Week 5

Aggregate Supply and Demand

What we do and do not do here

- Sketch the basic models of aggregate demand and supply without microfoundations
  - We add the foundations next week
- **Two-curve** analysis
  - Why is the supply-demand model of competition useful?
    - It describes two relationships that depend on different things
    - Together the two curves determine the variables of interest
  - We extend that style of analysis to the macroeconomy here
  - Many examples:
    - AD/AS with output and price level
      - Expenditure and monetary variables affect AD
      - Cost and production variables affect AS
    - IS/LM with output and interest rate
      - Expenditure behavior affects IS
      - Monetary/asset conditions affect LM
    - IS/MP as alternative to IS/LM when central bank has an interest-rate rule
    - Open-economy models also break down into two curves
      - Sometimes like IS and LM
      - Sometimes with ε on the vertical axis

Two sides of macroeconomy

- **Aggregate demand**: Desired expenditures (consumption, investment, net exports in open economy), monetary and fiscal policies
- **Aggregate supply**: Production, labor market, technology/productivity, capital stock

Two key variables

- Real GDP Y measures total output, income, and expenditures in economy (in terms of goods and services)
  - We avoid aggregation problem by just assuming that all goods are identical
- Aggregate price level P measures cost of one unit of generic goods in terms of money
- AS/AD can be done in terms of levels or of changes (growth and inflation)
  - We won't worry about the details

Aggregate demand

- Alternative theories of AD
  - IS/LM model comes out of Keynes's *General Theory* and describes a multiplier process in which more spending leads to more income, which leads to more spending.
    - Hicks exposition was first to formalize this version
  - IS/MP is David Romer's variant on IS/LM that provides for monetary policy to be set in terms of an interest-rate target rather than a target level of *M*
  - Mundell-Fleming model is a variant of the IS/LM model that applies to an open-economy with high international mobility of borrowing and lending

IS/LM Model with Fixed Prices

- Traditional IS/LM vs. "neo-Keynesian" IS/LM
  - Traditional is based on simple, intuitive relationships
  - Modern models are grounded in assumptions about individual choice
  - Romer 3rd edition presents basic, traditional model
    - Also in standard "intermediate" macro texts
  - Romer 4th edition develops neo-Keynesian model with more rigor
    - We don't have time for the details of this derivation but will discuss the conclusions and the ideas

Traditional IS/LM derivation

- Income-expenditure model of closed economy
  - $Y = C + I + G$
  - $C = C(Y - T)$
  - $I = I(r)$
- *IS* curve
  - Shift variables: *G, T,* anything that shifts the demand for consumption or investment (other than Y or r)
- Money demand: $M / P = L(Y, i)$, $i = r + \pi$
- *LM* curve
  - Shift variables: M/P, anything that shifts the demand for money other than Y or r, including π^e
  - Zero lower bound on i
- Effect of ΔP and AD curve
  - Shift variables for AD curve: *G, T, M,* π^e, anything else that shifts *IS* or *LM*
  - Note ZLB case with vertical AD curve

Romer's *MP* curve

- Modern central banks act by setting the interest rate, not by setting targets for money supply
- Romer's *MP* is $r = r(Y, \pi)$ with positive effects from both
- *IS*/*MP* model looks a lot like *IS*/*LM*

Open-Economy Models

Basic concepts

- International trade: $Y = C + I + G + NX = E(Y, r, T, G, \varepsilon)$
  - *NX* depends on $\varepsilon = eP^*/P$, where
    - *e* is price of foreign currency in terms of domestic
    - Increase in *e* = *depreciation* of domestic currency
    - ε is price of foreign goods in terms of domestic goods
    - *NX* is increasing in ε
  - $Y = E^D(Y, r, G, T) + NX(Y, r, G, T, \varepsilon)$
    - $E^D(Y, r, G, T) \equiv C + I + G$
- Perfect capital mobility: $r = r^*$ if the real exchange rate is not expected to change
  - Must include a term for expected depreciation of currency if non-zero:

    $$r = r^* + \frac{E(\dot{\varepsilon})}{\varepsilon}$$

  - This term can lead to interesting effects, including "overshooting" of exchange rate.
  - We won't have time to discuss this in detail and will assume it is zero.

Mundell-Fleming model

- Floating exchange rates and perfect capital mobility
- From *MP** curve $r^* = r(Y, \pi)$ sets a given level of Y (given π and r^*)
  - We plot the *MP** curve in (Y, ε) space, and it is vertical because ε does not appear in the equation
  - Note that the central bank has ***no control over r*** in the case of perfect capital mobility.
  - But a "stimulative monetary policy" will raise Y in this case:
    - Central bank tries to lower *r* by expanding *M*
    - This leads to capital outflow as *r* tries to fall below *r**
    - Capital outflow depreciates the currency, which makes exports cheaper and imports more expensive
    - *NX* increases, which raises the demand for Y and shifts the *MP** curve to the right
- *IS** curve is $Y = C + I + G + NX = E(Y, r^*, G, T, \varepsilon)$ with positive effect of ε on Y

  - Positively sloped in (Y, ε) space.
  - Shift variables: G, T, r^*, and anything that shifts the demand curves for C, I, NX
- Can also do this model in regular IS/MP and (Y, r) space
- Note importance of zero expected change in exchange rate
  - Modified capital mobility equation is $r = r^* + \frac{E(\dot{\varepsilon})}{\varepsilon}$
  - Speculative attack: Expected depreciation increases r and decreases demand for goods

