Oana Simona HUDEA (CARAMAN)
Academy of Economic Studies
Sorin George TOMA
University of Bucharest
Marin BURCEA
University of Bucharest

THE NEW CLASSICAL THEORY AND THE REAL BUSINESS CYCLE MODEL

Empirical study

Keywords
New classical theory
Real business cycle
Rational expectations,
Macroeconomic modelling
Technology shock
Monetary policy

JEL Classification
B21, B22, B23, C54

Abstract

The present paper aims at describing some key elements of the new classical theory-related model, namely the Real Business Cycle, mainly describing the economy from the perspective of a perfectly competitive market, characterised by price, wage and interest rate flexibility. The rendered impulse-response functions, that help us in revealing the capacity of the model variables to return to their steady state under the impact of a structural shock, be it technology or monetary policy oriented, give points to the neutrality of the monetary entity decisions, therefore confirming the well-known classical dichotomy existing between the nominal and the real factors of the economy.

Introduction

The new classical theory, one of the latest reference points of the tumultuous history of economic thinking, inherited several features of the incipient pure classical conception and of the subsequent neoclassical one, while creating its own way to the modern economic analysis. If the early predecessors of the new classical economists provided them with a clearly defined vision on the dichotomy between the real and the nominal factors of the economy or on the perfect competition manifested within the considered markets, involving a high degree of flexibility at the level of prices, wages or interest rates, and the neoclassicists came with a macroeconomic study based on the aggregation of the microeconomic decisions of the rational representative agents, the new classicists mainly focussed on the determinant role of technology in impacting on the economic evolution.

The new classicism gave birth to the Real Business Cycle (RBC) model, characterised by this theory-related distinctive elements, such as the economic agents' rationality, reflected by an optimum, well-grounded reaction to the real shocks on preferences, productivity or public acquisitions, the dynamic Walras general equilibrium-based analysis of the economy, considering the rational as opposed to previous adaptive expectations of economic agents, or the neutral role of the monetary policy decisions in exerting influences on the business cycle fluctuations.

1. The Real Business Cycle Model

The basic RBC model, rendered for the first time by Kydland and Prescott (1982), and exemplified in this paper by a simplified version of the variant constructed by Gali (2008), starts by maximising the satisfaction of the representative economic agents on a perfectly competitive market with flexible prices.

Households pursue to maximise their utility function:

$$E_0 \sum_{t=0}^{\infty} {}^{t} U(C_t, N_t) \qquad (1)$$

where E_0 is the expected value, at time 0, , the subjective discount factor, U, the utility function, C_t, the consumption, at time *t*, and N_t, the labour hours, at time *t*

under the budget constraint:

$$P_t \times C_t + Q_t \times B_t \le B_{t-1} + W_t \times N_t - T_t \qquad (2)$$

where P_t is the price of the consumption good, W_t, the nominal wage, B_t, the one period zero-coupon bond, at time t, Q_t, the price of bonds, T_t, the agreed value of incomes (i.e: dividends) and expenses (i.e: fees), at time *t*

Each bond is deemed to produce, on due date, an income amounting to 1 m.u.

We analyse the case when households deviate from the initial optimum schema, by adjusting the consumption and the number of labour hours (dC_t, dN_t), ceteris paribus:

$$U_{c,t} dC_t + U_{n,t} dN_t = 0 \qquad (3)$$

where $U_{c,t}$ is the derivative of the utility function in relation to consumption and $U_{n,t}$, the derivative of the utility function in relation to the labour hours:

$$P_t dC_t = W_t dN_t \qquad (4)$$

We obtain the optimum condition:

$$-\frac{U_{n,t}}{U_{c,t}} = \frac{W_t}{P_t} \qquad (5)$$

We also consider the case when we reallocate the consumption between *t* and *t+1* (dC_t, dC_{t+1}), the consumption related to other periods and the labour hours remaining unchanged:

$$U_{c,t} dC_t + \quad \times E_t \{U_{c,t+1} dC_{t+1}\} = 0 \qquad (6)$$

$$P_{t+1} \times C_{t+1} + Q_{t+1} \times B_{t+1} = \\ = \frac{B_{t-1} + W_t \times N_t - T_t - P_t \times C_t}{Q_t} + \\ + W_{t+1} \times N_{t+1} - T_{t+1} \qquad (7)$$

$$P_{t+1} dC_{t+1} = -\frac{P_t}{Q_t} dC_t \qquad (8)$$

The optimum condition becomes:

$$Q_t = \quad \times E_t \left\{ \frac{U_{c,t+1}}{U_{c,t}} \times \frac{P_t}{P_{t+1}} \right\} \qquad (9)$$

By using a Bernoulli utility function:

$$U(C_t, N_t) = \frac{C_t^{1-¥}}{1-¥} - \frac{N_t^{1+¨}}{1+¨} \qquad (10)$$

we get the optimum conditions:

$$C_t^{¥} N_t^{¨} = \frac{W_t}{P_t} \qquad (11)$$

$$Q_t = \quad \times E_t \left\{ \left(\frac{C_{t+1}}{C_t} \right)^{-¥} \times \frac{P_t}{P_{t+1}} \right\} \qquad (12)$$

