

Teaching modern general equilibrium macroeconomics to undergraduates: using the same theory required for advanced research

Max Gillman

Cardiff Business School

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Motivation

- Undergrad Macro not based strictly on Micro theory:
- with many ad hoc elements.
- No smooth integration of micro with macro, in general.
- Research Macro articles now built mainly on microeconomic theory
- with only some added ad hoc elements.
- Challenge: how to teach undergrad Macro so
- Revise towards Microfoundations with seamless step to grad Macro.
- Bigger Challenge: Do this at intermediate Macro level,
- not just a third year Advanced macro course.
- Methodological consistency (Obstfeld-Rogoff 96): at lower Level, more consistent

Existing Literature: Current Textbooks

- Many excellent macro texts but almost all include Split analysis:
- Macro Dichotomy:
 - Neoclassical elements of labor-leisure, growth, business cycles
 - Keynesian general equilibrium with no derivation of equilibrium.
- Trend: Include increasingly more Microfounded elements
- Main Microfounded approach: Barro; but lacks the full model/math.
- Almost all others are a mix, or hodgepodge of approaches.
- Problem: simple Keynesian model almost never used in research.
- Makes large sections of most texts inconsistent with graduate work.

Approach to Bringing Intermediate Macro in line with Graduate Macro

- Intermediate Macro: a level above the graphs, intuition of intro macro
- Fair game to use Calculus, Algebra, solving of systems of equations
- Solution: Use general equilibrium from beginning to end, as is standard in Research
- Use simplest general equilibrium, of one Representative agent for closed economy
- Two agents for open economy: "heterogeneous agents" at simplest level.
- Methodologically consistent Microfoundations from beginning to end.

- Always use log utility
- Always use Cobb-Douglas production.
- Use Calibration consistent with Research, but simple as possible
- Always can have full analytic solution of equilibria.
- Graph actual mathematic functions of Supply, Demand
- Use Chain Rule and partial derivatives.

Specific Structure: Part 1, Labor, Capital and Goods

A. Labor and Goods Market

- One Derivative: Equil Condition
- Labour-Leisure tradeoff in simple gen equil with one agent
- Capital assumed fixed. Firm Profit goes back to Consumer
- Key condition: Marg Prod Labour = Marg Rt Subst Goods-Leisure
- Decentralize problem into Consumer and Firm: gives wage rate
- Extend to 2 agents, one with higher Marg Prod than other
- Trade between agents at equil wage: utility comparison
- Comparative statics of Marg Product changes.

Graphical Approach

- Graphs are Two dimensional
- Show Gen Equil: with Exact Util Levels and Prod Function
- Show Decentralized Markets: Labour and Goods, Supply and Dem
- Relative Price is wage rate w or $1/w$ for each Market
- Again, Exact Functional Representation of Supply and Dem
- Uses Scientific Word Graphics
- With 2 Agents, 2 Supply and Demand lines in each market

