Issues in DSGE modelling

Marian Vavra
Advisor to the Ministry of Finance
e-mail: marian.vavra@gmail.com

December 2008

Basic issues in DSGE modeling

1. Technical issues
   - Stationarity of variables,
   - Rational expectations,
   - Estimation procedures.
2. Theoretical issues
   - Labour market imperfections,
   - Financial market imperfections,
   - Interaction of fiscal and monetary policy.

Stationarity of variables

Let us assume the following simplified CES production function

$$Y_t = \left[\omega(Z_t L_t)^\theta + (1-\omega)(K_t)^\theta\right]^{1/\theta},$$

where Y_t is a production, Z_t is labour-augmenting productivity, L_t is employment, K_t capital stock, and θ is a parameter of substitution between labour and capital. Especially the parameter θ can be problematic both for estimation and solution.

- Scaling of variables: Let us divide all variables of equation by $Z_t N_t$, a productivity and population: $y_t = Y_t/Z_t N_t$, $k_t = K_t/Z_t N_t$, and $l_t = L_t/N_t$. Then the production function can be expressed

$$y_t = \left[\omega(l_t)^\theta + (1-\omega)(k_t)^\theta\right]^{1/\theta}, \tag{1}$$

  which is a stationary but definitely not a simple linear function.

- Deviations form (constant) steady states: Using the second approach, we can simply log-linearize the non-linear production function into the form

$$\hat{y}_t = \omega(\hat{z}_t + \hat{l}_t) + (1-\omega)\hat{k}_t, \tag{2}$$

which is a standard linear equation and can be estimated simply by OLS.

It is worth noting that after log-linearization we can loose some important features from the model. However, we believe that this is a reasonable trade-off.

Rational expectations

GDP comprises from the following components

$$\hat{y}_t = \omega_{yc}\hat{c}_t + (1-\omega_{yc})\hat{g}_t, \tag{3a}$$
$$\hat{c}_t = \omega_{cc}\hat{c}_{t-1} + (1-\omega_{cc})E_t(\hat{c}_{t+1}) - \omega_{cr}E_t(\hat{i}_t - \hat{\pi}_{t+1}) + u_t^c, \tag{3b}$$
$$\hat{g}_t = \omega_{gg}\hat{g}_{t-1} + u_t^g. \tag{3c}$$

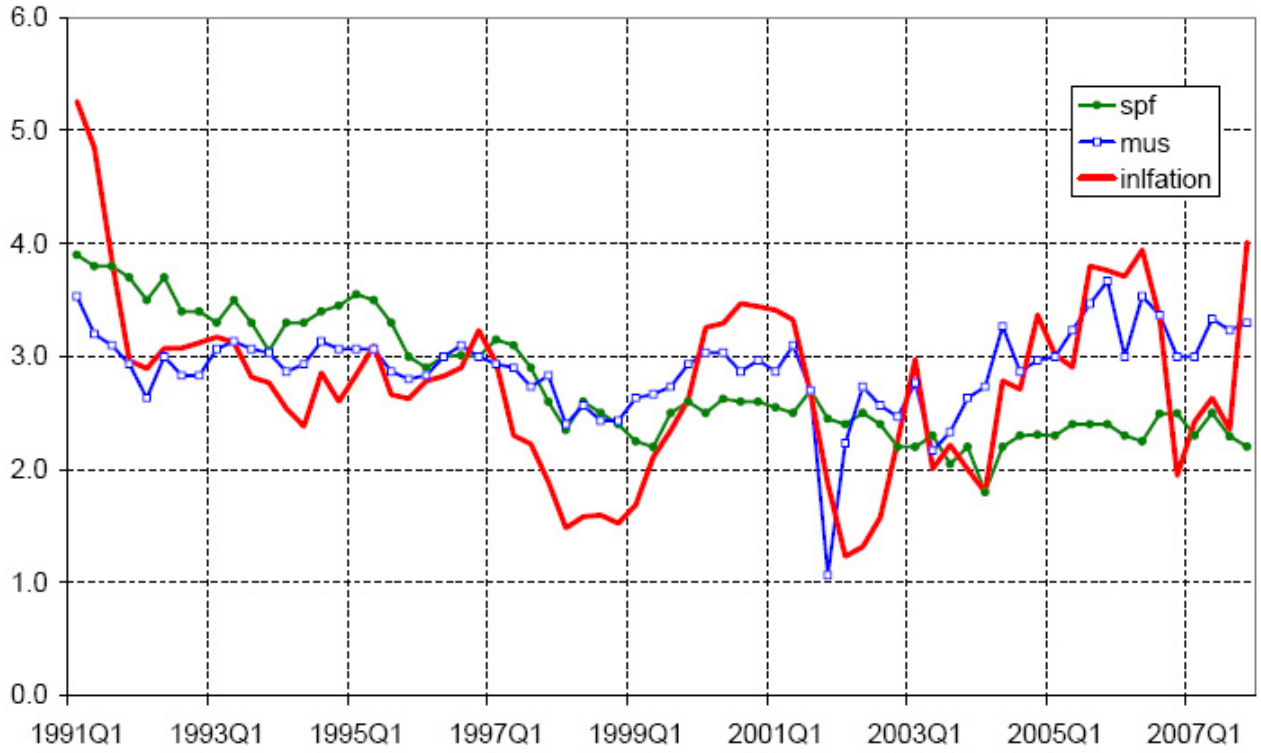
The Phillips curve specification is as follows

