ECON 310 - MACROECONOMIC THEORY

Instructor: Dr. Juergen Jung

Towson University

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Chapter 2: Measurement

- Understand basic issues concerning measurement of key macroeconomic variables
- Need understanding of variables to understand the important role they play in economic models

Measurement: A Review

- Gross Domestic Product (GDP): dollar value of final output produced during a given period of time domestically.
- In the United States (US) measured quarterly as part of **National Income and Product Accounts** (NIPA).
- Three approaches:

1. Product - sum of all the value-added in the economy (do not count intermediate goods).
2. Expenditure - total spending on all final goods and services in the economy (do not count intermediate goods).
3. Income - add up all incomes received by economic agents contribution to production.

Measurement: A Review (cont.)

- All three approaches will yield the same answer:

$$Y = C + I + G + NX.$$

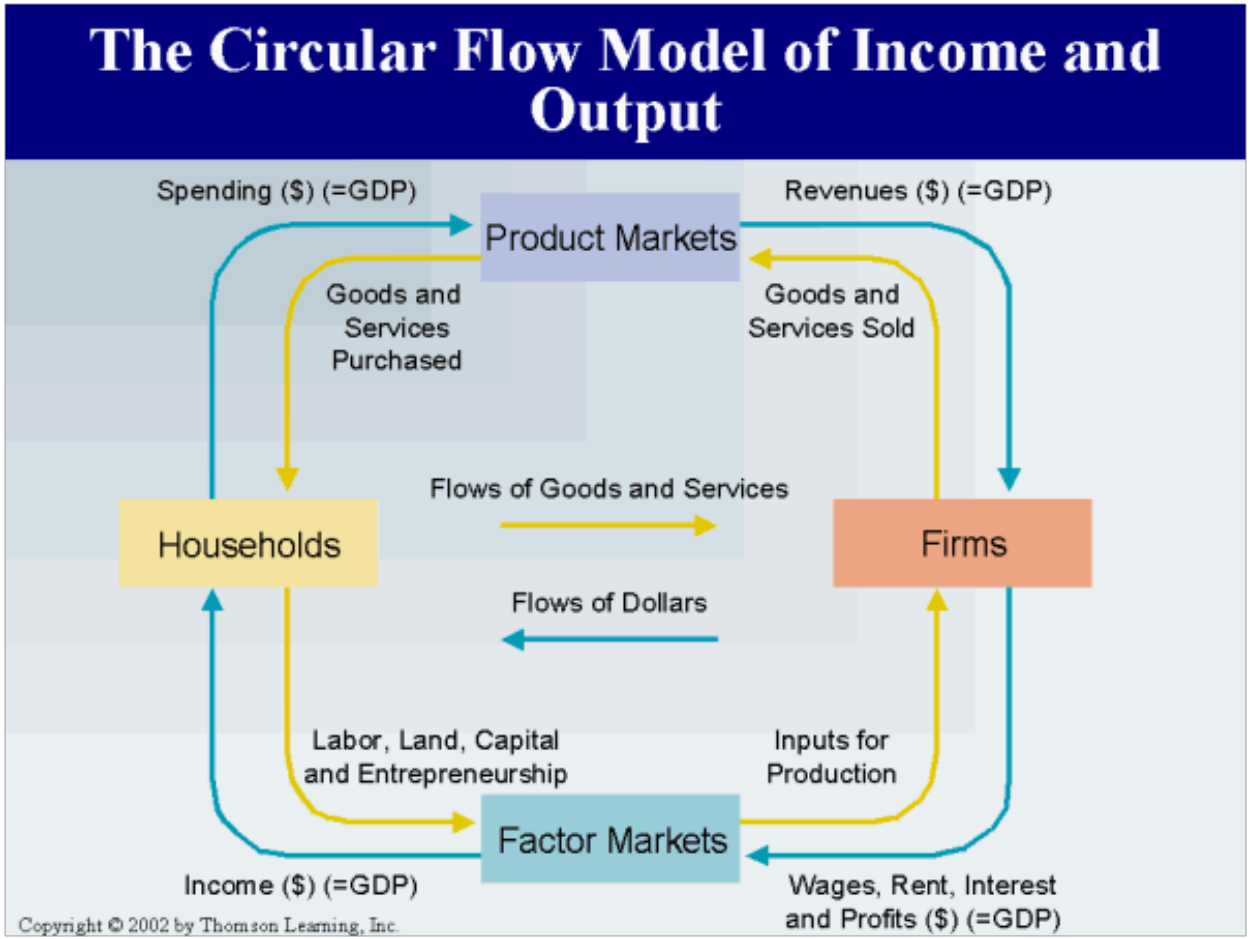
- Income-expenditure identity
- Gross National Product (GNP) is GDP + Net Factor Payments:

