Principles of Macroeconomics

- Focus on three key variables (for clarity, other variables implied):

1. **Gross Domestic Product** (Y) = aggregate real output (GDP).
   - Link to employment: production creates jobs. Rate of change = Economic Growth.

2. **The real interest rate** (r) = Measure of borrowing cost & return to saving.
   - Safe benchmark: Treasury rates (TIPS). Obtain interest rates on risky fixed income assets (bonds, bank deposits, loans, etc) by adding “spreads.” Obtain nominal interest rates by adding expected inflation.

3. **Inflation** (π) = Growth rate of consumer prices (cost of living)
   - Related: Consumer price index (P). Expected inflation (π^e). Nominal interest rates.

- **Equilibrium analysis**: study markets for goods, for financial assets, for money.
  - Demand & supply curves imply equilibrium values.
  - Disturbances (“shocks”) trigger shifts to new equilibrium values.

- Start with **Classical model**: Real economy (Y, r) separate from monetary issues.
  - Later: Keynesian analysis of how money influences real variables.
Goods Market: Supply Side

- **Labor market**: Demand & supply implies equilibrium real wage
  
  [Here omit details – assume known from Econ 101]

- **Production function**: Capital stock & equilibrium labor => Real output: \( Y = Y^s \).
  
  - Monetary economics usually omits long-term productivity growth to focus on short and medium term fluctuations [Assume Solow model is known – set aside.]
  
  - Sources of fluctuations: tax incentives, shocks to productivity (relative to trend), changes in other inputs, e.g. cost of energy, demographics. All: Shocks to \( Y^s \).

- Preview of Keynesian objections: Supply may differ from \( Y^s \) when firms are reluctant to change posted prices and workers negotiate over nominal wages.
  
  => Firms satisfy demand. Short-run analysis more is complicated.

- For now take Classical perspective: Keep it simple, assume \( Y = Y^s \).
**Goods Market: Demand Side**

- **Components of GDP:** \( Y = C + I + G + NX \)
  - Consumption: assume households maximize utility for given real return on saving \( r \) and given disposable income \( Y-T \). Implies \( C = C(r, Y-T,...) \) and \( S^h = (Y-T) - C = S^h(r, Y-T,...). \)
  - Investment decisions by firms implies \( I = I(r,...) \) with negative slope.
  - Government sets spending \( G \) and taxes \( T \) exogenously; defines fiscal policy.
  - Net exports \( NX \) taken as exogenous. Total demand = sum of components.

- **Graphical analysis:** Demand curve \( Y = Y^d(r) \) links \( Y \) and \( r \).
  - Draw with negative slope: high \( r \) => incentives to save, more costly to borrow.
  - **Sources of fluctuations:** changes in household/firm expectations about future income/sales; shifts in \( G \); shifts in \( T \); shifts in \( NX \). All: shift in \( Y^d(r) \) curve.

- **Combine with supply:** draw \( Y = Y^s \) as vertical. [Argument for positive slope: high \( r \) may encourage labor supply; but effect is small enough to disregard.]
Alternative Perspective

• Why does is make sense that the good market determines the real interest rates?

• Idea: **Saving** = Income in excess of current spending = Demand for securities.
  
  **Investment** = Spending in excess of current income = Supply of securities.

  => The real interest rate that balances demand & supply for goods also balances
  the total demand & supply for securities, summed over all financial markets.

• Algebraic argument:

  \[ I = Y - C - G - NX = (Y-T-C) - (G-T) + (-NX) = S^h + S^g + S^f = S \]

  where \( S \) = total savings: consists of household savings, government (dis-)savings
  (budget deficit \( G-T \)), \( -NX \) = foreign savings in the U.S.

• Implication: \( Y = Y^d(r) \) is satisfied whenever \( I(r) = S(r,Y) \).
  
  - Goods market equilibrium and saving-investment equilibrium are equivalent
    ways to describe the equilibrium interest rate.
  
  - Motivates label “IS curve” for the \( Y^d(r) \) line.
Classical Analysis of the “Real” Macroeconomy

- **Graphs:** (Caution: slope of S(r) is uncertain. Usually use good market diagram.)

  ![Graphs](image)

  - **Real interest rate & real output**
  
  - **Saving & investment**

- **Examples of disturbances:**
  - Government spending G up: \( Y^d \) shifts right; S shifts left \( \Rightarrow r \) up.
  - Temporary drop in productivity: \( Y^s \) shifts left; S shifts left \( \Rightarrow r \) up; \( Y \) down.
  - Permanent rise in productivity: \( Y^s \) shifts right, I shifts right, \( \Delta S \) small \( \Rightarrow r \) up; \( Y \) up.

- **Balanced growth (Solow):** productivity trend \( \Rightarrow Y^s \) & \( Y^d \) shift right, \( r \sim \text{const.} \) [usually omit]
The Demand for Money

- Economic Determinants:
  - Volume of real transactions – measured by real output Y.
  - Prices at which these transactions take place – measured by the price level P.
  - Opportunity cost of holding money – measured by the interest rate on non-monetary assets i. (High i => incentive to hold less money.)
  - Efficiency of the payment system: number of times a unit money can be used to purchase goods (at a given opportunity cost; more frequent use if opportunity costs are high).

