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. Obtain interest rates on risky fixed income assets (bonds, bank deposits, loans, etc) by adding “spreads.” Obtain nominal rates by adding expected inflation. Or obtain real rates from T-bill rate minus $\pi^e$.

3. **Inflation** ($\pi$) = Growth rate of consumer prices (cost of living)
   
   Related: **Consumer price index** (P). **Expected inflation** ($\pi^e$).

• **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 omit 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
    \[
    C = C(r, Y-T,...) \quad \text{and} \quad S^h = (Y-T) - C = S^h(r, Y-T,...).
    \]
  - Investment decisions by firms implies \( I = I(r,\ldots) \) 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 it 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:
  \[ I = Y - C - G - NX = (Y-T-C) - (G-T) - NX = S + (-NX) \]
  where \( S = \text{National Saving: consists of } Y-T-C = \text{household saving, minus } G-T = \text{government budget deficit. } (-NX) = \text{Saving by foreigners 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.)

<table>
<thead>
<tr>
<th>Real interest rate &amp; real output</th>
<th>Saving &amp; investment</th>
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<tbody>
<tr>
<td><img src="image1" alt="Graph" /></td>
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- **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, $r \sim$ 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]

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

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

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

    - 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).

      => The price level is determined (largely) by the supply of money.

• Graphical illustration: M-P diagram with $M^s = $ 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 $\Rightarrow$ 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 \( \Rightarrow \) nominal rate \( i = r + \pi^e \).
  - Main exception: persistent changes in money growth cause persistent changes in actual inflation \( \Rightarrow \) Sooner or later, expected inflation will change.
  - Question: How quickly? Answer: depends on available information/context.
    \( \Rightarrow \) Best examined with examples.

- General logic: higher money growth \( \Rightarrow \) higher inflation \( \Rightarrow \) higher expected inflation \( \Rightarrow \) higher nominal interest rate \( \Rightarrow \) higher velocity \( \Rightarrow \) higher \( P \)
  \( \Rightarrow \) 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 \( \Rightarrow \) 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 $P = \text{inflation}$.
  - 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.