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Evaluation of the methodological relationship between real business cycle model and macroprudential policy

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Abstract. *While real business cycle model excluded nominal demand and monetary changes in proof of aggregate output fluctuations, the 2008 crisis proved otherwise. The systemic risk that emerged in this process affected the financial and real sector transmission mechanism towards a contraction. Macroprudential policy brought a solution to the problem, especially with banking loan activities. The aim of this study is to explain the methodological relationship between real business cycle model and macroprudential policy intervention based on the results of the 2008 crisis. In the study, the lack of information set limits the methodological relationship, including the duration of real economic shocks, the degree of interaction between the financial and real sector, and the magnitude of the credit cycle volatility.*

Keywords: real business cycle model, macroprudential policy, 2008 crisis, systemic risk, financial and real sector.

JEL Classification: E32, E52, E58.

1. Introduction

Real business cycle model sees technological shocks as the cause of aggregate output fluctuations. According to Blinder (1979), supply shocks and labor productivity are the basis of this approach. Because, as a result of the increase in oil prices by OPEC in the 1970s, it was observed that supply-side factors were determinant in ensuring macroeconomic stability (Gazda, 2010, pp. 42-43). The inadequacy of the demand-weighted Keynesian approach to explain the increasing course of unemployment and inflation in the course of the future strengthened the existence of real effects. In the early 1980s, dynamic models of real economic shocks were first made by Kydland and Prescott (1982), Long and Plosser (1983), and the work of Long and Plosser (1983) was named "Real Business Cycle". In these studies, which adopt the Neo-Classical growth model, it was emphasized how real factors and their effects spread over time at the origin of shocks as opposed to being monetary (McCallum, 1988, p. 1).

However, real economic shocks have gained a different dimension after the 2008 crisis. Initially, financial instability in the USA and Europe has turned into a global contraction as a result of the interaction between financial and real sectors. Because, while the increase in investments in developed and deepened financial systems brings rapid economic growth, systemic risk triggered by high cross-border capital requirements leads to macroeconomic vulnerabilities (Lee et al., 2017, pp. 1-2). To prevent this, a macroprudential policy has been developed that offers a regulatory and supervisory perspective. The ultimate goal of macroprudential policy is to contain the damages of systemic risk to the real sector (Borio, 2010, pp. 2-3). For this purpose, the banking system is engaged to ensure harmonization of the financial system and business cycle. Thus, both the loan needs of households and firms are met and banks create a loan portfolio through deposits (Lee et al., 2017, pp. 1-2).

At the same time, there are recent empirical studies focusing on the macroeconomic effects of various macroprudential policy instruments. Neanidis (2015) investigated the relationship between macroprudential regulations, financial volatility and economic growth. At the end of the study, which included 78 countries with different economic development levels, it was determined that macroprudential regulations consisting of banking activity restrictions, banking sector entry requirements and external government index alleviated the effect of volatility in foreign capital flows on economic growth. Alam et al. (2019) supported the argument that the negative effects of macroprudential policy are not statistically significant when considered in terms of economic growth. 134 credit-value limits, one of the loan-targeted macro prudential policy tools for developed and emerging market economies, have been found to have a particularly strong impact on consumption.

For all that, Boar et al. (2017) analyzed the effect of credit supply-investment link on economic growth for 64 developed and emerging market economies in line with macro prudential activism, and concluded that unsystematic macroprudential measures may negatively affect economic growth. Kim and Mehrotra (2017) determined that the tightening macroprudential policy used to limit credit growth in Asian and Pacific countries, which adopted inflation targeting, negatively affected the general level of economic growth and prices. In fact, Kim (2019), in his study involving 11 Asian countries, found that the macroprudential policy implemented through loan-to-value ratio and

required reserves had significant negative effects on output. Finally, Belkhir et al. (2020) stated that in 100 developed, low-income developing and emerging market economies, the macroprudential policy index provides financial stability by suppressing economic growth.

On the other hand, Richter et al. (2018) explained that central banks are increasingly focusing on macroprudential measures to manage the financial cycle. However, in the study conducted for the developed and emerging market economies, the trend of the change in the maximum loan-to-value ratios on output and inflation could not be determined clearly. Rojas et al. (2020) stated that for Argentina, Brazil and Uruguay, the direction of the impact of macroprudential policy in the form of legal requirement on output is uncertain.

The aim of this study is to contribute to the literature by focusing on the interaction between the real and financial sectors, in line with the real business cycle model and the meteodological relationship of macroprudential policy interventions.

The general lines of the study are as follows: Section 2 is, the basic operation of the real business cycle model of Long and Plosser (1983) has been taken as basis and the external shocks developed by Kiyotaki (2011) in connection with the 2008 crisis are given. Section 3 is, macroprudential policy implementation in Poutineou and Vermandel (2017) is included in the methodology. Section 4, concludes.