$$GNP = GDP + NFP$$

- In the US - GDP and GNP are roughly the same.
- GDP = 15,094 bill. USD in 2011
- GNP = 15,339 bill. USD in 2011
- NFP = 245 bill. USD

- Not the same with other countries!

- See Table 2.9 breakdown of GDP


The Circular Flow Model of Income and Output
Spending ($) (=GDP)
Revenues ($) (=GDP)
Product Markets
Goods and Services Purchased
Goods and Services Sold
Flows of Goods and Services
Households
Firms
Flows of Dollars
Labor, Land, Capital and Entrepreneurship
Inputs for Production
Factor Markets
Income ($) (=GDP)
Wages, Rent, Interest and Profits ($) (=GDP)
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National Income Accounting Example

- Fictional Island Economy with three sectors:
- Firm: A coconut producer and a restaurant
- Household: Consumers
- Government

- Coconut producer produces 10 million coconuts
- Sell for $2.00 each.
- Producer pays wages and taxes
- Of the 10 million coconuts, 6 million go to restaurant and 4 million are consumed directly by consumers
- Restaurant pays wages and taxes and sells $30 million in restaurant meals
- Government collects taxes and provides national defense
- GDP?

Table 2.1 Coconut Producer

Total Revenue	$20 million

Table 2.2 Restaurant

Total Revenue	$30 million

GDP Using the Product Approach

- Products:
  - Private: coconut (goods) and restaurant (services)
  - Public : defense

- Value added
  - Coconut producer: TR - TC of (intermed.good i.e. coconuts) $= 20mil$
  - Restaurant: TR - TC of coconut product $= (30 - 12)mil$
  - Government: TR - TC $= 5.5mil$. Cost of defense has no market price.

Table 2.6 GDP Using the Product Approach

Value added - coconuts	$20 million
Value added - restaurant food	$18 million
Value added - government	$5.5 million
GDP	$43.5 million

GDP Using the Expenditure Approach

- Total expenditures on all final goods and services
- Total expenditure = C + I + G + NX
- In our example, I = 0 and NX = 0.

Table 2.7 GDP Using the Expenditure Approach

Consumption	$38 million
Investment	0
Government Expenditures	$5.5 million
Net Exports	0
GDP	$43.5 million

GDP Using the Income Approach

Households

- work for firms and government and earn wages
- own firms and earn after-tax profits
- provide loan to coconut producers and collect interests
- pay income tax to government

Table 2.8 GDP Using the Income Approach

Wage Income	$14.5 million
After-tax profits	$24 million
Interest Income	$0.5 million
Taxes	$4.5 million
GDP	$43.5 million

Extensions

- Production of 13 million coconuts (instead of 10) and storing the additional 3 million Distribution of wealth/income is also not considered
- Restaurant imports 2 million coconuts from other islands for $2.00 each and all of the coconuts are used in the Restaurant