Imperfect capital mobility

- $CF = CF(r - r^*),\ CF' > 0$
- Capital inflows must match trade deficit: $CF(r - r^*) + NX(Y, r, G, T, \varepsilon) = 0$
  - Can rewrite this as "IS" curve: $Y = E^D(Y, r, G, T) - CF(r - r^*)$
  - This curve is downward-sloping in r but flatter than standard IS because increase in r leads to capital inflow, which appreciates ε and reduces NX, so there is an additional decrease in expenditures.
  - Shift variables: G, T (not ε because we have "solved it out")
- MP curve is upward-sloping as before
  - Central bank regains some control over r with imperfect capital mobility
  - Control is limited because of very elastic IS curve

Fixed exchange rates

- Let $NX = NX(\varepsilon)$
- Suppose that central bank fixes $\varepsilon = \bar{\varepsilon}$
  - In order to fix exchange rate, central bank must buy or sell its currency (for foreign currency) to balance supply with demand at $\bar{\varepsilon}$
- $CF(r - r^*) + NX(\bar{\varepsilon}) = RG$ = "reserve gain," the amount of foreign currency that the central bank buys (+ or –) to balance the market
  - Constraint: $RG \geq 0$ or it would run out of reserves eventually
  - Central bank must set r high enough to keep its net reserve gain non-negative
  - Let r_0 be the lowest interest rate at which this occurs, then the central bank can set r by its MP curve as long as the r it would choose is $\geq r_0$
  - MP curve has kink and becomes horizontal at r_0
- IS curve is the usual one including NX with ε fixed

Phillips Curve and Aggregate Supply

- Keynesian IS/LM model provided aggregate demand side.

- How did Keynesians explain price change over time?
  - Romer's models are complicated and (to me) don't help much
- Phillips curve was empirical relationship between (wage) inflation and unemployment
  - Original was for UK wage inflation
  - Looks about the same with price inflation and for other countries
- Simple "theory"
  - When output booms ($Y > \bar{Y}$), then unemployment is low and wages will tend to rise
  - Wage increases will be passed along through prices, so inflation is high when unemployment is low
  - Downward-sloping Phillips curve results
  - Problem with simple theory is that it fails to distinguish between real and nominal wages
    - Tight labor market should increase *real* wages
    - For real wages to rise, nominal wage must increase by more than prices

Modern Phillips curve (due to Friedman and Phelps)

- There is a long-run equilibrium ***natural*** rate of unemployment to which the labor market tends to return
  - Natural rate depends on structural characteristics of labor market, which vary greatly across countries and time
  - In an equilibrium labor market (no general shortfall or surplus of demand for labor), unemployment is a process of matching workers with jobs
  - Because both are highly heterogeneous, this will be highly imperfect and there will be pools of vacant jobs and unemployed workers coexisting
  - The size of this equilibrium pool of unemployed workers (as a percentage of the labor force) is the natural unemployment rate
  - Natural rate will depend on degree of heterogeneity, mismatch, information flows, and legal framework (unemployment insurance, minimum wage, etc.)
  - We will study natural rate of unemployment toward the end of the course
- We think of $u = u_n$ when $Y = \bar{Y}$, although in practice u tends to lag behind Y
- Given people's expectations of inflation, real wage will increase iff increase in nominal wage exceeds expected inflation
- Modern version of Phillips's adjustment hypothesis:

  $Y > \bar{Y} \Leftrightarrow u < u_n \Rightarrow \pi > \pi^e$

  $Y = \bar{Y} \Leftrightarrow u = u_n \Rightarrow \pi = \pi^e$

  $Y < \bar{Y} \Leftrightarrow u > u_n \Rightarrow \pi < \pi^e$
- Modern Phillips curve predicts:
  - Vertical long-run Phillips curve at natural rate
    - No long-run tradeoff between unemployment and inflation

  - Short-run Phillips curve slopes downward through $\left(u_n, \pi^e\right)$
- Consider effects of sustained aggregate demand growth (over-stimulative policy)
  - In short run, economy moves up along Phillips curve to lower u and somewhat higher π
  - Eventually, expectations catch up and π^e increases, which shifts PC upward
  - In long run, economy is back at natural rate (on long-run PC) with much higher inflation
  - This is a simple story that fits the quantitative and qualitative data from the 1960s pretty well: repeated policy stimulation (Vietnam War, monetary expansion) led to high inflation

Phillips curve and aggregate supply

- Phillips curve is drawn in (u, π) space, but can do the same diagram in (Y, π) space or, given last period's price level, in (Y, P) space
- This is simple graphical representation of modern theory of aggregate supply:
  - SRAS curve slopes upward through $\left(\overline{Y}, P^e\right)$ or $\left(\overline{Y}, \pi^e\right)$
  - LRAS curve is vertical at $\overline{Y}$
- Expansion of AD leads to increase in Y and P in short run, but as expected price level catches up, Y goes back to $\overline{Y}$ in long run and only P is affected
- Long-run equilibrium with inflation:
  - Steady growth in M causes AD to shift up year after year
  - Growth in AD is expected, so P^e goes up by same amount
  - Rising P^e shifts SRAS upward along with AD, so equilibrium (ignoring growth) shifts up along LRAS with no increase in Y but steady inflation at rate of monetary expansion
  - Note consistency with LM curve here: if M and P rise by same proportion ($\pi = \mu$) then M/P is constant and LM curve stays put
- We now turn to the microeconomic underpinnings of theories of aggregate demand and supply
  - All of the supply theories that we examine will have a result that more or less mirrors the simple theory above: SRAS slopes upward and LRAS is vertical