

An Analysis of Unemployment Dynamics in Romanian Economy using a New Keynesian Model¹

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Abstract. A New Keynesian model with unemployment is estimated for Romanian economy. The approach is Bayesian and it is done using quarterly data on a post 2000 sample. The estimation is used afterwards to analyze dynamically the unemployment based on impulse response functions and historical decompositions of shocks.

Keywords: Unemployment, New Keynesian Models, Bayesian Methods.

1. Introduction

A typical feature of an economic crisis, as is the case of the last economic and financial crisis, is the rise in the unemployment. This phenomenon represents one of the most serious aspects of an economic recession implying additional constraints for the policy makers and increased social and economic distress. In this paper we approach the issue of unemployment dynamics for Romanian economy, one of the countries severely affected by the financial and economic crisis, within the recent framework of dynamic stochastic general equilibrium models. We estimate a New Keynesian model with unemployment using the Bayesian approach and analyze the dynamics of unemployment within this estimated model.

2. The Model and Its Estimation

2.1. Unemployment in a New Keynesian Model

The New Keynesian framework (NK, hereafter), also known as the DSGE approach (dynamic stochastic general equilibrium), is a general equilibrium approach which implies the use of micro-foundations, intertemporal optimization and rational expectations. The reference NK model introduces imperfections by considering monopolistic markets and Calvo rigidities in the prices. However, the recent literature has started to show that the standard NK model suffers from the lack of essential features that characterize the market economy, one such feature being the lack of involuntary unemployment, see Abbritti et al. (2006).

Following papers tried to address this evident imperfection by proposing several alternatives to include unemployment in the NK approach. One line of research is due to Mortensen and Pissarides (1994) who proposed the search and matching approach for modeling the unemployment in a general equilibrium approach. Several studies further advanced this approach, among them, Christoffel and Linzert (2005), Trigari (2004 and 2009), or Walsh (2005).

A second significant line of research was due to Blanchard and Gali (2006) and it is based on real wage stickiness. Following these contributions, Abbritti et al. (2006) proposed an alternative to the above

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mentioned lines of research. They proposed the idea of hiring costs together with endogenous real rigidity which might explain some of the shortcoming of the standard NK model, including the lack of involuntary unemployment.

The structural model used here it is of a New Keynesian type with sticky prices and hiring costs. As argued above, the model is inspired from Blanchard and Gali (2008) and is original through the fact that it introduces unemployment by augmenting the standard NK model with the Diamond-Mortensen-Pissarides labor market imperfections. In the next paragraphs, I present the model I use in the estimation and analysis from the next sections. The model is already in log-linear form. The model I use is slightly different in some equations, as explained below.

$$\hat{y}_t = E_t \hat{y}_{t+1} - (r_t - E_t \pi_{t+1} - \log(\beta)) + ey_t \quad (1)$$

$$r_t = \gamma_\pi \pi_t + \gamma_y \hat{y}_t + er_t \quad (2)$$

$$\hat{u}_t = -(1-u)\hat{n}_t \quad (3)$$

$$(1-u)\hat{\alpha}_t = -\hat{u}_t + (1-x)(1-\delta)\hat{u}_{t-1} \quad (4)$$

$$\hat{y}_t = \hat{a}_t + \frac{1-g}{1-\delta g} \hat{n}_t + \frac{g(1-\delta)}{1-\delta g} \hat{n}_{t-1} - \frac{\alpha g}{1-\delta g} \hat{\alpha}_t \quad (5)$$

$$\pi_t = \beta E_t \pi_{t+1} - \kappa_0 \hat{u}_t + \kappa_L \hat{u}_{t-1} + \kappa_F E_t (\hat{u}_{t+1}) - \lambda \Phi \gamma \hat{a}_t + ep_t \quad (6)$$

$$\hat{a}_t = \rho \hat{a}_{t-1} + ea_t \quad (7)$$

The first equation is a standard New Keynesian IS (Investment Savings) curve. Current output \hat{y}_t depends on expected output \hat{y}_{t+1} . Current output is influenced also by the real interest of rate (nominal interest rate r_t less expected inflation π_{t+1}) and the demand shock. The monetary policy rule is a Taylor type one and is presented in equation (2). The interest rate, r_t , depends on inflation and output gap \hat{y}_t . The parameters of the equations are given by the inflation coefficient, γ_π , and the output gap coefficient, γ_y . Equation (3) expresses the basic relationship between the unemployment and employment, with u the steady state unemployment rate.