U.S. GDP: Key Components

Table 2.9 Gross Domestic Product for 2011

Component of GDP	$Billions	% of GDP
GDP	15,094.0	100.0
Consumption	10,726.0	71.1
Durables	1,162.9	7.7
Nondurables	2,483.7	16.4
Services	7,079.4	46.9
Investment	1,916.2	12.7
Fixed Investment	1,870.0	12.4
Nonresidential	1,532.5	10.2
Residential	337.5	2.2
Inventory Investment	46.3	0.3
Net Exports	−578.7	−3.8
Exports	2,085.5	13.8
Imports	2,664.2	17.7
Government Expenditures	3,030.6	20.1
Federal Defense	824.9	5.5
Federal Nondefense	407.9	2.7
State and Local	1,797.7	11.9

Nominal versus Real variables

- Compare a variable like GDP dollar value over time.
- However, price levels change (inflation) so must make adjustments
- GDP dollar value change is due to two components:
- real growth in resources (real change)
- inflation of the price level (norminal change)
- How to separate out these two components?
- Construct a price index as a measure of the (average) price level.
- Calculate inflation rate of this price index
- Use inflation rate to back out real changes in GDP
- Price index - weighted average of the prices of a set of goods and services produced in the economy.

An Example of Nominal and Real GDP

Table 2.10 Data for Real GDP Example

	Apples	Oranges
Quantity in Year 1	$Q_1^a = 50$	$Q_1^0 = 100$
Price in Year 1	$P_1^a = \$1.00$	$P_1^0 = \$0.80$
Quantity in Year 2	$Q_2^a = 80$	$Q_2^0 = 120$
Price in Year 2	$P_2^a = \$1.25$	$P_2^0 = \$1.60$

An Example: Nominal GDP

- Period 1 nominal GDP is
  $GDP_1 = P_1^a Q_1^a + P_1^o Q_1^o = (1.x50) + (.8x100) = 130.$
- Period 2 nominal GDP is
  $GDP_2 = P_2^a Q_2^a + P_2^o Q_2^o = (1.25x80) + (1.6x120) = 292.$
- Percentage growth in nominal GDP from 1 to 2 is :
  $\frac{GDP_2 - GDP_1}{GDP_1} x100 = 125$ percent

An Example: Real GDP

- Setting period 1 real GDP as period 1 nominal GDP
  $RGDP_1 = GDP_1 = 130.$
- Holding prices constant in period 1 prices
  $RGDP_2 = P_1^a Q_2^a + P_1^o Q_2^o = (1.x80) + (.8x120) = 176.$
- Percentage growth in real GDP from 1 to 2 is :
  $\frac{RGDP_2 - GDP_1}{RGDP_1} x100 = \frac{176}{130} - 1 = 35.4$ percent
- Holding prices constant in period 2 prices, real GDP in period 1 is
  $RGDP_1 = P_2^a Q_1^a + P_2^o Q_1^o = (1.25x50) + (1.6x100) = 222.5$

Choice of Base Year and Real GDP Calculation

- If we use period 2 as the base year, we can shown that the percentage increase in real GDP is 31.2 percent
- Choice of base year for prices matters for real GDP calculation. Difference is worse the further out the data point is from the base year
- Solution: Use chain-weighted measure of real GDP

