Estimation of DSGE models

Calibration

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Overview

- Econometrically, a DSGE-Model is a state-space model of which one has to determine the parameters.
- Three concepts:
  1. **Calibration**: The parameters are set in such a way, that they closely correspond to some theoretical moment or stylized fact of data.
  2. **Methods of limited information** or weak econometric interpretation: Minimize the distance between theoretical and empirical moments, i.e. *General-Method-of-Moments* or *Indirect Inference*.
  3. **Methods of full information** or strong econometric interpretation: The goal is an exact characterization of observed data, i.e. *Maximum-Likelihood* or *Bayesian methods*.

Calibration

- Goal: To answer a specific quantitative research question using a structural model.
- Construct and parameterize the model such, that it corresponds to certain properties of the true economy.
- Use steady-state-characteristics for choosing the parameters in accordance with observed data.
- Often: stable long-run averages (wages, working-hours, interest rates, inflation, consumption-shares, government-spending-ratios, etc.).
- You can use micro-studies as well, however, one has to be careful about the aggregation!

Hints

- Use long-term averages of interest rates, inflation, average growth of productivity, etc. for *steady-state* values.
- BUT: Weil (1989) shows, that in models with representative agents there is an overestimation of *steady-state* interest rates (*risk-free rate puzzle*). It is possible that you get absurd constellation of parameters, like a discount-factor of $\beta > 1$.
- Usual mark-up on prices is around 1.15 (Corsetti et al (2012)).
- Intertemporal elasticity of substitution $1/\sigma$ somewhere between $\sigma = 1$ and $\sigma = 3$ (King, Plosser and Rebelo (1988), Rotemberg and Woodford (1992), Lucas (2003)).

Hints

- Rigidity of prices: For an average price adjustment of 12-15 months see Keen and Wang (2007).
- Coefficients of monetary policy: Often Taylor-Rule, you can use the relative coefficients to put more emphasize/weight on the stability of prices or on smoothing the business cycle.
- Parameters of stochastic processes: Often persistent, small standard-deviations, otherwise you get high oscillations. You can also estimate the production function via OLS (Solow-residual).
- How to choose shocks: Look at similar studies: Christiano, Eichenbaum and Evans (2005), Smets and Wouters (2003), etc..
- Ultimately: Try & Error!

Pros

- Calibration is commonly used in the literature. It gives a first impression, a flavor of the strengths and weaknesses of a model.
- A good calibration can provide a valuable and precise image of data.
- Using different calibrations, one can asses interesting implications of different policies:
  - How does the economy react, if the central bank focuses more on smoothing the business cycle than on price stability?
  - What happens to consumption, if the households have a strong intertemporal elasticity of substitution? What if it is low?

Cons

- This Ad-hoc-approach is at the center of criticism of DSGE-models.
- There is no statistical foundation, it is based upon subjective views, assessments and opinions.
- Many parameter, such as those of the exogenous processes, leave room for different values and interpretations (intertemporal elasticity of substitution, monetary and fiscal parameters, coefficients of rigidity, standard deviations, etc.).

Prescott (1986, S. 10) regarding RBC-models:

The models constructed within this theoretical framework are necessarily **highly abstract**. Consequently, they are necessarily false, and statistical hypothesis testing will reject them. This does not imply, however, that nothing can be learned from such a **quantitative theoretical exercise**.

Exercise

The representative households problem is

$$max_{\{c_t,l_t\}} E_0 \sum_{t=0}^{\infty} \left[\beta^t \frac{(c_t^\theta (1-l_t)^{1-\theta})^{1-\tau}}{1-\tau} \right]$$

subject to

$$\begin{aligned} c_t + i_t &= \exp(z_t) k_t^\alpha l_t^{1-\alpha} \\ k_{t+1} &= i_t + (1-\delta) k_t \\ z_t &= \rho z_{t-1} + s\epsilon_t \end{aligned}$$

$\rightarrow$ Derive the equilibrium conditions!
(Hint: Substitute out i_t in a first step!)

Exercise

(a) Interpret your equations. What are *state* variables, what are control variables, what are the parameters of the model?

(b) Write a mod-file for the model. Use the parameters $\theta = 0.357$,$\tau = 2$, $\tau = 2$, $\rho = 0.95$ and $s = 0.007$.

(c) Write a m-script to calibrate the free parameters α and δ. Use the expected capital stock of $E[k] = 29.1$ and expected consumption $E[c] = 1.5$. Further use a grid for $\alpha = [0.35; 0.45]$ and $\delta = [0.004; 0.05]$ and search for the combination of parameters which minimizes the sum of quadratic deviations of your model moments and the given *empirical* expected values.