In equation (4) we have an expression for the relationship between the labor market tightness and the unemployment rate. The labor market tightness variable is given by \hat{x}_t . As Blanchard and Gali (2008) argue, the expression $(1-x)(1-\delta)$ gives a measure of how rigid is a labor market. The higher the value of $(1-x)(1-\delta)$, the more “sclerotic” is the respective labor market. In equation (5) we find an expression for the market equilibrium, which combines the production function and hiring costs function. Inflation process, see equation (6), is expressed as a New Keynesian Phillips curve with current inflation depending on expected inflation, current, past and expected unemployment. The parameters defining the NK Phillips curve are presented below:

$$\kappa_0 = \frac{\lambda h_0}{1-u}; \quad \kappa_L = -\frac{\lambda h_L}{1-u}; \quad \kappa_F = \frac{\lambda h_F}{1-u}$$

And,

$$h_0 = \left(\frac{\alpha g M}{\delta} \right) \left(1 + \beta(1-\delta)^2(1-x) \right) + \beta(1-\delta)gM(\xi_1 - \xi_0);$$

$$h_L = -\left(\frac{\alpha g M}{\delta} \right) (1-\delta)(1-x) - \beta(1-\delta)gM\xi_1$$

$$h_F = -\beta(1-\delta)gM \left(\left(\frac{\alpha}{\delta} \right) - \xi_0 \right)$$

While

$$\xi_0 = \frac{1-g(1+\alpha)}{(1-\delta g)};$$

$$\xi_1 = \frac{g(1-\delta)(1+\alpha(1-x))}{(1-\delta g)}$$

Finally, the productivity process for \hat{a}_t is expressed in equation (7) as a typical AR (1) process.

2.2. Model Estimation

I estimate the model given in the equations (1)-(7) using a Bayesian estimation algorithm. The estimation was done for the period between 2000 and 2010 using quarterly data. I used as observed variables the domestic quarterly GDP, domestic inflation rate, interest rate and the unemployment rate. Quarterly GDP was seasonally adjusted, logged, and filtered using the Hodrick-Prescott filter, where GDP is in constant prices at the level of year 2000. Quarterly inflation is the annualized GDP deflator at quarterly level. The quarterly interest rate is the average of the monthly refinance rate used by the national bank. The unemployment rate is a quarterly average of the monthly unemployment rate. This series was also seasonally adjusted and filtered with Hodrick-Prescott.

The set of parameters to be estimated is given by

$$\{\alpha, \beta, u, x, \gamma, \varepsilon, \delta, \rho, \gamma_y, \gamma_\pi, \xi_0, \xi_1, h_0, h_L, h_F, \kappa_0, \kappa_L, \kappa_F, \Phi, M, B, g, \sigma_a, \sigma_i, \sigma_p, \sigma_y\}$$

Before applying the Bayesian estimation; several of the parameters are calibrated. The calibration is done according to the literature, following mainly previous studies for Romanian economy, like Caraiani (2009, 2010). β is calibrated to 0.99. For ε , the value chosen was at 6. The value for the parameter γ , the degree of wage rigidity is fixed at 0.5 in the middle of range of possible values. The parameters related to the labor market $\{u, x\}$ are set following the literature as well as intuition about Romanian economy. The steady state unemployment rate is set at 0.1, which is reasonable in the light of historical data. There is no reliable data regards the labor market tightness, but we can use the value proposed by Blanchard and Gali (2008) to characterize the more “sclerotic” labor market in Europe, namely $x=0.25$. The parameters

$$\{\xi_0, \xi_1, h_0, h_L, h_F, \kappa_0, \kappa_L, \kappa_F, \Phi, M, B, g\}$$

are derived from the relations presented in the section before. For example, M is derived from the value set for ε , as $M=\varepsilon/(\varepsilon-1)$.

The prior distributions with respect to means were set following previous studies for Romanian economy as well as the general approach in the literature. For example, the prior mean for inflation coefficient in the Taylor rule was set to 1.5 since the disinflation process in Romania required a more conservative monetary policy.

I run two chains each of 500.000 extractions using the Metropolis-Hastings algorithm. The Metropolis Hasting algorithm allows generating draws from the posterior distribution found through the application of the Bayes theorem. The average acceptance ratios are 39.0% and 39.1% for the two chains. The values are in an acceptable range of 20%-40% and we also underline the fact that the difference between the acceptance ratios between the two chains is under 1%. Table 1 shows the results of the Bayesian estimation. The posterior distributions indicate a reasonable variability of the estimated parameters.

Table 1 Bayesian Estimation Results

PARAMETERS	PRIOR MEAN	POSTERIOR MEAN	CONFIDENCE INTERVAL		PRIOR DISTRIBUTION	STANDARD DEVIATION
λ	0.10	0.05	0.01	0.08	Beta	0.05
α	2.00	2.00	1.67	2.34	Normal	0.25
γ_π	1.50	1.25	1.11	1.39	Normal	0.25
γ_y	0.50	1.29	1.01	1.58	Normal	0.20
ρ	0.70	0.46	0.35	0.56	Beta	0.20
σ_a	0.10	0.47	0.39	0.55	Inv. Gamma	Infinite
σ_i	0.10	0.24	0.19	0.28	Inv. Gamma	Infinite
σ_p	0.10	0.19	0.16	0.22	Inv. Gamma	Infinite
σ_y	0.10	0.07	0.05	0.08	Inv. Gamma	Infinite

Source: Own Computations

Coefficient λ characterizes the Calvo probability of keeping the prices fixed and was estimated to have a posterior mean of 0.05, implying a high rigidity for prices. For the Taylor rule I obtained expected values for inflation and output gap. As the Romanian National Bank adopted the Inflation Targeting regime which implies the stabilization of prices, the inflation coefficient is relatively high, estimated at 1.25, while the output gap coefficient was estimated at 1.29. The National Bank, as the estimates show, followed not only

the price stability but also output changes. We may also note a stronger than in previous estimates for the output gap coefficient. This might be due to the last quarters in the sample in which the National Bank reacted quite strongly to the ongoing crisis and tried to stimulate the economy.