Chain-weighted Measure

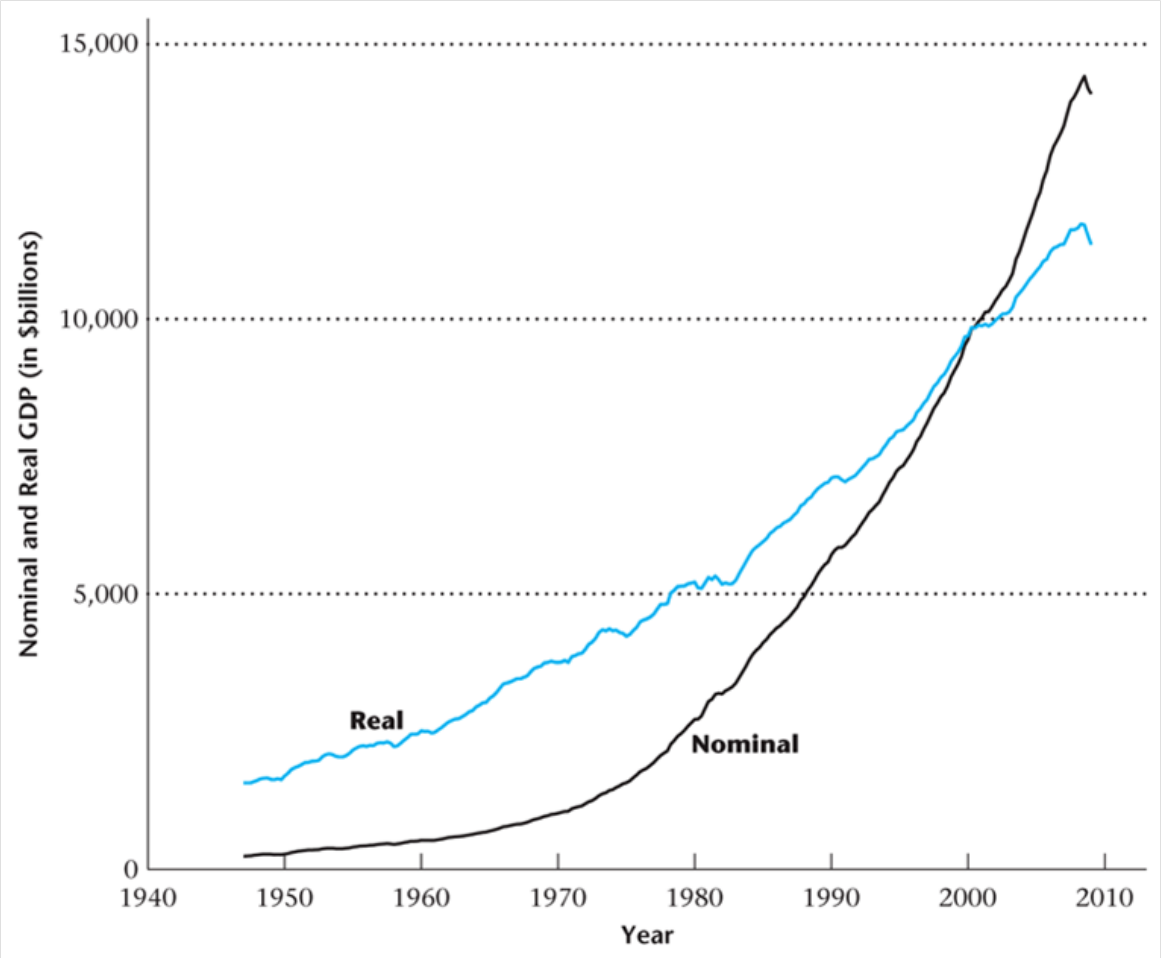
- Chain-weighted ratio of real GDP between two periods is:
  $g_c = (g_1)^{.5}(g_2)^{.5}$
  $g_c = (RGDP_2^1/RGDP_1^1)^{.5}(RGDP_2^2/RDGP_1^2)^{5\cdot} = 1.333$

- This is a geometric average between consecutive ratios, each using either base year.

- So period 2 real GDP in period 1 dollars is
  $GDP_1 \times g_c = 130 \times 1.333 = 173.29$

- Or period 1 real GDP in period 2 dollars is
  $GDP_2 \div g_c = 292 \div 1.333 = 219.05$

Figure 1: Nominal and Chain-Weighted GDP



Measures of Aggregate Price Level

- General Price Level (PGDP)

$$\text{Implicit GDP price deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} * 100$$

- Consumer Price Index (CPI)

$$\text{CPI} = \frac{\text{Price}_{\text{current}} * \text{Quantity}_{\text{base}}}{\text{Price}_{\text{base}} * \text{Quantity}_{\text{base}}} * 100$$

- $\text{CPI}_1 = 100$ and $\text{CPI}_2 = \frac{222.5}{130} = 171.2$
- Substantial difference in inflation using implicit deflator or CPI
- CPI is more volatile than PGDP (eg: 1979) - See Figure 2.2

