ECON 3510 - Intermediate Macroeconomic Theory

Fall 2015

Mankiw, *Macroeconomics, 8th ed.*, Chapter 11

Chapter 11: Aggregate Demand 1: Building the IS-LM Model

Key points:

- Keynesian Cross
- IS curve
  - Derivation
  - What shifts it?
- LM curve
  - Derivation
  - What shifts it?
- Eq'm in the IS-LM model

The Keynesian Cross (aka, The Aggregate Expenditures Model):

- Two concepts: Actual expenditure and planned expenditure
  - Demand (expenditures) might be less than expected $\Rightarrow$ inventories rise
  - Demand (expenditures) might be more than expected $\Rightarrow$ inventories shrink
- Planned expenditures: $PE = C + I + G$
  - Fix $\bar{G}, \bar{T}, \bar{I}$
  - use consumption function: $C = C(Y - T)$
  - $\Rightarrow PE = C(Y - \bar{T}) + \bar{I} + \bar{G}$
  - DRAW planned expenditure function. PE on vertical, Y on horizontal axis, slope = marginal propensity to consume
- Equilibrium: Planned expend = actual expend ($PE = Y$)
  - Recall, GDP = income = expenditures
  - DRAW planned expenditure function. PE on vertical, Y on horizontal axis. Draw Y=PE (45 degree line) on same graph. Not that intersection determines eq'm, Y^* (explain 45 degree line is that with slope = 1)
  - Know lines will cross b/c $MPC < 1$ (can't consume more than income)
  - The equation describing the equilibrium is: $Y = C(Y - T) + I + G$. The Y that solves this equation is the eq'm income/expenditure amount

The Multiplier:

- Gov't spending:

- DRAW planned expenditure function and 45 degree line. Show shift up in PE due to gov't spendinging (recall PE = C + I + G) - so PE increase dollar for dollar. Show initial eq'm Y then eq'm after increase in G. NOTE how $\Delta Y > \Delta G$
- The fact that the change in $Y >$ change in G is called the multiplier effect
- The government spending multiplier is given by $\frac{\Delta Y}{\Delta G}$
- Why $\Delta Y > \Delta G$?
  - Trace through the income effects:
  - 1: Expend (and thus income) rise by ΔG
  - 2: Since income rises, consumption increases, $\Delta C = MPC \times \Delta G$
  - 3: Income and expend increase b/c increase in C, income rises by ΔC, so consumption again increases: $\Delta C = MPC \times \Delta C = MPC^2 \times \Delta G$
  - 4: Income and expend increase b/c increase in C...
  - A geometric series: $\Delta Y = \Delta G + MPC \times \Delta G + MPC^2 \times \Delta G .... = (1 + MPC + MPC^2 + ...)\Delta G$
  - Solution to an infinite geometric series is: $\Delta Y = \frac{1}{1-MPC} \times \Delta G$
  - So the multiplier is: $\frac{\Delta Y}{\Delta G} = \frac{1}{1-MPC}$
  - Another way to see this:
  - Eq'm $\Rightarrow Y = PE = C(Y - T) + I + G$
  - Differentiate both sides by Y and G: $dY = \frac{\partial C}{\partial Y} dY + dG$
  - $\Rightarrow \frac{dY}{dG} = \frac{1}{1 - \frac{\partial C}{\partial Y}} = \frac{1}{1-MPC}$
  - In words: Initial spending $\uparrow C \Rightarrow \uparrow$ income $\Rightarrow \uparrow$ consumption $\Rightarrow \uparrow$ income ... (eventually effects are small and approach 0) - it's an initial series the converges to the multiplier effect
- Multipler effect = $\frac{\Delta Y}{\Delta G} = \frac{1}{1-MPC} > 1$, b/c $MPC < 1$.

- Tax cut
  - DRAW planned expend function and 45 degree line. Shift PE up to represent tax cut. Note new and old eq'm. Note that diff between PE curves is MPCx change in taxes. Note change in Y
  - The multiplier effect from tax cuts = $\frac{\Delta Y}{\Delta T} = \frac{-MPC}{(1-MPC)}$
  - DON'T NEED to go through, but find from differentiate both sides of eq'm: $dY = \frac{\partial C}{\partial Y} dY - \frac{\partial C}{\partial T} dT = MPC dY - MPC dT$, which implies that $\frac{dY}{dT} = \frac{-MPC}{1-MPC}$
  - Note that since the $MPC < 1$, this is less than the gov't spending multiplier...

- The multiplier in practice: The American Recovery and Reinvestment Act of 2009 (ARRA or "The Stimulus Bill")
  - Recession causing economy to perform at below it's natural rate of output
  - Economists estimated that economic output about \$14 trillion per year, natural rate about \$15 trillion per year (think of this as potential output)
  - How do we close this gap? Should the gov't spend \$1 trillion?
  - According to model, gov't can help, but doesn't need to spend \$1 trillion.
  - How much?
  - Christina Romer (economic advisor to Obama) and others have estimated the gov't spending multiplier to be on the order of about 1.5.
  - Thus, to close the gap, the amount of gov't spending needed solves: \$1 trillion = $1.5G$ or $\Delta G = \frac{\$1 \text{ trillion}}{1.5} \approx \$660$ billion.
  - This is about the amount of spending the President was asking for!
  - After going through congress, final bill came out to about \$500 billion in spending and \$288 in tax cuts (\$787 total). So still close to what theory would suggest when you account for tax cut multiplier being lower than spending multiplier...

