Analyzing the Romanian Economy through a DSGE Modelling Framework

by Adrian Liviu Dorofte

1.1 Introduction

The main scope of this article is to assess the characteristics of the Romanian economy based on a comparison between two different DSGE frameworks. The first model is entirely based on the classic Smets and Wouters model (2002), hereafter called SW. It incorporates the standard sticky components for prices, wages and employment and it also features external habit formation as in Fuhrer (1999). The second model is an enhanced version of the classic SW in the sense that it adds a financial friction mechanism as in Gertler and Karadi (2011), hereafter entitled SWGK.

The original SW model was designed to come as an alternative to the existing Area Wide Model used by the European Central Bank (ECB) for macreconomic studies and analysis. Gertler and Karadi (2011) reinterpret financial frictions in a DSGE model. They construct a mechanism in which the main source of the frictions is represented by the banking sector, a view that is opposite to that of Bernanke, Gertler and Gilchrist (1999), the inventors of the financial accelerator.

The first chapter of this paper is dedicated to the literature review in the field of DSGE modelling, listing the main articles, studies and findings. The second part deals with mathematics behind the two models and it is entirely based on Smets and Wouters (2002) and Gertler and Karadi (2011). I briefly present the most important equations that shall be used during the computation process.

The results of the estimation are exposed in the third part of the article. The performance of the estimation is analyzed through the estimated parameters and shocks, the impulse response functions and the historical variance decomposition for both DSGE models used.

The last section sums up the main findings and conclusions that arise from the estimation procedure presented in the previous part, pointing out which model is more relevant for the analysis of the Romanian economy.

1.2 Literature Review

DSGE modelling is the latest advancement in the field of macroeconomic research and, through time, these type of models have also been further enriched to become a powerful tool for monetary policy analysis. The roots of DSGE models can be traced back to 1980s: then, Kydland and Prescott (1982) developed the first architecture of a Real Business Cycle (RBC) model, in fact an ancient predecessor to DSGE models. The main feature of the RBC frameworks is that the rational expectations are perfectly explained by the equations of the model. Consequently, it was discovered this hyopthesis was not entirely correct as the RBC became subject to the Lucas (1976) critique, which states that it is naïve to think that one can predict the future based solely on historical data.

A further development came with the work of Calvo (1983), which for the first time postulated the existence of a certain stickiness or slugishness of prices. This feature prevents agents from freely adjusting their prices in a given period. Seventeen years later, Erceg et. al (2000) introduced the same stickiness mechanism for wages. Compared to the debateable flexibility of prices in the RBC models, DSGE models nowadays incorporate more accurate elements of sticky prices and wages.

Taylor (1993) proposes a conventional monetary policy reaction function with importance coefficients assigned to the inflation deviation from its target level and to the output gap. Rotemberg and Woodford (1996) construct a neoclassical growth model with imperfect competition to explain the negative influence of an increase in oil price to output and real wages. Gali, Clarida and Gertler (1998) develop a forward-looking Taylor curve, which has become an integral part of today's modern DSGE architecture.

Nobel prize winners Mortensen and Pissarides (1994) write an article about job destruction and job creation and find out that aggregate and dispersion shocks produce opposite effects on the two processes. Moreso, they also reveal job destruction has more volatile dynamics than job creation, which thus becomes a source of labor market frictions.

The term external habit formation is not a new one in New Keynesian approaches. It is attributed to Fuhrer (2000), who first described it as a consumer's will to maintain his previous level of consumption into the following period as well. To do that, one would sacrifice spare time to work more as to achieve the same level of welfare.

For the first time, Bernanke et. al (1999) estimate a dynamic general equilibrium model for the United States and develop on the concept of financial frictions by exhibiting the financial accelerator. The source of frictions is represented by the non-banking sector. The central idea of the accelerator is that adverse shocks to the economy could get amplified by the worsening financial market conditions.

The DSGE models that Smets and Wouters developed have been gradually enhanced with new features. If the first model from 2002 boasted only nominal frictions and is addressed to the Euro Area, the 2005 and 2007 generations incorporate several real frictions in order to assess the US business cycles and discover the main sources of fluctuations.

Christiano, Eichenbaum and Evans (2005) and Christiano, Trabandt and Walentin (2010) devise a DSGE framework to investigate the monetary policy. The first incorporate nominal rigidities in their model to account for the observed inertia in inflation and persistence in output. The latter do a review of the latest advancements in the field of monetary DSGE models based on particular versions that have been developed. The conclusion is that the models fit the data very well, but for more accuracy further elements of labor market and financial frictions need to be added for higher consistency and robustness.

Last, but not least, Gertler and Karadi (2011) introduce an alternative to the standard financial accelerator from Bernanke et. al (1999). This has the advantage that it does not modify the utility and production functions of a standard DSGE model. The source of fluctuations is represented by the banking sector, also taking into consideration the ability of the central bank to lend funds. The autors add a mechanism which deals with the dynamics of equity and net worth for banking institutions at an aggregated level, while also introducing the leverage which shows how prone are bankers to take excessive risks in order to expand their wealth.

