Calibration

Numerical Methods

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Calibration

- What it is
- Why we do it
- Pitfalls
- Why theorists do not like it

Calibration: What is it and what is it needed for?

- Research in applied macro/micro typically proceeds in the following steps:
- Canova (2007):
  1. Choose an economic question to be addressed
  2. Select a model with some relevance to the question
  3. Choose functional forms for the primitives of the model
  4. Find a solution for the endogenous variables in terms of the exogenous ones and the parameters
  5. Select parameters and specifications for the exogenous processes and simulate paths for the endogenous variables
  6. Evaluate the quality of the model by comparing its outcomes with a set of "facts" of the actual data
  7. Propose an answer to the question, characterize the uncertainty surrounding the answer, and do policy analysis if required

Examples for Generic Research Questions

Questions usually display four types (Canova 2007):

1. How much of fact X can be explained with impulses of type Y?
   [Kydland and Prescott (1982), How much of the variation in output can be accounted for by technology shocks?]

2. Is it possible to generate features F by using theory T?
   [Shimer (2005): Is the DMP model able to generate the observed volatility in labor market outcomes?]

3. Can we reduce the discrepancy D of the theory from the data by using feature F?
   [Abel (1990): Can preferences augmented with habit formation resolve the equity premium puzzle?]

4. How much do endogenous variables change if the process for the exogenous variables is altered?
   [Ljungqvist and Sargent (1998): How much does unemployment react to the "observed" rise in economic turbulence?]

- What role does calibration play in this process?

- In order to make economic models "computable" and in order to compare their predictions to actual data, they need to be calibrated:

    1. Impose functional forms on preferences, technology and other relevant functions. Sometimes it's sufficient to calibrate relevant aspects of these functions rather than the functions itself.

    2. Select the parameters of preferences, technology etc.

- How does one do this?

- There is disagreement in the profession (Surprise!) about what the term "Calibration" is actually referring to

- Most widespread view: Calibration is the process by which researchers choose the parameters (and functional forms) of their economic models from various sources. Most commonly, this is done by
  - the use of time series averages of the levels or ratios of economic variables
  - the estimation of single equations
  - reference to econometric studies based on either macro- or micro-data
  - setting the parameters so that the model replicates certain empirical facts such as conditional or unconditional moments of the data

Using time series averages

Examples:

In partial eq., the interest rate r as an average over time:

$$\hat{r} = \frac{\sum_{t=1}^{T} r_t}{T}$$

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With Cobb-Douglas, α is labor share over time:

$$\hat{\alpha} = \frac{\sum_{t=1}^{T} (w_t L_t / Y_t)}{T}$$

Estimating single equations

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TFP as AR(1) in data:

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Individual's wage as AR(1) in data:

$$w_t = \rho w_{t-1} + \nu_t$$

Of course, more sophisticated specifications are possible (Guvenen and co-authors)

Reference to other studies

- CRRA σ has been estimated before; $\sigma \in [1, 3]$ aprox.
- Discount factor β used in several different papers; around 0.96
- etc, etc
- "I have never seen a β in the street..."

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- Run the model to replicate data targets

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$$\hat{\Theta} = arg \min_{\Theta} [M_m(\Theta) - M_d]' [M_m(\Theta) - M_d]$$

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Remember the role of distributions in computing the moments (conditional and unconditional)

Some issues

- Targets need to be sufficiently responsive to changes in the parameters
- Issue of "identification" / Observational equivalence
- Do sensitivity checks to assess the uncertainty around the calibrated parameters