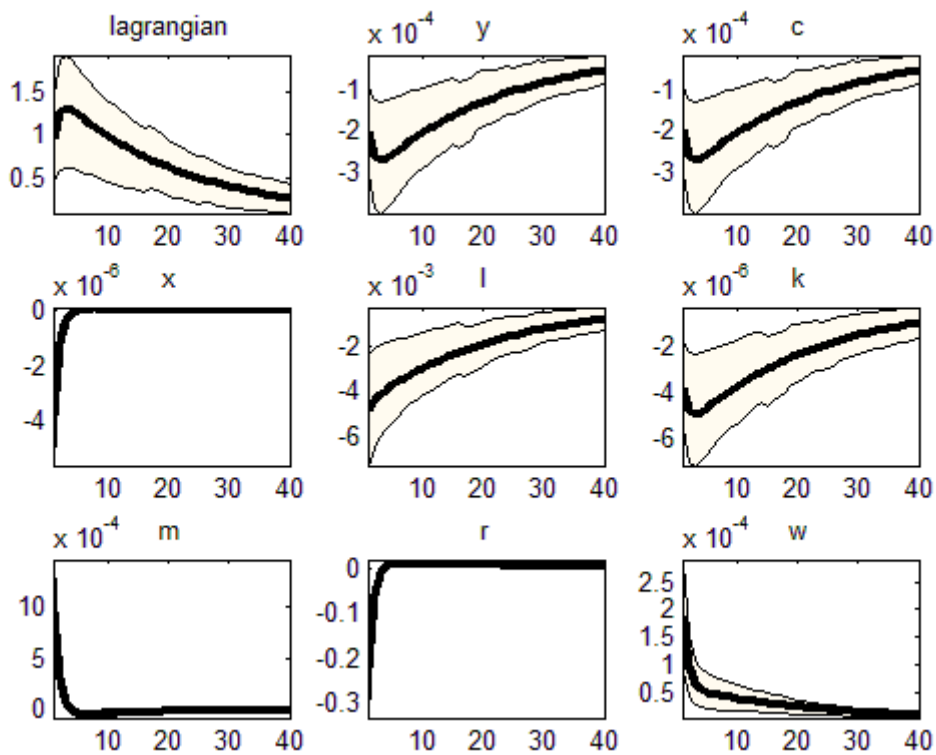


Figure 9: Figure



5

Figure 10: Figure 5 :



6

Figure 11: Figure 6 :

Table 1 : Calibrated parameters						
Parameters	Value	Description	Parameters	value	Description	
?	0.98	Discount factor	Autoregressive coefficient (persistence) of the shocks			
?	0.35	Elasticity of output to capital ratio	? d	0.8	Degree of smoothing the preference shock	
?	1/3	The weight on leisure	? z	0.8	Degree of smoothing the productivity process	
?	0.5	Frish elasticity	lab supply	? ?	0.8	Degree of smoothing of labor supply shock
A	1	Technology level	Shock standard deviation			
?	0.025	Depreciation rate of capital	? d	0.025	Standard preference process	
?	8	Elasticity of substitution	? ?	0.01	The standard deviation of labor supply shock	
?	0.75	a fraction of firms that keep price.(does not change price)	the previous	? z	0.01	The standard deviation of technology (productivity) shock
?	1.005	Target level of inflation	? m	0.005	The standard deviation to monetary shock	
?	1.5	The degree of interest rate smoothing				

Figure 12:

2

Parameter	Value	Description	Parameter	Value	Description	
Utility			mc	0.875037	Marginal cost	
lagrangian multiplier	1.20317	Lagrangian multiplier	?	1.005	Inflation rate	
allocation			? *	1.01623	Inflation at the equilibrium	
y	1	output	Rn	1.02551	Nominal interest rate according to taylor rule	
c	0.831141	consumption	v	1.00144	Price inefficiency	dispersion
x	0.168859	Investment	Auxiliary function			
l	0.333333	labour	g1	4.47853	Recursive equation for prices2	
k	6.75437	capital	g2	5.11832	Recursive equation for prices 3	
Prices			Stochastic process			
m	0.98	Pricing kernel	d	0	Intertemporal shock	
r	0.0454082	Interest rate	?	0	Labor shock	
w	1.70878	Real wage	z	0	Productivity shock	

Figure 13: Table 2 :

3

Parameter	Prior distribution	Prior Mean	Prior Standard deviation	Maximized posterior mode	Maximized posterior mean	Posterior distribution (MH) Confidence interval 5%	Posterior distribution (MH) Confidence interval 95%
? (bbeta)	gamma_pdf, G2(μ , ?, p3)	0.250	0.1000	0.0705	0.0705	0.0698	0.0712
? (ppsi)	normal_pdf, N(μ , ?)	9.000	3.0000	19.9816	20.2257	20.0599	20.4362
? (zzeta)	normal_pdf, N(μ , ?)	1.000	0.2500	1.5330	1.5128	1.4888	1.5321
? (aal-pha)	normal_pdf, N(μ , ?)	0.300	0.0250	0.4121	0.4102	0.4079	0.4119
? (ddelta)	beta_pdf, B(μ , ?, p3, p4)	0.025	0.0030	0.0365	0.0366	0.0363	0.0369
? (eep-silon)	normal_pdf, N(μ , ?)	1.500	0.3700	2.7001	2.7209	2.6673	2.7799
? (ttheta)	beta_pdf, B(μ , ?, p3, p4)	0.500	0.1000	0.4897	0.4997	0.4911	0.5071
? (rrhod)	beta_pdf, B(μ , ?, p3, p4)	0.500	0.2000	0.6731	0.6855	0.6709	0.7011
? (rrhophi)	beta_pdf, B(μ , ?, p3, p4)	0.500	0.2000	0.9925	0.9554	0.9401	0.9718
? (rrhoz)	beta_pdf, B(μ , ?, p3, p4)	0.500	0.2000	0.999	0.9999	0.9999	0.9999

Figure 14: Table 3 :

4

Parameter	domain	Prior distribution	Prior	Standard	Maximized posterior		Confidence interval	
			Mean	deviation	mode	mean	5%	95%
? d (ssig- mad)	R+	inv_gamma_pdf,	0.100	2.0000	0.1302	0.0566	0.0302	0.0832
? ? (ssigmaphi)	R+	inv_gamma_pdf	0.100	2.0000	0.0396	0.0574	0.0259	0.0828
? z (ssig- maz)	R+	inv_gamma_pdf	0.100	2.0000	0.5410	0.5357	0.4801	0.5880
? m (ssig- mam)	R+	inv_gamma_pdf	0.100	2.0000	0.0464	0.0725	0.0245	0.1231

Figure 15: Table 4 :

5

Figure 16: Table 5 :

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