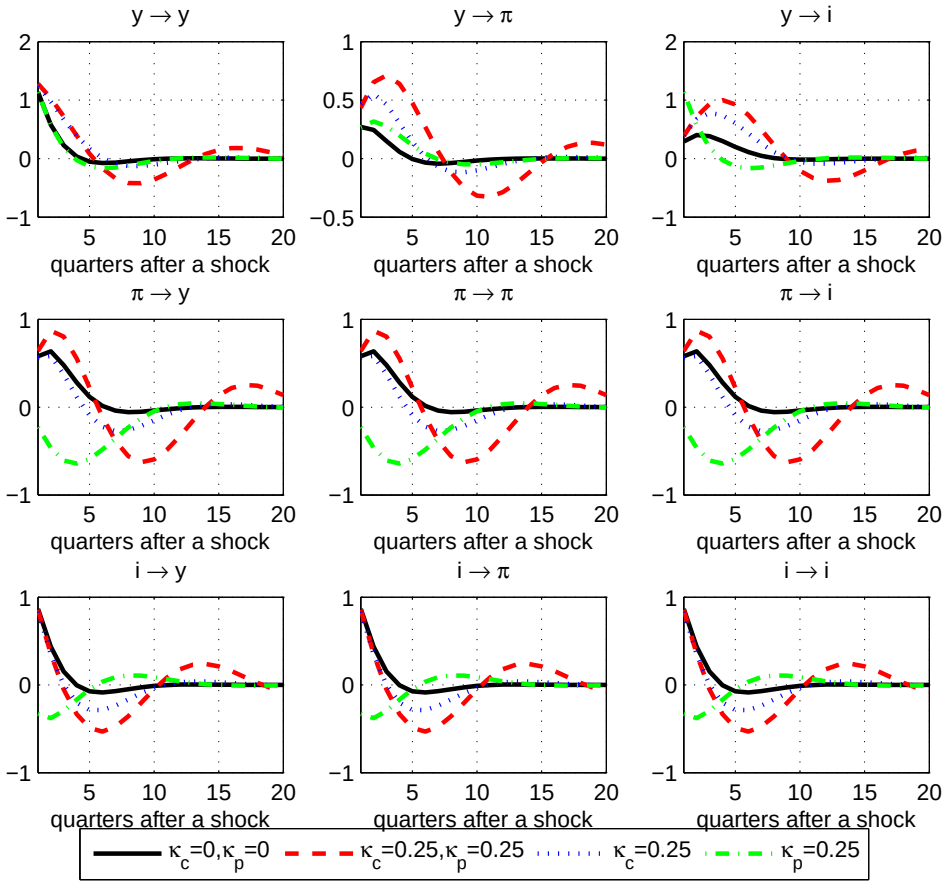
$$\hat{\pi}_t = \omega_{pc}\hat{mc}_t + \omega_{pp}\hat{\pi}_{t-1} + (1-\omega_{pp})E_t(\hat{\pi}_{t+1}) + u_t^p, \tag{4a}$$
$$\hat{mc}_t = \omega_{my}\hat{y}_t + \omega_{mc}\hat{c}_t - \omega_{mcc}\hat{c}_{t-1} - \omega_{ma}\hat{a}_t, \tag{4b}$$
$$\hat{a}_t = \omega_{aa}\hat{a}_{t-1} + u_t^z. \tag{4c}$$