2. Real business cycle model

The real business cycle models explains the reaction of rational economic actors against real economic shocks (Deng, 2009, pp. 11-12). Under the assumption of perfect competition where household and firm heterogeneity is abstracted, it realizes resource allocation that maximizes household benefits (Kiyotaki, 2011, p. 196). In this context, the operation is as follows (Long and Plosser, 1983, pp. 44-46):

$$U = \sum_{t=0}^{\infty} \beta^{+} u(C_t, Z_t) \quad (1)$$

In equation (1), U – utility; β – reduced consumption factor; C_t – current period consumption vector, Z_t is leisure. Household utility maximization depends on consumption and leisure preferences.

$$Y_{t+1} = \mathrm{F}(L_t, K_t;\ \lambda_{t+1}) \quad (2)$$

Equation (2) expresses the constant-income production possibilities curve to scale for N commodities in the economy. Y_{t+1} – total output stock realized in the period $(t+1)$; L_t – current period labor vector; K_t – current period capital vector; λ_{t+1} is the random productivity shock that occurs in the period $(t+1)$. The special cases of production technology are as follows: i) L_t ve K_t are allocated independently; ii) λ_t indicates that there is no technological change.

On the other hand, every period in the economy is restricted by household consumption and leisure preferences as follows:

$$Z_t + \sum_{i=1}^{N} L_{it} = H,\ t = 0,1,2,3, \ldots \quad (3)$$

In Equation (3), H represents the total available workforce / free time preference.

$$C_{jt} + \sum_{i=1}^{N} K_{ij} = Y_{jt},\ j = 1,2,3, \ldots, N_j \quad (4)$$

Equation (4) is household consumption.

Subject to equations (2), (3) and (4), the available leisure utility function is:

$$V(S_t) = \max.\varepsilon\left[\sum_{s=t}^{\infty} \beta^{s-t} u(C_t, Z_t) \,\middle|\, S_t\right] \quad (5)$$

or

$$V(S_t) = \max.\varepsilon\left\{\sum_{s=t}^{\infty} \beta^{s-t} u[C(S_s), Z(S_s)] \,\middle|\, S_t\right\} \quad (6)$$

In here, $V(S_t)$ – current leisure utility; S_t – the steady state vector and $S_t = (Y_t, \lambda_t)$'dir. Accordingly, equilibrium in the economy is defined as the process of (C_t, Z_t, L_t, K_t) and perfectly competitive relative prices.

2.1. Production possibilities

Except for stochastic parameters, the production possibilities in line with the Cobb-Douglas production function with constant return to scale are as follows (Long and Plosser, 1983, p. 47):

$$Y_{i,t+1} = \lambda_{i,t+1} L_{it}^{bi} \pi_{j=1}^{N} K_{ijt}^{aij},\ i = 1,2,3, \ldots, N \quad (7)$$

In equation (7), λ_i – standard production technology; $b_i$ve a_{ij} are positive constant parameters. Production possibilities are based on efficient allocation of inputs. This situation requires determining the optimal consumption and input amounts for the current period.

2.2. Optimal quantities

For the current period, the optimal quantities of consumption, leisure time, labor and capital are obtained as follows (Long and Plosser, 1983, p. 48):

$$C_{ij}^{*} = \left(\frac{\theta_i}{\gamma_i}\right) Y_{it},\ i = 1,2,3, \ldots, N \quad (8)$$

$$Z_i^{*} = \theta_0(\theta_0 + \beta \sum_{i=1}^{N} \gamma_i b_i)^{-1}\ H \quad (9)$$

$$L_{it}^{*} = \beta\gamma_i b_i(\theta_0 + \beta \sum_{i=1}^{N} \gamma_i b_i)^{-1}\ H,\ i = 1,2,3, \ldots, N \quad (10)$$

$$K_{ijt}^{*} = \left(\frac{\beta\gamma_i a_{ij}}{\gamma_i}\right)\gamma_{jt},\ i,j = 1,2,3, \ldots, N \quad (11)$$

When these equations are evaluated in general, the results of employment fluctuations are encountered. Accordingly, the firm's demand for labor and capital in the current period depends on market prices. The marginal product of labor equals real wages, and the

marginal product of capital equals the real interest rate. Hence, the increase in real wages decreases the demand for labor while increasing the demand for capital. Moreover, the leisure choice of labor results in lower marginal productivity and real wages, while capital intensive production stands out.

Exogenous shocks

How are the effects of the decline in the export rates of countries after the global contraction in 2008 interpreted in terms of the real business cycle model? This question will be addressed under the assumption of a monopolistic competition market rather than a perfect competition market. Because perfectly competitive firms do not perceive demand changes directly, as they make their production decisions according to data market prices. Hence, total output in terms of differentiated goods is defined as follows (Kiyotaki, 2011, pp. 198-199):

$$Y_t = \left[\sum_{f=1}^{f} (X_{zt})^{\frac{1}{\sigma}} (Y_{zt})^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \quad (12)$$

In equation (12), Z – monopoly firms; X – differentiated goods; σ is the substitution elasticity between differentiated goods and $\sigma > 1$'dir.