The log-linearization of equations leads to:

$$¥ \times c_t + ¨ \times n_t = w_t - p_t \qquad (13)$$

$$c_t = E_t\{c_{t+1}\} - \frac{1}{¥} \times \left(i_t - E_t\{®_{t+1}\} - °\right) \qquad (14)$$

with

$$c_t = \log C_t$$

$n_t = \log N_t$

$w_t = \log W_t$

$p_t = \log P_t$

$i_t = -\log Q_t$

$° = -\log$

$E_t\{®_{t+1}\} = \log E_t\left\{\frac{P_t}{P_{t+1}}\right\}$

The demand for real balances, in its log-linear form, is represented by:

$$m_t - p_t = y_t - ¦ \times i_t \qquad (15)$$

where $¦$ is the interest semi-elasticity of money demand, with $¦ \geq 0$

We assume the hypothesis of a representative firm with a Cobb-Douglas production function:

$$Y_t = A_t \times N_t^{1-\sim} \qquad (16)$$

where A_t is the technological level

Firms pursue to maximise their profit:

$$Max\{\Pr\} = Max\{P_t \times Y_t - CT\} \qquad (17)$$

with

$$CT = W_t \times N_t \qquad (18)$$

where $\Pr$ is the profit and CT the total expenses of the firm

We get the optimum condition:

$$\frac{W_t}{P_t} = (1-\sim) \times A_t \times N_t^{-\sim} \qquad (19)$$

which, by log-linearization, becomes:

$$w_t - p_t = \log(1-\sim) + a_t - \sim \times n_t \qquad (20)$$

where $a_t = \log A_t$, it evolving exogenously, according to a stochastic process

At equilibrium, by ignoring, for simplification purposes, certain variables such as investments, governmental acquisitions and net exports, we obtain:

$$Y_t = C_t \qquad (21)$$

becoming, by log-linearization:

$$y_t = c_t \qquad (22)$$

Combining the household and firm optimality conditions, we get:

$$n_t = · _{na} \times a_t + ³_n \qquad (23)$$

$$y_t = · _{ya} \times a_t + (1-\sim) \times ³_y \qquad (24)$$

where

$$· _{na} = \frac{1-¥}{¥ \times (1-\sim) + \sim + ¨}$$

$$³_n = \frac{\log(1-\sim)}{¥ \times (1-\sim) + \sim + ¨}$$

$$· _{ya} = \frac{1+¨}{¥ \times (1-\sim) + \sim + ¨}$$

$$³_y = (1-\sim) \times ³_n$$

By using equation (14), we determine the real interest rate, starting from the Fisher equation:

$$r_t = i_t - E\{®_{t+1}\} \qquad (25)$$

and arriving to:

$$r_t = ¥ \times E_t\{\Delta y_{t+1}\} + ° \qquad (26)$$

Considering the variation of y_t, based on equation (24), we rewrite r_t:

$$r_t = ¥ \times · _{ya} \times E_t\{\Delta a_{t+1}\} + ° \qquad (27)$$

We also may assume that the Central Bank determines the nominal interest rate based on the following monetary rule:

$$i_t = ° + ¤_® \times ®_t \qquad (28)$$

with $¤_® \geq 0$

or, considering equation (25)

$$¤_® \times ®_t = E\{®_{t+1}\} + \hat{r}_t \qquad (29)$$

where $\hat{r}_t = r_t - °$

Finally, we determine the real wage, by resorting to (20):

$$µ_t = w_t - p_t \qquad (30)$$

$$µ_t = · _{wa} \times a_t + ³_w \qquad (31)$$

where

$$· _{wa} = \frac{¥ + ¨}{¥ \times (1-\sim) + \sim + ¨}$$

$$³_w = \frac{\log(1-\sim) \times [¥ \times (1-\sim) + ¨]}{¥ \times (1-\sim) + \sim + ¨}$$

2. The Model Impulse-Response Function Analysis

The impulse-response function (IRF) is designed for rendering the reaction of the model variables as result of the occurrence of a structural shock, acting like a brief input signal at the level of the economy. More precisely, the IRF describes the response of the generic $X_{i,t+s}$ variable to the impulse given by the $£_{j,t}$ shock, all other *t* or *t-n* variables being held constant, and takes the following form:

$$IRF \rightarrow \frac{\partial X_{i,t+s}}{\partial £_{j,t}}$$

In order to perform the IRF analysis and to obtain the related results, we have calibrated the model parameters, according to the related literature, starting from the steady state of the observed variables or considering the specific level of items. Thus, the production elasticity in relation to the capital share (~) is set, as in the study of Almeida (2009), to 0.323. According to Andrés et al. (2006), the subjective discount factor ( ) directs towards the threshold of 0.992, closely compliant with Smets and Wouters (2003), who provide the same with a value of 0.999. The sensitivity of the Central Bank with respect to inflation (¤®) and the elasticity of labour supply (¨) are established to 1.5, respectively to 2, based on Almeida et al., (2008). Finally, the risk aversion coefficient (¥) receives the unit value and the elasticity of the money demand with respect to the nominal interest rate (¦) amounts to 4.