The interest rate setting is given by

$$\hat{i}_t = \omega_{i\pi}\hat{\pi}_t + \omega_{iy}\hat{y}_t + \omega_{ii}\hat{i}_{t-1} + u_t^i, \tag{5a}$$
$$\tag{5b}$$

All the parameters ω's are reduced form parameters and are functions of deep (structural) parameters. Now, what about if $E_t(X_{t+1}) \neq X_{t+1} + \epsilon_{t+1}$ but a fraction κ_x of agents is backward-looking in their expectations?


6.0
5.0
4.0
3.0
2.0
1.0
0.0
1991Q1
1993Q1
1995Q1
1997Q1
1999Q1
2001Q1
2003Q1
2005Q1
2007Q1
spf
mus
inlfation


y → y
y → π
y → i
π → y
π → π
π → i
i → y
i → π
i → i
quarters after a shock
κc=0,κp=0
κc=0.25,κp=0.25
κc=0.25
κp=0.25

Estimation

- Maximum likelihood:
  - strict assumptions about a distribution of error terms,
  - no analytical solution usually available,
  - numerical differentiation $\neq$ analytical counterpart,
  - very useful properties.
- Bayesian methods:
  - strict assumptions about a prior distribution,
  - no analytical solution usually available,
  - numerical integration for finding moments of from posterior distribution,
  - very powerful tool but...
- Simulated methods of moments/indirect inference models:
  - for models where no analytical solution is available (e.g. GMM),
  - requires "stable" moments (raw, auto, or cross ones),
  - requires a "correct" specification of the model under a simulation,
  - very flexible and powerful tool.

Labour market imperfections

There are two labour market imperfections: sticky wages and relationship between labour demand and supply.

- Sticky wages: this problem is usually solved using both adjustment cost function of Calvo type contact for wages. Both formulations lead to the same results in fact.

- The link between labour demand and supply is usually underestimated in current DSGE models. Very promising, but not without problems, is an approach based on matching functions, see Moyen and Sahuc (2005).

Financial market imperfections

- Conducting monetary policy is based on setting short-term interest rates.

- However, there is some evidence in the literature that behaviour of agents is affected rather by (real) long-term, credit and/or deposit rates. A very nice example is the **mortgage rate** which can be fixed for several years in an individual contract.

- DSGE models usually completely ignore a problem of interest rate pass-through.

- A possible solution can be in extending DSGE models by a banking sector, see Vavra (2008).

Interaction of fiscal and monetary policy

The main problem of standard DSGE mdoels is that a fiscal block is usually missing. If not, it is usually some ad hoc specification but

- optimal economic policy $\neq$ optimal monetary + optimal fiscal policy.

Moreover, an ad-hoc specified simple fiscal policy rule can constrained performance of Taylor based monetary policy rules and lead to ineffectiveness, see Ascari and Ranking (2007) for details.

The end

Thanks for your attention.