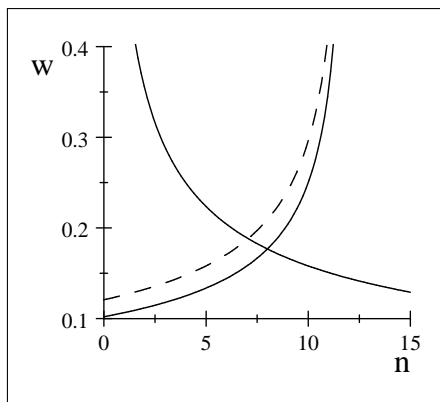


Figure 2.15. Labor Market with a Tax Financed Dole

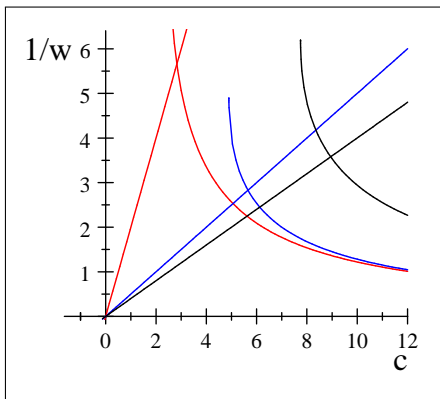


Figure 3.2. The Goods Market under Free Trade

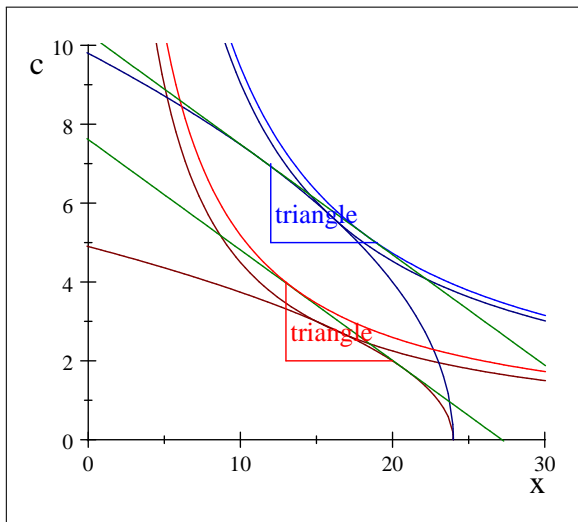


Figure 3.3. General Equilibrium Goods and Labor Markets Under Free Trade

Part 1, B. Capital Dimension

- One Derivative: Equil Condition
- Investment-Savings and Intertemporal Consumption Smoothing
- Simple 2 period Model with full depreciation and zero initial capital
- Margin: Marg Rt of Intertemp Subst = Marg Prod of Capital
- This gives the dynamic Euler equation of Consumpt Growth
- Standard analysis as with Labor, but now Capital and Goods markets
- Then also decentralized into Consumer and Firm sides
- and then 2 representative agents with trade: Open Econ.
- easy extension to 1000 agents of 2 types.

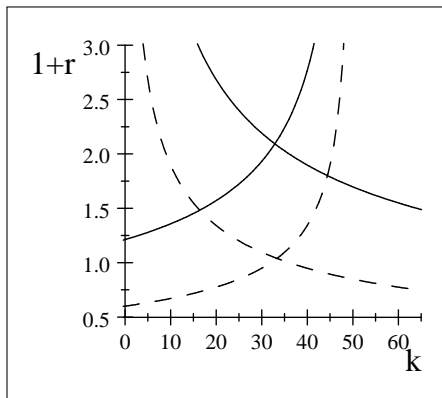


Figure 4.9. Shift upwards in the Supply and Demand for Capital from a Productivity Increase

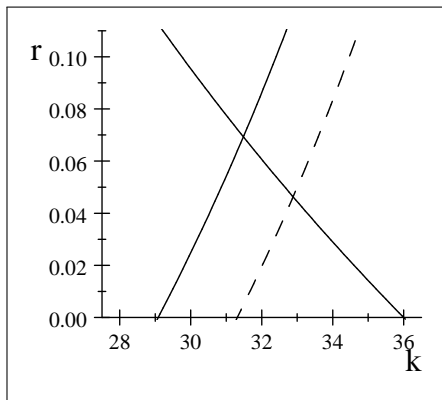


Figure 4.12. The Shift Back in Savings When a Tax on Gross Capital Income of 10% is Levied

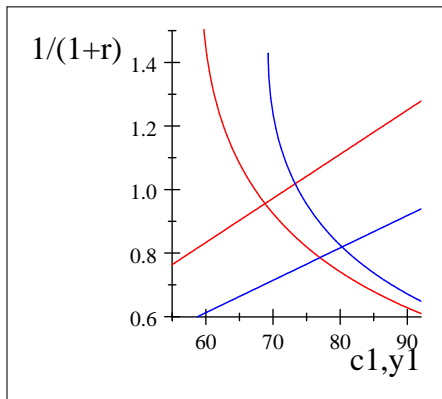


Figure 4.6. Market for Future Period Consumption

Part 2.A. Bringing together Labour and Capital Markets

- Go from two dimensional to dynamic Equilibrium
- Transition into Recursive Dynamic Framework
- Show Exact Same First Order Conditions
- of Previous Part 1, but now from Recursive model.
- Creates Modern AS-AD from Neoclassical Model
- First time? accomplished totally rigourously
- And totally consistent with standard research framework

Recursive Economics and Undergrad Macro

- Must face up to issue of teaching Recursive Dynamic Equil
- Do this by showing First Order Conditions (FOC)
- same as 2 standard Labour and Capital margins.
- New part: envelope condition, FOC in state variable capital k_t :
- Says that discounted Marg util of Cap k at $t + 1$ is Marg Util of current c_t
- That yields back the main Margin for Capital, plus have Labour margin.
- This identical equilibrium makes attractive Recursive Methodology.
- Need this to avoid more complicated Dynamic equilibrium FOC:
- Gives a simple 2 period framework instead of infinite horizon.

Recursive Model: 3 Derivatives; Capital, Labor, State Var

$$V(k_t) = \underset{c_t, x_t, l_t, k_{t+1}}{\text{Max}} : u(c_t, x_t) + \beta V(k_{t+1}),$$

$$c_t = A_G l_t^\gamma k_t^{1-\gamma} - k_{t+1} + k_t (1 - \delta_k)$$

$$x_t = 1 - l_t.$$

$$V(k_t) = \underset{l_t, k_{t+1}}{\text{Max}} : u\left(A_G l_t^\gamma k_t^{1-\gamma} - k_{t+1} + k_t (1 - \delta_k), 1 - l_t\right) + \beta V(k_{t+1}).$$

$$MP_l = \gamma A_G l_t^{\gamma-1} k_t^{1-\gamma} = \frac{u_x(c_t, x_t)}{u_c(c_t, x_t)} = MRS_{c,x}.$$

$$u_c(c_t, x_t) = \beta V'(k_{t+1});$$

$$V'(k_{t+1}) = u_c(c_{t+1}, x_{t+1}) \left[(1 - \gamma) A_G l_t^\gamma k_t^{-\gamma} + (1 - \delta_k) \right];$$

$$MRS_{c_t, c_{t+1}} = \frac{u_c(c_t, x_t)}{\beta u_c(c_{t+1}, x_{t+1})} = \left[1 + (1 - \gamma) A_G l_t^\gamma k_t^{-\gamma} - \delta_k \right] = MP_k;$$