Deriving the IS Curve:

- IS stands for investment and savings
- The IS curve is a function of interest rates and income
- Derive the IS curve using the investment function and the Aggregate Expenditures Model
- DRAW:
  - Investment function, a downward sloping function of interest rates
  - The agg expend model. Show to PE curves, one for higher and low expend due to fall in I
  - Draw IS curve under agg expend model. Vert axis is r, horiz is Y. Points on IS curve traced out over different r's by fall in E from agg expend model
- The IS curve slopes downward because:
  - Higher r means less investment
  - Less investment means less income in eq'm of the Agg Expend Model
- The IS curve represents all the combination of r and Y that are equilibria in the market for goods and services.

Shifting the IS Curve:

- $\uparrow G \Rightarrow$ shift IS out:
- DRAW:
  - The agg expend model. Show to PE curves, one for higher and low expend due to increase in G
  - Draw IS curve under agg expend model. Vert axis is r, horiz is Y. Points on IS curve traced out over different r's by fall in E from agg expend model. Show that IS shifted out because for same values of r, now have higher values of Y.
  - Note: r fixed $\rightarrow$ unchanged by $\uparrow G$ (i.e., no crowding out when we consider just the market for good and services -we'll see this later when we use the full $IS - LM$ model)

Another way to derive the IS curve: the Loanable Funds Market:

- In market for loanable funds:
  - Supply = savings
  - Demand = investment
  - Eq'm $\Rightarrow$ supply = demand $\Rightarrow$ savings = investment
- Savings is a function of income (recall this from before)
- Investment a function of interest rates
- DRAW:
  - Market for loanable funds. I(r) a downward sloping. Vertical S(Y) curve. Shift S(Y) out for increase in income.

  - at same level as above, draw IS curve. Show how traded out because interest rates fall as income increase so IS downward sloping

- IS slopes downward b/c:
  - Higher income $\Rightarrow$ higher savings
  - Higher savings means lower interest rates
- Shifting IS in this framework:
  - $\uparrow G(\downarrow T)$ shifts savings to the left
  - This reduced supply of loanable funds and thus raises the interest rate the equilibrates I and S
  - The result is that the IS curve shifts to the right because for the same Y now have higher interest rate r
  - DRAW IS curve shifting out

The Theory of Liquidity Preference:

- Market for real money balances ($\frac{M}{P}$)
- Supply of money fixed at $\bar{M}$
- P exogenous also, fixed at $\bar{P}$
- $\Rightarrow$ supply of real money balances is fixed at $\frac{\bar{M}}{\bar{P}}$
- Demand: $(\frac{M}{P})^d = L(r, Y)$
  - Opportunity cost of holding money is given by r
  - $\Rightarrow$ as $r \uparrow$, demand for real money balances falls
  - As $Y \uparrow$, demand for real money balances increases
- Supply + Demand:
  - DRAW vertical axis r, horiz M/P. Draw downward sloping L(r,Y) curve. Vertical M/P curve. Show intersect at r*
  - Note that r* is equilibrium interest rate; supply = demand
- Monetary policy and interest rates
  - DRAW vertical axis r, horiz M/P. Draw downward sloping L(r,Y) curve. Vertical M/P curve. Show intersect at r_1^*. Now shift vertical M/P b/c contract money supply. Show new higher r*
  - Contracting the money supply (e.g. by selling bonds) increases the interest rate

Deriving the LM Curve:

- LM stands for liquidity and money
- DRAW:
  - Mkt for real money balances. Show L(r,Y) curve shift out because of increase in income from Y1 to Y2. Show new eq'm interest rate.
  - Note: $\uparrow Y \Rightarrow \uparrow r$ b/c shift demand for money out

  - On same level, draw the LM curve. Vert axis is r, horiz is Y. Show how shifting L(r,Y) traces out LM curve because as Y increase, r increases.

- LM slopes upward because:
  - Increases in income mean more demand for money
  - Higher demand for money means that a higher rate of interest is needed to bring mkt into eq'm

Another Way to Derive the LM Curve:

- Quantity theory: $MV = PY$
- Let V be a function of r: $V(r)$
  - $\uparrow r$ means $\uparrow V$ b/c hold less cash (b/c opp cost higher)
- In the short run, P fixed
- M controlled by central bank, so it's also fixed
- $MV(r) = PY$
  - $\Rightarrow Y \uparrow$, V must $\uparrow$, $\Rightarrow r \uparrow$
  - $\Rightarrow LM$ curve slopes upward

Shifting the LM Curve:

- An increase in M, lowers interest rates, for a fixed level of income, $\bar{Y}$
- DRAW money market and LM curve next to each other. Note on graph of LM the different interest rates for the same Y. Need two curves to go through these two points.
- Monetary policy can shift the LM curve - out in expansionary (lowers rates), down if contractionary (increases rates).

Short Run Equilibrium:

- IS: $Y = C(Y - T) + I(r) + G$
- LM: $\frac{M}{P} = L(r, Y)$
- Each curve is an equilibrium in a different market
  - IS is the goods market
  - LM is the money market
- This means that we are now working with a General Equilibrium Model (Keynes' "General Theory")
  - GE just means that we consider effects across all markets
  - Solution to the GE model involves eq'm in each market
- DRAW IS and LM curves together. Show that where intersect is eq'm interest rate. The r^* and Y^* we get here are the equilibrium interest rate and income level that equate supply to demand in both the goods market and the money market.
- Go back to the flow chart drew at beginning of class to see where we went