- Specification with general money demand function:
  - Real money demand: \( L(i, Y) \) [decreasing in i; increasing in Y]
  - Nominal money demand: \( M^d = L(i, Y) \cdot P \)

- Specification with velocity
  - Define \( V = \) number of times money is used to buy a unit of nominal GDP.
    High i => incentive to use money more quickly => \( V = V(i) \) is increasing.
  - Write money demand as \( M^d = \frac{1}{V(i)} \cdot Y \cdot P \) or \( L(i, Y) = \frac{1}{V(i)} \cdot Y \)

=> Real (or nominal) money demand is proportional to real (or nominal) output and inversely proportional to velocity.
**Equilibrium in the Market for Money**

- Assume the central bank controls the money supply $M=M^s$ [How? See later]

  $\Rightarrow$ Equilibrium requires:  
  
  $$M = L(i,Y) \cdot P \quad \text{or} \quad M = \frac{1}{V(i)} \cdot Y \cdot P$$

- How is the equilibrium obtained? Classical answer: Price level adjusts.
  - If more money is outstanding than demanded $\Rightarrow$ more spending $=$ more demand for goods $\Rightarrow$ sellers can raise prices $\Rightarrow$ $P$ rises until $M^d$ matches $M^s$.

  $\Rightarrow$ Basic theory of the price level:  
  
  $$P = \frac{M}{L(i,Y)} \quad \text{or} \quad P = M \cdot V(i)/Y$$

  - Price level = Ratio of nominal money supply over real money demand.
  - Treat $(i,Y)$ as given ($i$ determined by $r$ & $\pi^e$, $Y$ determined by production).

  $\Rightarrow$ The price level is determined (largely) by the supply of money.

- Graphical illustration: M-P diagram with $M^s = \text{given}$ and $M^d$ proportional to $P$.

- Next steps:
  1. Explain inflation as percentage change in prices.
  2. Allow for changes in expected inflation.
Determinants of Inflation

- Math Fact: growth rate of a product = sum of growth rates. Apply to:
  \[ M \cdot V = Y \cdot P \quad \Rightarrow \quad %\Delta M + %\Delta V = %\Delta Y + %\Delta P \]
  
  \[ \Rightarrow \quad \pi = %\Delta P = %\Delta M - %\Delta Y + %\Delta V \]

- Key result to remember:

  Inflation = Money growth – Output growth + Velocity growth.

- Implications:
  - Money growth is inflationary.
  - Output growth reduces inflation, unless the Fed responds by raising %\Delta M
  - Rising velocity (due to changes in transactions technology or in interest rates) raises inflation, again unless the Fed responds.
Classical Monetary Theory

- Combine/restate:

  1. Inflation = Money growth – Output growth + Velocity growth

     \[ \pi = \%\Delta P = \%\Delta M - \%\Delta Y + \%\Delta V \]

  2. Classical macro: Output is determined by production (~Solow model)

     => Output growth ~ productivity growth + population growth

  3. Quantity theory: velocity is approximately constant or at least predictable

     => Inflation is determined (largely) by money growth.

- Foundation for successful central banks’ policy: European Central bank (until ~2006),
  German Bundesbank (pre-1999), Swiss National Bank; also for IMF recommendations.

  - Recipe: Estimate \( \%\Delta Y \), estimate \( \%\Delta V \), set target \( \pi^* \) for inflation

     => Implied target for money growth \( \%\Delta M = \%\Delta Y - \%\Delta V + \pi^* \)

  - Example: \( \%\Delta Y = 3\% \), \( \%\Delta V = 0.5\% \), \( \pi^* = 2\% \) => Set \( \%\Delta M = 4.5\% \)

- Powerful theory: (a) for the long run; (b) for high-inflation economies.
Evidence on Money Growth and Inflation #1

Positive relationship over long time intervals.
Evidence on Money Growth and Inflation #2

Positive relationship across countries, especially at high inflation rates.
Evidence on Money Growth and Inflation #3

Weaker relationship over short periods, especially when there are structural changes in the financial sector (Deregulation => unstable velocity).
Complication: Expected Inflation and Velocity

- Real interest rate is determined by real factors (demand/supply for real output).
- Basic analysis takes expected inflation as given => nominal rate $i = r + \pi_e$.
  - Main exception: persistent changes in money growth cause persistent changes in actual inflation => Sooner or later, expected inflation will change.
  - Question: How quickly? Answer: depends on available information/context.
    => Best examined with examples.

- General logic: higher money growth => higher inflation => higher expected inflation => higher nominal interest rate => higher velocity => higher $P$
  => Feedback loop: Effects of money growth on inflation tend to be magnified.

- Results for moderate money growth: $V$ stabilizes eventually, then basic formula for inflation applies again => feedback relevant only during the adjustment.
- Possible instability for high money growth: explosive process of rising $V$ feeding into more inflation: explanation for hyperinflation & collapse of currencies.
Examples – Part I

(Examples posted on Gauchospace)

• Review main lessons:
  1. Changes in M have proportional impact on price level P
  2. Changes in the real economy (Y,r) have impact on P; that is, unless the central bank responds with offsetting changes in M.
  3. Changes in velocity have impact on P; again, unless M responds.

• Insights for problem solving:
  - Jumps in exogenous variables cause jumps in P.
  - Growth in exogenous variables causes growth in P = inflation.
  - If exogenous changes are temporary, changes in P are temporary.
    Then no persistent inflation – reasonable to assume zero expected inflation.
Examples – Part II

• Review main lessons:
  - Persistent changes in growth of M, Y, and V cause persistent changes in the inflation rate.
  - Nominal interest rates move with expected inflation: Fisher effect applies.

• Insights for problem solving:
  - For initial $\pi$ and $i$: unambiguous numerical results.
  - For long run $\pi$ and $i$: unambiguous numerical results.
  - For $\pi^e$ and $i$ in the short run: Outcomes depend on information. Inflation dynamics complicated by shifts in $V(i)$ when $i$ changes.

• Here focus on stable outcomes and on long-run answers.