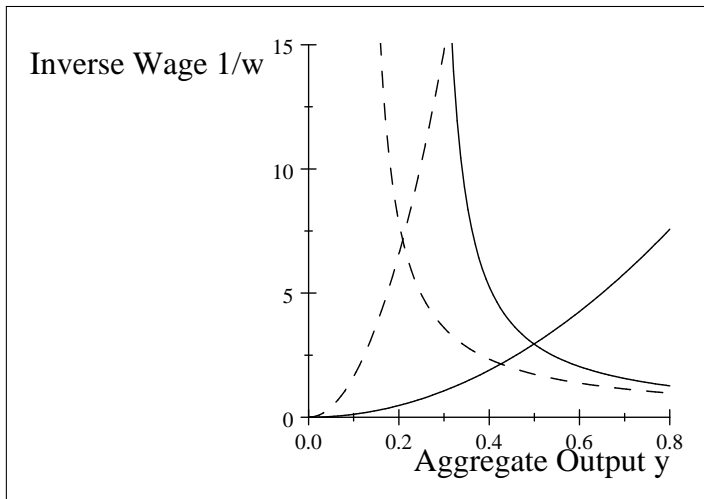
Get AS-AD within Dynamic Neoclass Growth and RBC Model

- Trick 1: Frame within Balanced Growth Path (BGP) equilibrium
- Trick 2: first assume zero Growth. Makes interest rate r exogenous.
- Then add Consumption demand to Investment demand to get AD
- AS comes directly from the firm problem
- AD and AS are functions of prices w and capital k , and parameters
- Trick 3: need correct equilibrium k value to get the BGP equil w .
- Given correct k , and a Calibration, can graph and then do comparative statics
- Focus on Change in TFP Productivity, as in Growth/Real Bus Cycle.

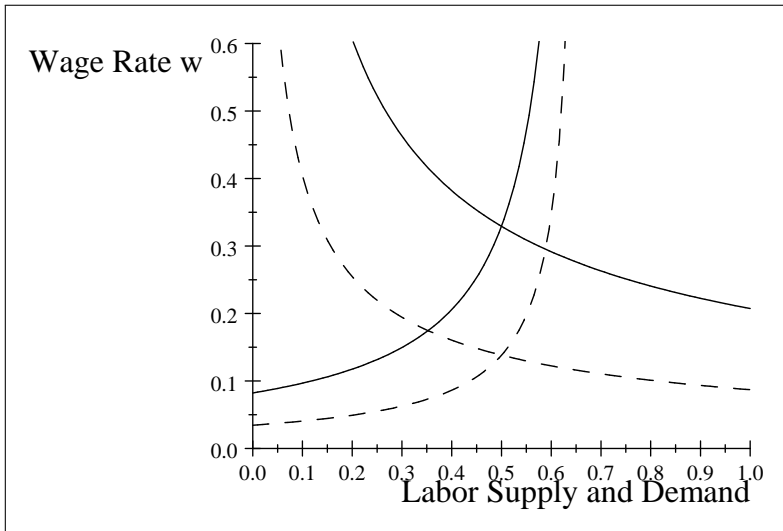
Finding the Equilibrium State Variable

- Devote whole (next) chapter to this
- Solve model until a single equation in k_t .
- Then plug in parameters and solve k_t .
- Comparative statics by changing parameters, find new k
- Then plug in new k and new parameter to $AS - AD$
- Find new equilibrium price w , in Agg. goods output or Labor market.
- w found graphically and analytically
- Add Fixed wage rigidity

AS-AD and Labour Graphs



AS-AD Equilibrium with A_G Increase



Aggregate Labour Market with A_G Increase

2.B. Focus Next on Growth and Business Cycles

- Standard Solow Exog Growth along BGP, with $AS - AD$
- Then introduce Human Capital and Endogenous Growth
- Transition to RBC: show how a shock process accumulates
- Say how similar to static TFP change.
- Add Market, Non-Market Sectors
- Transition to International RBC
- Part 3. Topics in Uncertainty, Insurance and Asset Prices
- Apply to Government Fiscal Tax and Monetary policy.
- Colours: Historical Development towards Modern Macro
- Policy Applications

Conclusions

Can teach Modern Macro with full Microfoundations:

Depends on how you do it.

Can be made Simple enough: key of 2 dimensions, one derivative

And can be made Internally Consistent

And can be Complete in certain ways

Revives $AS - AD$ within Modern Theory

100% Microfounded