The price index (P_t) corresponding to the total output is as follows:

$$P_t = [\sum_{Z=1}^{Z} (X_{zt})(P_{zt})^{1-\sigma}]^{\frac{1}{1-\sigma}} \quad (13)$$

Total demand that will maximize household consumption and firms' production will be expressed as follows:

$$\left(\frac{P_{zt}}{P_t}\right) Y_{ZT} = X_{zt} (Y_t)^{\frac{1}{\sigma}} (Y_{zt})^{1-\frac{1}{\sigma}} \quad (14)$$

Under budget constraints, export demand shocks that alter aggregate demand will affect the real income of firms, and employment fluctuations will be seen in connection with the previous section.

3. Macroprudential policy

Macroprudential policy is a regulatory and supervisory policy that limits systemic risks and is implemented for the stability of the financial system (Borio, 2010, p. 2). Systemic risk is the malfunctions in the functioning of the financial system (Vinals, 2011, pp. 7-8). As the functioning of the financial system is related to macroeconomic developments, it significantly affects the real sector. Therefore, systemic risk has negative consequences on the real economy. Accordingly, systemic risk emerges as instabilities in credit, asset prices, exchange rates and interest rates. Macro prudential policies also alleviate sectoral vulnerabilities against these instabilities (Dumičić, 2017, p. 90).

In this framework, referring to the exogenous shocks in the previous section, macroprudential policy will come into play as regulations on the credit market. Macro prudential policy, taking into account the cyclical effects of the credit market, will be implemented as follows (Poutineou and Vermandel, 2017, pp. 199-201):

$$\in_t \pi^B_{i,t+1}(b) = \left[\in + \delta^{\in}_{i,t+1} + (1-\mu^B)\left(1-\delta^{\in}_{\text{i},t+1}\right)\right]\left(1+R^L_{i,t}(b)\right)L^s_{i,t+1} -$$

$$-(1+R_t)L^{RF}_{i,t+1}(b) - \left(1+R^D_{i,t}\right)D_{i,t+1}(b) \qquad (15)$$

In Equation (15), deposit and loan services of a bank in the monopolistic competition market to households and firms are represented. The bank receives deposits from households, $(D_{i,t})$ at an interest rate of $(R^D_{i,t}(b))$; Provides refinancing $(L^{RF}_{i,t})$ from central bank (R_t) at policy interest rate, grants firms loan $(L^s_{i,t})$ at interest rate $(R^L_{i,t}(b))$.

However, banks face the risk of non-repayment of loans $\left(1-\delta^{\in}_{\text{i},t+1}\right)$, and therefore proportional audit cost (μ^B). In this case, the optimal credit market for the bank under balance sheet constraint would be:

$$L^s_{i,t+1}(b) = D_{i,t+1}(b) + L^{RF}_{i,t+1}(b) + BK_{i,t+1}(b) \qquad (16)$$

In here, $BK_{i,t+1}$; is the bank's equity capital.

Finally, since the marginal cost of the credit cycle will affect the policy stance, the macroprudential policy will be defined as follows:

$$1 - MC^L_{i,t} = \frac{(1+R_t)(MP_{i,t})\varphi_i}{\left[1-\mu^B\left(1-\delta^{\in}_{i,t+1}\right)\right]} \qquad (17)$$

In equation (17), $MC^L_{i,t}$; loan cycle marginal cost, $MP_{i,t}$; macroprudential policy, φ_i; policy stance and $\varphi_i > 0$'dır.

In summary, the financial system strengthens the business cycle. The interaction between the financial and real sectors, which are the main elements of this circularity, is provided by banks' credit (Claessens et al., 2013, pp. 157-158). However, while banks lose resistance in the face of long-term real economic shocks, their lending functions may be interrupted (Grace et al., 2015, pp. 90-93). As a result, the costs to be incurred by the debtors will increase and there will be a contraction in economic activities. Therefore, the stability of the credit cycle plays a key role.

4. Conclusion

In addition to technological shocks, real business cycle model includes shocks arising from the preferences of economic actors, public spending and terms of trade to real economic shocks. On the other hand, it evaluates the dynamic fluctuations in economic activities without relating to monetary policy.

Real economic shocks at the center of the real business cycle model resulted in a global contraction in the 2008 crisis. This situation has become widespread in a vicious circle as the negative reflection of financial instability on the real sector. The explosion in credit and asset prices has resulted in economic and social costs for households, firms and banks. The macro prudential policies implemented considering the said costs were aimed to prevent possible systemic risks by intervening in the volatility in the credit cycle.

As a result, in this study based on negative export shocks and banking loan activities that emerged after the 2008 crisis, it is thought that the methodological relationship between real business cycle model and macroprudential policy remains limited. Including the information set on the duration of the real economic shocks, the degree of interaction between the financial and real sector, and the magnitude of the credit cycle volatility in the analysis will strengthen this relationship.

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