Revision Lecture

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Advanced Monetary Economics 2020

L1: Mathematical Methods

- Over and over again we solve problems that look like the following

$$\max_{c_t, k_{t+1}} \sum_{t=0}^{\infty} \beta^t \left\{ \frac{c_t^{1-\sigma}}{1-\sigma} - \chi n_t \right\}$$

subject to

$$c_t + k_{t+1} - (1-\delta)k_t = n_t w_t + r_t k_t$$

L1: Mathematical Methods

- What are the key equations from solving this problem?
- Euler equation.
- Labour supply.
- What margins to these two equations get at?

L2: Non-Neutrality of Money

- This was the qualitative stuff.
- You've had lots of practice at this.
- Keynesian intuition for policy changes.

L3: Real Business Cycle Model

- Stochastic model with productivity shocks.
- Key equation

$$\log(a_t) = \rho_a \log(a_{t-1}) + \epsilon_{a,t}, \quad \epsilon_{a,t} \sim N(0, \sigma^2)$$

  where $0 < \rho_a < 1$.
- Realisations to the shock term $\epsilon_{a,t}$ are what drive business cycles.
- Size of the persistence term ρ_a determines how long it takes to return to steady state.
- Competitive equilibrium yields same solution as social planner's problem.
- Business cycles are a natural part of life.
- No money; need a numeraire good.

L4: Real Business Cycle Model with Money

- Cash serves as a unit of account.
- What role can monetary policy have?
- People only hold cash if $q_t = 1$.

L5: Money in the Utility Function Model

- First attempt at modelling money.
- Augment preferences with a desire for real balances

$$\sum_{t=0}^{\infty} \beta^t \left[\frac{c_t^{1-\sigma}}{1-\sigma} - \frac{n_t^{1+\varphi}}{1+\varphi} + \frac{(m_{t+1}/p_t)^{1-\nu}}{1-\nu} \right]$$

  which generates a demand curve for money.
- Other key equation: central bank's money supply.
- Money demand and supply determine equilibrium in money market.
- This approach is just like sticking another good into the model.
- With separable utility across consumption, labour and real balances, the money market equilibrium has no impact on other real variables.

L6: Cash in Advance Model

- Generates money demand by assuming certain types of goods require cash for purchase.
- Other goods not requiring cash are referred to as credit goods.
- The effect of money on the economy depends strongly on which goods are assumed to require cash.
- Arbitrary: this is no good.
- E.g. if consumption goods require cash, then you'll have constraint

$$p_t c_t \leq m_t + \tau_t$$

where τ_t is a government transfer of cash to the household (may be zero or non-zero).

L7: Overlapping Generations Model

- Assumes that agents only live for a certain number of periods.
- New generation born at each time t.
- The equilibrium of the model can be inefficient.
- Nobody wants to lend money to the old since they can't pay it back.
- Creates a role for money: old can give money to the young.
- Only works in a monetary equilibrium (when money is valued).
- Money will be valued when people today think it will be valued tomorrow.

L8: New Keynesian Part I: Imperfect Competition

- First ingredient into the NK model.
- Introduced a static model with monopolistically competitive firms: each makes a different variety $j \in [0, 1]$.
- Households have preference over varieties $j \in [0, 1]$.
- Households undertake two-stage budgeting:
  - **(1)** How much of each variety do I want to consume?
  - **(2)** Given my answer to (1) above, how much do I want to consume in total?
- Step (1) generates demand curves $C(j) = \left(\frac{P(j)}{P}\right)^{-\epsilon}$.
- Step (2) generates the labour supply condition.

L8: New Keynesian Part I: Imperfect Competition

- Firms maximise their profits given the answer to (1) above, i.e. $C(j)$.
- Optimal solution is to set price as a markup over marginal cost.
- Markup depends on the elasticity of substitution across different varieties.

L9: New Keynesian Part II: Price Stickiness

- Second ingredient into the NK model.
- Calvo price setting: θ is the probability that a firm will be stuck with the price they set today tomorrow.
- Optimal price when we get a re-set (probability $1-\theta$) maximises the expected value of future profits given this price we choose today.
- Discount future profits using the household's stochastic discount factor.
- Household's stochastic discount factor is generally different from β. Why?

L9: New Keynesian Part II: Price Stickiness

- Rotemberg price setting allows prices to change at an adjustment cost.
- Difference between the two approaches: price dispersion with Calvo and none with Rotemberg.
- No dispersion with Rotemberg since all the firms are the same.

L10: New Keynesian Part III: NK Phillips Curve

- Old Keynesian Phillips curve: empirical relationship between the state of the economy and inflation: lower unemployment can only happen with high inflation.
- Old idea criticised based on a lack of micro-foundations and failure to account for future expectations.
- New Keynesian Phillips curve incorporates these features

$$\hat{\pi}_t = \kappa \hat{y}_t^g + \beta \mathbb{E}_t[\hat{\pi}_{t+1}]$$

where κ parameter gets at the old Phillips curve idea and the expectation accounts for the future inflation.

L11: Solving DSGEs Part I: Analytical Methods

- Method of undetermined coefficients or "guess and verify".
- Always guess that the endogenous variables are functions of the state variables and shocks.
- Recall that the state variables summarise the "state" of the system at time t. They contain all the necessary information.
- E.g. in RBC model, there are productivity shocks and last period's capital stock and productivity is the state variable. So you'd conjecture, say for next period's capital, that

$$\hat{k}_{t+1} = \phi_a \hat{a}_{t-1} + \phi_k \hat{k}_t + \phi_\epsilon \epsilon_{a,t} \tag{1}$$

where the ϕ terms are coefficients that we need to find.

L11: Solving DSGEs Part I: Analytical Methods

- This method says, we'll make an assumption about the form of the solution like in equation (1) (the guess part).
- We'll then substitute these guesses into the system of equations.
- Then gives us restrictions on the coefficients ϕ such that the guess indeed is the solution (the verify part).
- We use this method if the model is simple enough. Will give us the parameters we in (1) as functions of the parameters of the problem (e.g. utility function parameters etc).

L12: Solving DSGEs Part II: Numerical Methods

- We turn to numerical solutions if the model is too complicated for analytical methods.
- Can use Dynare easily for this purpose.
- Tells us what the policy functions are, (i.e. equation (1) is the policy function for capital's choice), for specific parameter values (e.g. $\sigma = 2.0$).
- We use these solution techniques for answering quantitative questions, (e.g. if monetary policy increases by 1%, how much will output decrease by?).

L13: New Keynesian Part IV: Optimal Monetary Policy

- Looked at optimal policy in the Calvo context.
- The deadweight losses of Calvo come from the price dispersion.
- Higher inflation means more price dispersion.
- Optimal policy was to achieve the flexible price equilibrium.
- No price dispersion in this case.
- Optimal policy was $\hat{i}_t = \hat{r}_t^n$ in equilibrium.
- Taylor principle: we need the central bank to target inflation to prevent a hyperinflation.

The End

- That's all from me.
- Stay healthy.
- Good luck and stay in touch!