1.3 The DSGE Modelling Framework

Throughout this section, I will briefly present the list of central mathematical equations behind the DSGE models used in the estimation. Basically, I choose two models, as previously mentioned in the introduction of this paper: the SW model and the SWGK model. The first is characterized by the standard version developed by Smets and Wouters (2002) incorporating habit persistence and nominal rigidities in prices, wages and employment. The second builds on the classic architecture of the SW by adding financial frictions á la Gertler and Karadi (2011). The main advantage of the mechanism chosen by GK is the fact that it does not require ample modifications in the utility and production functions. It only adds several equations which are linked to the standard SW model via Tobin's Q equation. As I show in the estimation chapter, the SWGK performs better than its counterpart. Both models characterize a small open economy, but for simplification matters, I will not take into account the export and the import, as in Smets and Wouters (2002). Contrary to Gertler and Karadi (2011), I ignore the lending capacity of the central bank. The endogenous are expressed in terms of logarithmic deviations from the steady state values of the respective variables. The list of log-linearized equations for estimating the two DSGE models is posted below:

Real Consumption Habits

$$\widehat{C_t} = \frac{h}{1+h}\widehat{C_{t-1}} + \frac{1}{1+h}\widehat{C_{t+1}} - \frac{1-h}{(1+h)\sigma_c}\left[\widehat{R_t} - \widehat{\pi_{t+1}} + \widehat{\varepsilon^b_{t+1}} - \widehat{\varepsilon^b_t}\right] \tag{1.1}$$

Real investment dynamics

$$\widehat{I_t} = \frac{1}{1+\beta}\widehat{I_{t-1}} + \frac{\beta}{1+\beta}\widehat{I_{t+1}} + \frac{\phi}{1+\beta}\widehat{Q_t} + \beta\widehat{\varepsilon^I_{t+1}} - \widehat{\varepsilon^I_t} \tag{1.2}$$

Tobin's Q

$$\widehat{Q_t} = -\left(\widehat{R_t} - \widehat{\pi_{t+1}}\right) + \frac{1-\tau}{1-\tau+\bar{r}^K}\widehat{Q_{t+1}} + \frac{\bar{r}^K}{1-\tau+\bar{r}^K}\widehat{r_{t+1}^K} + \eta_t^Q \tag{1.3}$$

Net worth dynamics (only for the SWGK model)

$$\widehat{N_t} = \theta\left[\left(\widehat{R_{kt}} - \widehat{R_t}\right)\varrho_{t-1} + \widehat{R_t}\right]\widehat{N_{t-1}} + \kappa\widehat{Q_t}\widehat{S_{t-1}} \tag{1.4}$$

Capital accumulation equation

$$\widehat{K_t} = (1-\tau)\widehat{K_{t-1}} + \tau\widehat{I_t} \tag{1.5}$$

Inflation dynamics

$$\begin{aligned}\widehat{\pi}_t = \frac{\beta}{1+\beta\gamma_p}\widehat{\pi_{t+1}} + \frac{\gamma_p}{1+\beta\gamma_p}\widehat{\pi_{t-1}} + \\ + \frac{1}{1+\beta\gamma_p}\frac{(1-\beta\xi_p)(1-\xi_p)}{\xi_p}\left[\alpha\widehat{r_t^k} + (1-\alpha)\widehat{w_t} + \eta_t^p - \varepsilon_t^a\right]\end{aligned} \tag{1.6}$$

Real wage dynamics

$$\begin{aligned}\widehat{w_t} = \frac{\beta}{1+\beta}\widehat{w_{t+1}} + \frac{1}{1+\beta}\widehat{w_{t-1}} + \frac{\beta}{1+\beta}\widehat{\pi_{t+1}} - \frac{1+\beta\gamma_w}{1+\beta}\widehat{\pi}_t + \frac{\gamma_w}{1+\beta}\widehat{\pi_{t-1}} - \\ \frac{1}{1+\beta}\frac{(1-\beta\xi_w)(1-\xi_w)}{\left(1+\frac{(1+\lambda_w)\sigma_L}{\lambda_w}\right)\xi_w}\left[\widehat{w_t} - \sigma_L\widehat{L_t} - \frac{\sigma_C}{1-h}\left(\widehat{C_t} - h\widehat{C_{t-1}}\right) - \eta_t^w - \varepsilon_t^L\right]\end{aligned} \tag{1.7}$$

Clearing condition

$$\widehat{Y_t} = (1-\tau k_y - g_y)\,\widehat{C_t} + \tau k_y\widehat{I_t} + g_y\varepsilon_t^G = \phi\varepsilon_t^a + \phi\alpha\widehat{K_{t-1}} + \phi\alpha\Psi\widehat{r_t^K} + \phi(1-\alpha)\widehat{L_t} \tag{1.8}$$