2.3. What Drives the Unemployment

We focus on the dynamic aspects of unemployment by considering what are the factors that proved as most important in the behavior of unemployment. We discuss two approaches, one based on impulse response functions, and the other on historical decomposition of shocks.

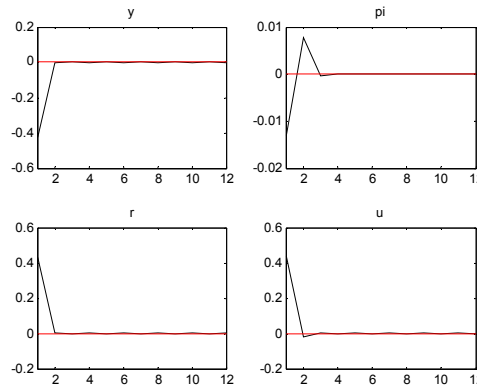


Figure 1: Impact of MP shocks on unemployment

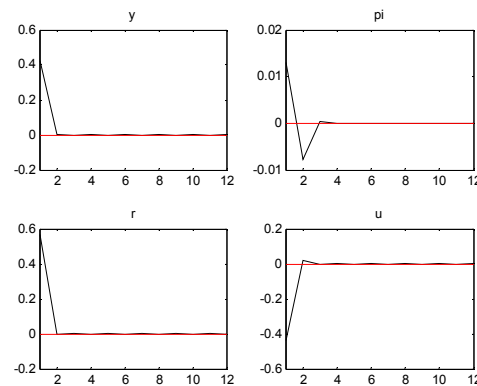


Figure 2: Impact of demand shocks on unemployment

Figures 1 and 2 show the response of key variables, output (y), inflation (π), interest rate (r) to two shocks, monetary policy (MP) shocks and demand shocks. Shocks are assumed to happen in the initial period, are of 1%, they are unexpected and not correlated.

In Figure 1 we see that output responds negatively, while unemployment increases. The maximum response of output is of -0.4%, while the maximum impact on unemployment is at 0.4%. Both peaks are reached in the initial period.

In Figure 2 we see the impact of a positive demand shocks. Unemployment responds negatively, while the inflation response is in the reverse sense. We can also derive a measure of the Okun coefficient based on these results. The immediate response of unemployment is at -0.40, which is in line with previous findings, see for example Caraianni (2010). The coefficient is rather strong, but the strong growth of unemployment during the financial crisis, suggests that that the estimation is sound.

I perform a historical decomposition of unemployment on the sample over which the model was estimated. The graphic in Figure 3 shows the contribution of each of the four shocks that affect the model – economy as well as the initial values to the actual values of unemployment.

For the last two years before the crisis, the graphic shows that the productivity shocks (ea) as well as the interest rate shocks (er) contributed mostly to the decrease of unemployment. For the crisis period, basically the last eight quarters in the sample, or year 2009 and 2010, the same two shocks however contributed to the

rise in the unemployment, except for 2010 when monetary shocks helped unemployment get lower. Inflationary shocks (ep) had also an important contribution, contributing to the higher unemployment in the second year of the crisis, 2010. The contributions from demand shocks (ey) seemed to matter less. As expected, they contributed to the rise in unemployment, although they did not matter too much.

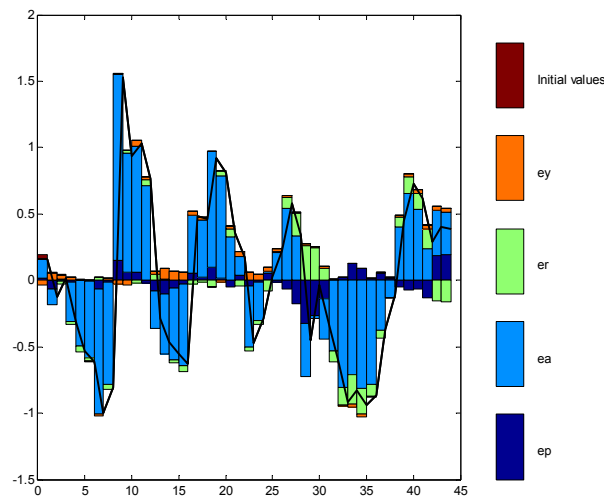


Figure 2: Historical Decomposition of unemployment dynamics.

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