Strategic interactions between fiscal and monetary authorities in a LQ multi-country New-Keynesian model of a monetary union

Tomasz Michalak
Liverpool University, Department of Computer Science
Ashton Street
L69 3BX Liverpool
The United Kingdom
e-mail: tomasz.michalak@ua.ac.be
url: www.ua.ac.be/tomasz.michalak

Joseph Plasmans
University of Antwerp, Department of Applied Economics
Prinsstraat 13
2000 Antwerpen
Belgium
e-mail: joseph.plasmans@ua.ac.be
url: www.ua.ac.be/joseph.plasmans

Jacob Engwerda
Tilburg University, Dept. of Econometrics and O.R.
P.O. Box 90153
5000 LE Tilburg
The Netherlands
e-mail: engwerda@uvt.nl
url: http://center.uvt.nl/staff/engwerda

Abstract
The creation of the (multi-country) European Monetary Union (EMU), with a common central bank (the ECB) but independent national fiscal policies urged the ongoing discussion about the need and feasibility of macroeconomic policy coordination within the EMU. As the ‘one-size-fits-all’ policy of the European Central Bank (ECB) cannot address country-specific shocks and other stabilisation mechanisms in the euro-zone (such as labour force mobility and financial assets mobility) are limited, then the general consensus is that the main burden of stabilisation should be born by fiscal policies. On the other hand, the abuse of fiscal policies can be detrimental to financial as well as economic stability and may result in undesirable suboptimal outcomes. Thus, budgetary positions in the EMU Member States are constrained, mainly by the provisions of the Stability and Growth Pact (SGP), and monitored by the European Commission (EC). All of these give raise to several important questions which are still on top of the research agenda related to monetary unions in general and to the EMU, in particular:
1. Is there a need for the coordination of monetary and fiscal policies in macro-economic stabilization?

2. Do different types of shocks call for different forms of cooperation?

3. Can cooperation in a monetary union be counter-productive and if so, under which conditions?

4. Will fiscal constraints like SGP hamper stabilization?

5. How does SGP influence possible cooperation agreements between fiscal or fiscal and monetary authorities?

The literature on monetary unions is vast and some of the above issues have already been extensively discussed, especially in the aftermath of 1999 when the first 11 countries of the EU finally adopted a common currency. This paper extends this literature by presenting and analysing a Multi-Country New-Keynesian Monetary Union Model which is cast in the framework of linear quadratic differential games (LQDGs), i.e. it includes multi-player strategic elements. To the best of our knowledge, it is the first model in the New-Keynesian Open Economy Macroeconomics (NKOEM) spirit which features strategic elements between more than three players. Essentially, the starting point of the NK approach is the explicit derivation of macroeconomic relationships from underlying microeconomic foundations. This principle is shared with New Classical macroeconomics, although the former includes a great deal of imperfections in the goods and labor markets. Recently, NK macroeconomics has constituted the core of the macroeconomic paradigm world-wide with a lot of research effort directed towards the issue of optimal monetary policy. However, as far as now, relatively little attention has been paid to the interactions between fiscal and monetary policies when stabilizing an economy after a shock, which is especially important in the EMU context. The strength of our NKOEM model is its multi-player (monetary union countries and the central bank) strategic dimension, which allows us to address all the above research questions in one study. In particular, we show that non-trivial conclusions can be drawn from analysing fiscal cooperation between only a subgroup of countries in a monetary union, which cannot be studied in the framework of two-country monetary union models which are popular in the literature due to their relative tractability.

Let fiscal and monetary players from a set \( N \) be divided in two groups: \( n \) countries \( i \) \( (i \in F) \) and one central bank \( b \) \( (b = B) \), with \( N = F \cup B \). Following NKOEM literature, we define the aggregate demand (AD) equations as:

\[
y_{i,t} = \kappa_{i,y} E y_{i,t+1} + (1 - \kappa_{i,y}) y_{i,t-1} + \gamma_i (i_{U,t} - E \pi_{i,t+1}) + \eta_i f_{i,t} \\
+ \sum_{j \in F/i} \rho_{ij} [-\kappa_{i,y} E y_{j,t+1} + y_{j,t} - (1 - \kappa_{i,y}) y_{j,t-1}] \\
+ \sum_{j \in F/i} \delta_{ij} [-\kappa_{i,y} E s_{ij,t+1} + s_{ij,t} - (1 - \kappa_{i,y}) s_{ij,t-1}] + v_{i,t},
\]
where $y_{i,t}$, $p_{j,t}$, $\pi_{i,t}$, and $f_{i,t}$ denote output, price level, inflation, and fiscal policy in country $i$, respectively and $i_{U,t}$ denotes union-wide common nominal interest rate. The second set of equations in our model are New-Keynesian Philips curves which relate inflation to cyclical activity and in the New-Keynesian model are derived from optimizing firms’ price-setting decisions subject to constraints on the frequency of price adjustment. We assume Philips curves are of the form:

$$\pi_{i,t} = \beta_i \left[ \kappa_i \pi_{i,t+1} + \left( 1 - \kappa_i \pi_{i,t-1} \right) \right]$$

$$+ \xi_i \left( \hat{y}_{i,t} + \sum_{j \in F/i} \varsigma_{ij} s_{j,t} \right) + v_{i,t}^\pi,$$

where we follow various studies in the literature allowing for $0 < \kappa_i, \pi < 1$ some degree of price inertia. In (1) and (2) $s_{ij,t}$ is a real exchange rate relationship that can be expressed as follows:

$$s_{1j,t+1} = s_{1j,t} + \pi_{j,t+1} - \pi_{1,t+1}.$$ 

(3)

The model is closed by introducing (feedback) monetary and fiscal Taylor-type policy rules of the form:

$$\dot{i}_{U,t} = \theta_i \pi_{U,t} + \theta_{y} y_{U,t} \quad \text{conventional monetary Taylor rule}$$

$$\dot{f}_{i,t} = \theta_i \pi_{i,t} + \theta_{y} y_{t} \quad \text{conventional fiscal Taylor rule}$$

(4)

(5)

where $\dot{f}_{i,t}$ and $i_{U,t}$ are the control variables of the players in the LQ differential game and denote deviation of the fiscal deficit and nominal common interest rate from standard monetary and fiscal Taylor-type policy rules.

The interpretation of the above policy rules in our setting is closely related to the assumptions of the LQDG. In particular, we assume the so-called open-loop information structure, which means that (i) every player only knows the initial state and model structure at time $t \in [0, \infty)$; and (ii) the set of admissible control actions are functions of time, where time runs from zero to infinity. Thus, this scenario can be interpreted as follows: the players simultaneously determine their actions and submit them to some authority who then enforces these plans as binding commitments.

In order to complete the construction of the LQDG we propose the following fiscal players’ objectives:

$$\min_{f_{i}(t)} J_i(t_0) = \min_{f(t)} \frac{1}{2} \int_{t_0}^{\infty} \left\{ \alpha_i \pi_{i}^2(t) + \beta_i y_{i}^2(t) + \chi_i f_{i}^2(t) \right\} e^{-\theta(t-t_0)} dt,$$

(6)

for $i = 1, 2, \ldots, n$, where $\alpha_i, \beta_i, \chi_i$ indicate relative preferences of fiscal players concerning deviations of national inflation rates, output gap and
fiscal deficit. The common CB’s objective function is defined in a similar way as:

\[
\min_{\hat{\imath}} \ J_{CB}(t_0) = \min_{\hat{\imath}} \ \frac{1}{2} \int_{t_0}^{\infty} \{\alpha_{CB} \pi_{U,t}^2(t) + \beta_{CB} y_{U,t}^2(t) + \chi_{CB} \hat{\imath}^2(t)\} e^{-\theta(t-t_0)} dt,
\]

where, \(\alpha_U\) and \(\beta_U\) indicate the relative preferences of the CB concerning deviations of inflation, output gap and interest rate in the MU as a whole. The above LQDG problem is solved using a dedicated toolbox for the MATLAB environment developed by Engwerda et al. (2008).

References
Engwerda, J., T. Michalak and J. Plasmans (2008), "A numerical toolbox to solve the N-player affine LQ open-loop differential game", mimeo, Tilburg University.