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

3. **The real interest rate** (r) = Measure of borrowing cost & return to savings.
   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 \( \pi^e \).
   Relation to Finance: interest rates central to valuing financial assets (present value).

• **Equilibrium analysis**: study markets for goods, for financial assets, for money.
  - Demand & supply => equilibrium.
  - Adjustment to “shocks” => shift to new equilibrium.

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

- **Labor market**: Demand & supply => Real wage [here omit details].

- **Production function**: Capital & equilibrium labor => Real output: $Y = Y^s$.
  - Sources of fluctuations: tax incentives, changes in productivity, changes in other inputs, e.g. cost of energy, demographics,… All: shifts in $Y^s$.

- Graphical analysis in Y-r diagram: **Supply curve** $Y = Y^s(r)$
  - Usually simplify: draw as vertical. (Argument for positive slope is that high $r$ encourages labor supply; but effect is small enough to disregard.)
  - Classical theory of real output: GDP determined by supply side.

- Preview of Keynesian objections: Supply may vary when firms are reluctant to change posted prices and workers demand fixed wages.
  - Short-run analysis more is complicated. Assessment: question of emphasis.
  - For now: Keep it simple. Classical model is good for the long run.
Demand Side

- Components of GDP: \( Y = C + I + G + NX \)
  - Consumption-savings decisions by households: maximize utility
    \[ \Rightarrow C = C(r, Y, \ldots) \text{ and } S^h = (Y-T) - C = S^h(r, Y, \ldots). \]
  - Investment decisions by firms: \( I = I(r, \ldots) \)
  - Government sets spending \( G \) and taxes \( T \): defines fiscal policy.
  - Net exports \( NX \) taken as exogenous. Total demand = sum.

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

- Savings-investment or Loanable Funds perspectives:
  \[ I = Y - T - C - G + T - NX = S^h + \text{Gov.Savings} + \text{Foreign funds}. \]
  Funds needed for capital investment = Supply of financial funds.
  \[ \Rightarrow \text{May interpret } Y^d(r)\text{-line as equilibrium interest rate for different } Y\text{-values} \]
Classical Analysis of the “Real” Macroeconomy

- Graphical analysis: two ways to determine real interest rates (equivalent, alt. perspectives)

<table>
<thead>
<tr>
<th>Real interest rate &amp; real output</th>
<th>Perspective of saving &amp; investment</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Graph showing real interest rate and real output" /></td>
<td><img src="image2.png" alt="Graph showing perspective of saving and investment" /></td>
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</tbody>
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- Balanced growth (Solow): rising productivity & incomes => $Y^s$ & $Y^d$ shift right, $r$~const.

- Examples of disturbances:
  - Government spending G up: $Y^d$ shifts right; $S$ shifts left => $r$ up (perhaps $Y$ up slightly).
  - Temporary drop in productivity: $Y^s$ shifts left; $S$ shifts left => $r$ up; $Y$ down.
  - Permanent rise in productivity: $Y^s$ shifts right, $I$ shifts right, $\Delta S$ small => $r$ up; $Y$ up.
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 $i$ $\Rightarrow$ 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 $V = \text{number of times money is used to buy a unit of nominal GDP}$.
    High $i$ $\Rightarrow$ incentive to use money more quickly $\Rightarrow V = V(i)$ is increasing.
  - Write money demand as $M^d = \frac{1}{V(i)} \cdot Y \cdot P$ or $L(i,Y) = \frac{1}{V(i)} \cdot Y$

$\Rightarrow$ 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: prices adjust.
  - 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. Note a complication: expected inflation raises $i$, which feeds back to $V$. 

Macroeconomic Principles
Determinants of Inflation

- Math Fact: growth rate of a product = sum of growth rates. Apply to:

\[ M \cdot V = Y \cdot P \implies \% \Delta M + \% \Delta V = \% \Delta Y + \% \Delta P \]

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

- 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 theory takes expected inflation as given => implies nominal rate $i = r + \pi^e$.
  - But 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
  => Effects of money growth on inflation tend to be magnified.

- Cases with moderate inflation: as V stabilizes eventually, basic formula for inflation applies again => complication only during adjustment.

- Possible instability: explanation for hyperinflation, for 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.