GDP: The **market value** of final goods and services, **newly produced** WITHIN a nation during a **fixed period**.

Value added: Value of output (market value) – purchased inputs (e.g. intermediate goods)
GDP is a flow variable

Adjusting GDP for inflation = uses GDP deflater ➔
**Real GDP = nominal GDP/GDP deflator**
GDP deflator = nominal GDP/real GDP

Adjusting for inflation ➔ uses the CPI
  - CPI = cost in current year/cost in base year
  - Nominal income/CPI = real income

**Problems of CPI**
**Quality adjustment bias**: price increases may not reflect quality improvements. (higher quality may justify higher prices)
**Substitution bias**: do not take into account that individuals may substitute out of goods. CPI assumes that people buy the same bundle of goods instead of individuals substituting for cheaper goods.

*Measuring National Economy*
Expenditure Approach to GDP

\[ Y = C + I + G + NX \]

- \( Y \) = GDP, output, total income, total expenditure
- \( C \) = consumption
- \( I \) = investment
- \( G \) = government purchases of goods and services
- \( NX \) = export – imports

GDP = GNP – NFP
NFP: (payments to domestic K & N) – (payments to foreign K & N)

Private disposable income = \( Y + NFP + TR + INT – T \)
Net gov’t income = \( T – TR – INT \)

*Consumption, Saving and Investment*

Saving = current income minus spending on current needs
REMEMBER THE SAVINGS IDENTITY ABOVE!!

\[ S^d = Y – C^d – G \] (assuming NFP = 0 or really small)

Or
Increase in G $\Rightarrow$ lowers S(nat’l), tax increases reduce C esp. if G and T is temp., C should fall less than G and T.

Decline in T or increase in TR $\Rightarrow$ normally increase C (decline in S) …except with Ricardian Equivalence Proposition.

**Savings (flow variable)**

Made up of private (business and household) and government savings. (p. 42)

\[
S(pvt) = (Y+NFP-T+TR+INT) – C
\]

(Priv. Disposable inc.) – C

\[
S(gov’t) = T – (G+TR+INT) = \text{revenue from taxes – gov’t spending}
\]

\[
S(gov’t) = (T-TR-INT) - G
\]

\[
S(nat’l) = S(pvt) + S(govt) = Y + NFP – C – G
\]

\[
S = I + CA
\]

S= 1 + (NX + NFP)

\[
S(pvt) = (-S(govt)) + I + CA \text{ (uses of savings identity) ALWAYS HOLDS TRUE!!!}
\]

**Real interest rate** ($r$) = $i – \pi$ or (nominal int. rate – inflation rate)

**Productivity, Output, and Employment**

**Production function**

\[
Y = AF(K,N)
\]

Cobb Douglas = \( Y = AK^0.3N^{0.7} \)

A = TFP (productivity)

Production function shows diminishing marginal returns (increases at a decreasing rate with an increase in K)

We should assume that capital and labor are complements. An increase in K will increase MPN, which means N is more productive.

Shifts in A (Positive and Negative Supply Shocks) pg. 69

Negative supply shocks reduce output, wages $\Rightarrow$ shortage of energy (e.g. oil), bad weather

Positive supply shocks increase output $\Rightarrow$ ex. New tech., increase in skills of N
Labor Model

MPN = ΔY/ΔN  
MRPN = w/N or W  
P*MPN – W = 0

Firm hires were marginal product = or > real wage (additional product value of one worker exceeds the real wage)

**Labor Demand Curve (ND)** → MPN in terms of \( w \)

Shifts of ND \( \Rightarrow \) ΔA, ΔK, ΔP  
Increase in A = shifts MPN curve up  
Decrease in A = shifts curve left  
More capital = increases MPN, shifts ND up and to the right  
Less capital = decreases MPN, shifts ND down and to the left  
Increase in price = more workers will be hired \( \Rightarrow \) shift in ND curve up and out.  
\( \Delta \) supply of labor, \( \Delta w \) = mov’t along curve

**Labor Supply Curve (NS)**

\( \text{MU(leisure)/MU(consumption)} = w(1) \)

Substitution effect: rise in current real wage causes people to substitute into work (can make more money working…cost of leisure goes up)  
Income effect: rise in wealth makes people richer causing them to work less and one will opt for leisure.