The equations subject to implementation, among the ones rendered above, were as follows: (11) - the consumer wage-related first order condition, (12) - the Euler equation of consumption, the money growth equation resulting from (15), (16) - the firm production function, (19) - the firm wage-related first order condition, (21) - the market clearing condition, (25) - the real interest rate equation and also the AR(1) process of the technology shock

The output rendered in Figure 1 and Figure 2 was generated by resorting to the Dynare tool, version 4.3.0., of Matlab 7.11.0.

The related figures reveal, as expected, the difference between the technology shock and the monetary policy shock in affecting the real economic variables.

If the model variables: output, consumption, inflation, nominal and real interest rate and money growth deviate from their steady state when the economy is hit by a sudden technological change, returning afterward to equilibrium by the end of the 40-period analysis, more exactly after 35 periods, save for the last one which recovers its initial status in about 13 periods, the modification occurred as result of some monetary policy decisions remains practically imperceptible, the equilibrium being recovered somewhere around 2.5 periods. We should mention that the impulse-response functions are exclusively displayed when the variable reaction exceeds 1e-10.

This result finally suggests what we had assumed, in fact, to empirically demonstrate, namely that on a perfectly competitive market, as the one considered in the new classical theory, the monetary authority has no decisive role in influencing the real economic life.

Conclusions

This study was designed as an incursion into the new classical theory and its associated Real Business Cycle model, its main purpose being that of outlining, theoretically as well as empirically, the irrelevance of the monetary entity actions in disturbing the decisions of the economic agents.

As both the model equations and the impulse-response functions described above revealed, and in compliance with the generally accepted characteristics of the new classical theory, the dynamic evolution of the equilibrium of employment, production and real interest rate is not dependent of the monetary policy, in this simple, basic model the real variables varying only in reaction to technological changes, the latter being the only decisive influence force at economic level.

Acknowledgement

This work was cofinanced from the European Social Fund through Sectoral Operational Programme Human Resources Development 2007-2013, project number POSDRU/159/1.5/S/134197 „Performance and excellence in doctoral and postdoctoral research in Romanian economics science domain”

Reference list:

[1] Almeida, V., Castro, G., & Felix, R. (2008). Improving competition in the non-tradable goods and labour markets: the Portuguese case. *Banco de Portugal Working Papers Series* 16

[2] Almeida, V. (2009). Bayesian estimation of a DSGE model for the Portuguese economy. *Banco de Portugal, Economics and Research Department Working Paper Series* 200914

[3] Andrés, J., Burriel, P., & Estrada, A. (2006). BEMOD: A DSGE model for the Spanish economy and the rest of the Euro Area. *Bank of Spain Working Paper* 0631

[4] Galí, J. (2008). *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework*. Oxford, UK: Princeton University Press.

[5] Smets, F., & Wouters, R. (2003). An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area. *Journal of the European Economics Association 1*(5): 1123-1175

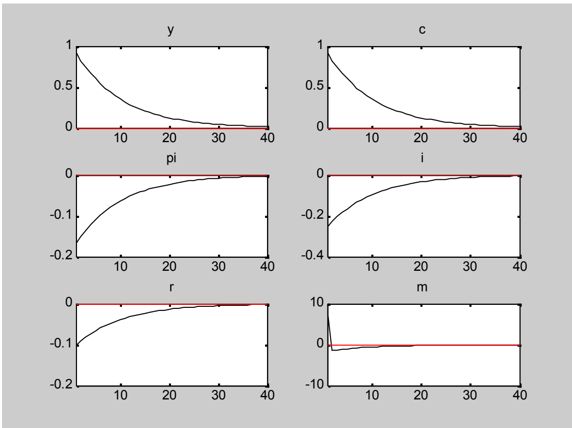

Figure 1. Reaction of the model variables to the technology shock

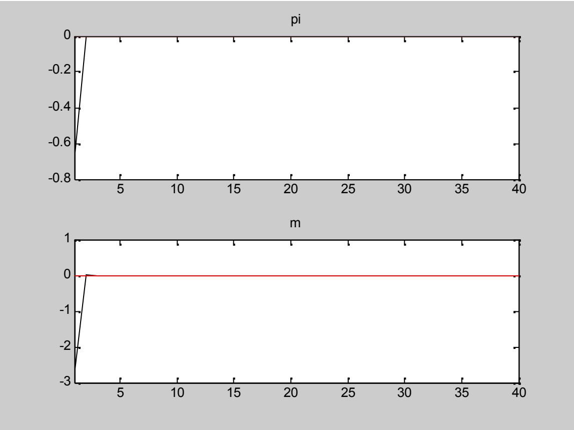

Figure 2. Reaction of the model variables to the monetary policy shock