The IS-LM Model

Adding Financial Markets
to the Real Side
Assumptions

• Continue to ignore aggregate supply
  – Prices/inflation fixed (business cycle assumption)

• Continue to ignore rest of world (X=M=0)
  – Closed economy/autarky or large economy
Add Financial Sector

• At least two assets necessary
  – Money: liquid, safe, low/zero return
  – Bonds: illiquid, risky, interest return
Changes to Real Markets

• *Investment* now depends negatively on interest rate because of PV reasons ($I = I_o - bi$)
  
  – A decline in interest rates ($i \downarrow$) causes investment to rise ($I \uparrow$)
  
  – Hence *multiple* expansion in income
Other Sectors

• Continue to use same (Keynesian) Consumption function

\[ C = C_0 + cY^D = (C_0 + cT) + c(1-t)Y \]

• Continue to treat G (direct government spending) as exogenous
Adding It All Up

- Y=C+I+G, but
  - C = C₀ + cY^D = (C₀ + cTr) + c(1-t)Y
  - I=I₀-bi

- Y= (C₀ + cTr) + c(1-t)Y + I₀-bi + G₀, so
- Y=[1/(1-c(1-t))]*(C₀ + cTr) + I₀-bi + G₀]
Graphically: IS

Algebraically
\[ Y = \frac{1}{1 - c(1 - t)} (C_0 + cT + I_0 - bi + G_0) \]

Technical Note: this is no longer a “reduced form” or “solution” since interest rates are endogenous and on right-hand side.
IS: Goods Market Equilibrium

• Name: Investment = Savings – but *only in a closed economy!*

• Equilibrium relationship between interest rate and level of output – the real economy/market for goods and services “clear” and are in equilibrium
IS Curve

• *Slope* of IS given by impact of change in interest rates on investment and hence output (through multiplier) – likely steep

• *Location* of IS changed by autonomous components of aggregate demand (e.g., autonomous investment, $I_0$ or fiscal policy, $G_0$)
  – Multiplier can also change (taxes, confidence/MPC)
Financial Market Equilibrium

• *Liquidity Preference* theory: equilibrium portfolios of money and bonds
  – Probably reasonable to assume continuous equilibrium for financial markets (prices move quickly)
  – Money is riskless, liquid but pays no interest
  – Bonds are risky, illiquid and pay interest (i)

• If money market clears, so does bond market and *vice versa*
  – “Walras' Law”
  – Hence ignore bond market equilibrium if money market in equilibrium
Money Market Equilibrium

• Demand for Real Money (Liquidity)
  – Positive function of real income (transactions demand)
  – Negative (small) function of opportunity cost (interest rate)

• Real Money Supply is given by ratio of money supply (determined by central bank) to fixed prices ($M^s/P$)
Money Market Equilibrium

\[ L(y_2) > L(y_{1,i}) \]

\[ L(y_{1,i}) \]

\[ \beta \]

\[ \alpha \]

Andrew Rose, Global Macroeconomics 9
LM Algebra

- \( \frac{M^s}{P} = L(i, Y) \)

Name: Demand for Liquidity (L) = Money Supply (M)
More on LM

• *Slope* of LM reflects interest and income elasticities of money demand (likely steep)

• *Location* of LM: *Expansionary Monetary Policy* raises real balances and hence lowers interest rates at a given level of real income
  – LM curve shifts down and to right
Together

\[
\frac{M_s}{P} = L(i, Y)
\]

\[
Y = \frac{1}{1 - c(1 - t)} (C_0 + cTr + I_0 - bi + G_0)
\]
IS-LM Equilibrium

• Both real and financial markets in equilibrium only at intersection of IS and LM curves

• Hence both interest rates and output are endogenous
  – Things that depend on interest rates (e.g., investment) also endogenous
  – Things that depend on income (e.g., consumption) also endogenous
Good Question

• How much does output fall if interest rates rise a little (e.g., 100 basis points)?
Fiscal Policy Shock: $G \uparrow$
Discretionary Fiscal Policy

- **Expansionary Fiscal Policy** (e.g., increase in G)
  - \( Y = \left[ \frac{1}{1-c(1-t)} \right] \left[ (C_0 + cTr) + I_0 - bi + G_0 \right] \)
  - G rises, shifts IS curve out and to right raising both interest rates and income
  - Extent depends on form of government financing (bonds/taxes/seigniorage – usually treat bonds as default)
    - “Printing Money” implies LM shifts as well
  - Direct government spending “crowds out” investment (since interest rates rise)
    - Present crowds out future; also, public crowds out private
  - Can also handle transfers (Tr) or taxes (t)
Expansionary Monetary Shock: M↑

- Money rises, shifts LM curve down/right, lowering interest rates (i↓) while raising income (Y↑)
Monetary Shock Graphically

\[ i_0 \to i_1 \]

\[ y_0 \to y_1 \]
More on Monetary Policy

• Money (M1) is defined as currency held by public and demand deposits
• But central bank doesn’t control deposits and hence money (directly)
• Instead, it directly controls a more narrow monetary aggregate
More on Money Supply

• $M^s = \mu \cdot HPM$
  
  – $\mu$ is “money multiplier”
    • $\mu$ a function of two ratios (Currency/Deposits), (Commercial Bank Reserves/DD)
    • Usually exogenous, moves slowly
    • Financial crisis may lead to “reserve hoarding” (2008-9)
  
  – HPM is “high-powered money” or “monetary base” controlled by Central Bank
High-Powered Money

• Liabilities of central bank:
  – Currency in circulation held by public
  – Commercial bank reserves (CBR)

• Asset side:
  – International Reserves (IR=FX + gold + SDRs)
  – Central Bank Credit (CBC=government debt held by central bank – not *all* treasuries, just those held by central bank)
  – Usually not private bonds/equity except in crisis

• That is, HPM \equiv IR + CBC = Currency + CBR
How Does Central Bank Actually Change Monetary Policy?

• An expansionary “open market operation” consists of central bank sale of Currency/CBR to the public in exchange for increase in CBC (government debt)
• Purchases of government debt raise their price, lower interest rates
  – “Provide liquidity” to markets
• Traditionally at short-maturity end of debt market
  – In US, this is done through “Federal Funds” market
  – Can also do unconventional “Quantitative Easing” at longer maturities – direct central bank purchases of other assets
Exceptional Cases

1. LM may be *flat* at low nominal interest rates
   - Japanese “Liquidity Trap”
Exceptional Cases

2. LM may be *vertical* if interest rates don’t matter
   – “Quantity Theory”
Two Concluding Notes

• Can derive *Aggregate Demand Curve* by changing prices, shifting LM curve out, raising income

• This all short-run analysis: effects of productivity, capital, labor, and debt accumulate but are ignored in the short run.
  
  – Remember: *prices are sticky only in short run*
Key Takeaways

• Interaction of Real and Financial Markets determine both interest rates and output
• Monetary Policy Shocks, open market operations
• Liquidity Trap