Field of presentation: Macroeconomics and macroeconomic policy

New Keynesian Model with Monetary and Fiscal Policy Interaction and Externality

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In the recent decades macroeconomic analysis of monetary and fiscal policies is mostly conducted in the framework of the New Keynesian (NK) models. Effects of different macroeconomic policies are then studied within the "shock – propagation" paradigm, whereby exogenous shocks cause responses of all the agents in the economy (consumers, firms, government) which are then propagated throughout the model. In case equilibrium of the model is locally determinate[1], it exhibits unique solution and regular dynamics which could be easy to predict.

However, it is well known that for some economically relevant sets of parameters a multidimensional NK dynamical model can demonstrate unpredictable behavior even in the absence of exogenous shocks [1-5]. Such development makes formation and control of agents' expectations difficult, throwing doubt on the government's ability to conduct macroeconomic policies. Thus, if possibility of irregular fluctuations is present, the question arises of introducing an external control in such a way that the model's limiting dynamics is stabilized. This could be accomplished by changing the regimes of monetary and/or fiscal policies. Therefore, in order to provide conditions for successful stabilization policy, investigating local behavior of the model around its equilibrium and conditions for emergence of irregular fluctuations are of great importance.

Local equilibrium determinacy of equilibria in NK models was studied extensively in case of monetary policy rules (see, e.g. [6-8]). The case of fiscal policy interacting with the monetary policy was first considered [9] as well as in more recent papers [10-12]. Most previous analyses were performed within discrete time NK models, with [9,13-15] being some of the exceptions.

[1] Locally determinate equilibrium ensures that the solution for the agents' choice variables is unique, and that their expectations are uniquely determined, as well. Otherwise, when the uniqueness of the equilibria is not ensured, the solution can be infinitely sensitive to small changes in parameters, and shocks to beliefs can temporarily influence economic outcomes [10].

We study New Keynesian models in continuous-time under different monetary and fiscal policy regimes. We consider 4-dimentional nonlinear NK model that describes dynamic behavior of aggregate consumption, government bonds, inflation and capital. We also allow for presence of externality in the production technology. We consider two regimes of monetary and fiscal policies (passive and active)[2] according to [9], and investigate their effects on local equilibrium determinacy.

We show that different combinations of regimes of monetary and fiscal policies in 4-dimensional NK model can lead to local equilibrium indeterminacy. The feedback coefficients of Taylor-type rules of monetary and fiscal policy as well as the degree of externality in production could be considered as bifurcation parameters. Crossing bifurcation boundaries changes the model dynamics. Our main result demonstrates that different combinations of policies' regimes do influence local equilibrium determinacy and could cause the system dynamics becoming unpredictable, making conduct of monetary and fiscal policies hard if not impossible.

In addition to determinate and indeterminate equilibria, a larger set of equilibria including those in which endogenous variables remain bounded but are never expected to return to the steady state, such as limit cycles, might appear, leading to global indeterminacy. Are business cycle fluctuations a response to a persistent exogenous shock or do they reflect a strong endogenous mechanism which produces recurrent boom-bust phenomena [16]? Combination of analytical and numerical methods of mathematical control theory and macroeconomic analysis to examine the notion of stochastic limit cycles can clarify this matter during the next few years.

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[2] Intuitively, passive monetary policy regime does not respond to inflation strongly enough and could allow deviation of inflation from its target level to persist, with active policy being able to stabilize inflation around the target. For fiscal policy the logic is the opposite: the regime of fiscal policy is called passive when the government stabilizes debt level by generating sufficient tax revenues, while under active fiscal policy the government disregards intertemporal budget constraint and allows the debt to increase, not collecting more taxes in order to finance rising debt.

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