Temporary increase = only a substitution effect/no increase in wealth.  
Permanent increase = sub and income effect

**NS Curve Shifters – pg. 83**

Increase in wealth \( \Rightarrow \) shifts NS to the left (richer and opt for leisure)  
Permanent increase in real wages \( \Rightarrow \) shifts curve left, real wage decreases  
Expected future real wage \( \Rightarrow \) shifts NS to the left (worker feels richer and opts for leisure)  
Increase in working age pop. \( \Rightarrow \) shifts NS to the right (more freakin’ workers)  
Increase in participation rate \( \Rightarrow \) shifts NS to the right (more workers want to work which increases NS)

Real data \( \Rightarrow \) gradual increase in real productivity has led to increase in real wage as individual are working less. (except 1970s we have decrease in A, oil shocks)

- permanent increase in wages = individuals work less  
- perm. Increase in wages w/ increase in K and productivity = work less  
- temp. \( \Delta w \) = work more

**Investment**

\( uc = (r + d) p_k \) (cost of using capital including interest)  
\( uc = (1 – r) * MPK(f) \)
\[ MPK^f = \frac{uc}{1-\tau} = \frac{((r+d) p_k)}{(1-\tau)} \]
\[ I_t = K_{t+1} - K_t + dK_t \]  
\( \Rightarrow \) desired gross investment equals net investment plus depreciation
Net investment = gross investment - depreciation
\[ Y = C^d + I^d + G \]  
\( \text{goods market equilibrium} \)
\[ S^d = I^d \]

**Shifters in Investment (p. 135)**

Increase in \( r \)  \( \Rightarrow \) investment falls b/c uc increases and desired capital stock drops
Increase in effective tax rate  \( \Rightarrow \) investment falls b/c uc increases and cap. Stocks fall
Increase Expected future MPK  \( \Rightarrow \) Investment rises b/c desired cap. Stocks rise
Increase taxes on capital  \( \Rightarrow \) investment falls
New tech.  \( \Rightarrow \) increases MPK, more investment
\( \Delta \) in depreciation rate or operating expenses also causes shifts.
Things that raise \( K^* \) also increase \( I \).

**Unemployment**

<table>
<thead>
<tr>
<th>Non in labor force – students, retirees, etc.</th>
<th>Unemployed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Employed</td>
</tr>
</tbody>
</table>

Whole box = total pop
Unemployed + employed = labor force

2 types of unemployment – frictional (temp. relocation) and structural (long term and chronic)

Okun’s law = every point of unemployment above the natural rate implies a loss of output approximately 2.5% of potential.

**Future and Current consumption** (basic ques: when to consume? Today? Tomorrow?)
Savings = \( y - c \)
\[ [y - c + a(wealth)] * (1+r) \]
\[ c(f) = (y - c + a)(1+r) + y(f) \]

consumption smoothing: most prefer stable consumption over time  \( \Rightarrow \) \( c = c(f) \)

**marginal propensity to consume (MPC)**: amount by which desired consumption rises when current output increases by one unit.
**Saving and Real Interest Rates**

\[ r = i - \pi \]

Substitution effect: higher \( r \) means you get more money for saving ... savings rise.

Income (wealth) effect: higher \( r \) makes savers feel wealthier which increases consumption and reduce savings. Can save less and still maintain consumption level.

**Saving and Investment in the Open Economy**

\[ CA + KFA = 0 \]

\[ S = I + CA = I + (NX + NFP) \]

\( S_{\text{priv}} \)

\[ S^d = I^d + NX \]

Absorption = \( C^d + I^d + G \)

\[ NX = Y - (C^d + I^d + G) \]

Budget deficits are associated with CA deficits b/c we have to borrow from abroad. Investment boom associated with CA deficits b/c we are borrowing from abroad (importing goods or sending transfers to other countries).

Interest rate above equilibrium = CA surplus or KFA deficit

Interest rate below equilibrium = CA deficit or KFA surplus

**Growth Accounting**

\[ \Delta A / A = \Delta Y / Y - a(k) * \Delta K / K - a(N) * \Delta N / N \]

Productivity growth = \( \Delta A / A \)

Output growth = \( \Delta Y / Y \)

Capital growth = \( \Delta K / K \)

Labor growth = \( \Delta N / N \)

Contribution to output growth of growth in capital = \( a(K) * \Delta K / K \)

Contribution to output growth of growth in labor = \( a(N) * \Delta N / N \)

\[ \Delta Y / N = y(t) = \text{output per worker in year } t \]

\[ \Delta C / N = c(t) = \text{consumption per worker in year } t \]

\[ \Delta K / N = k(t) = \text{capital stock per worker in year } t \text{ or capital-labor ratio} \]

**Solow Model**

Key assumption = savings rate is constant in steady state
Key conclusion = countries will converge to other countries standard of living of similar s, n, and production functions.

\[ y(t) = f(k(t)) \]

\[ I_t = (n + d) K_t \text{ (in the steady state)} \]

\[ C_t = Y_t - (n+d) K_t \Rightarrow c = f(k) - (n + d) k \]

\[ S_t = sY_t \]

\[ sf(k) = (n + d) k \text{ (in the steady state)} \]

steady-state investment per worker = (n + d) k
per worker production function = \( y = f(k) \)

key factors in determining level of steady state = savings rate (s), the rate of population growth (n) and productivity (TFP or A)