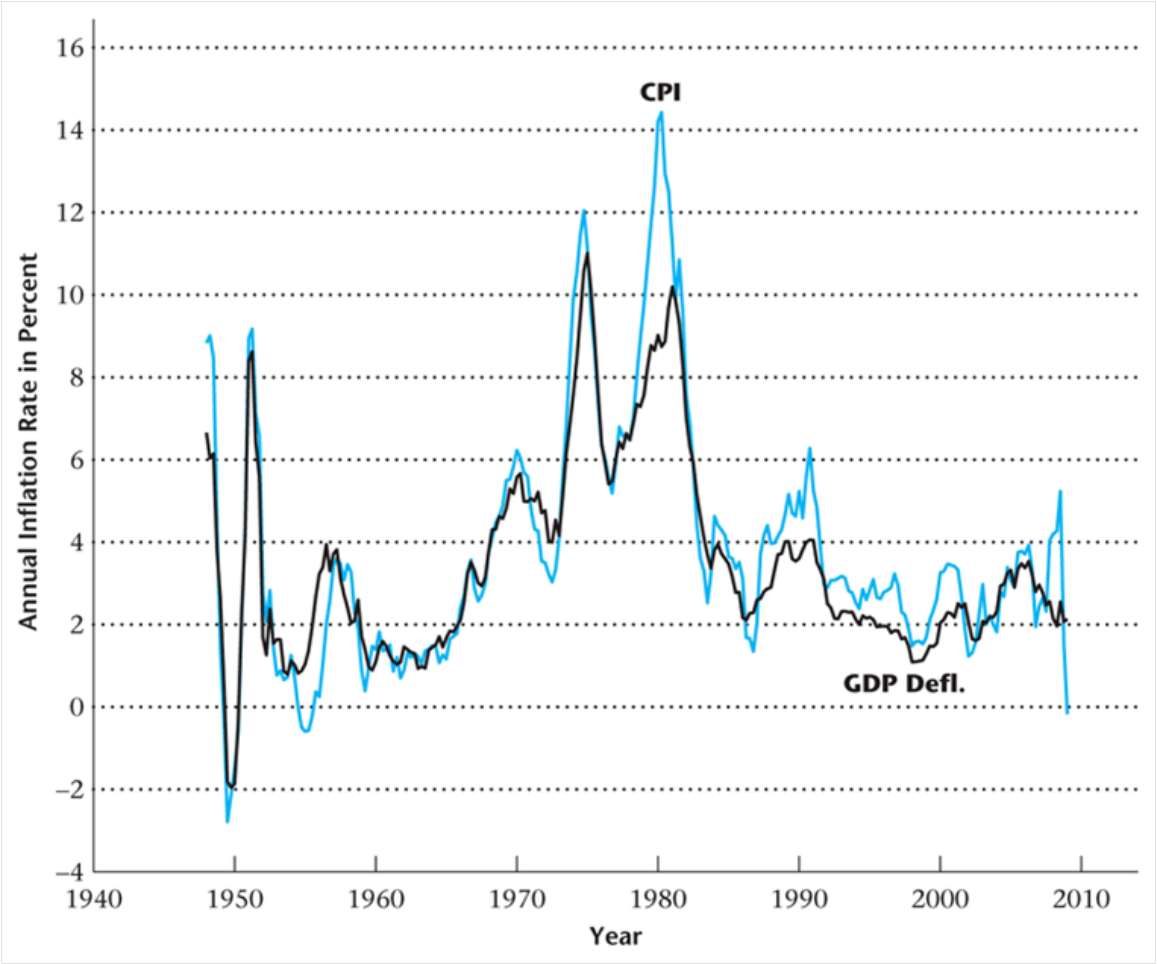
Measures of Aggregate Price Level (cont.)

Table 2.11 Implicit GDP Price Deflators, Example

	Year 1	Year 2	% Increase
Year 1 = base year	100	165.9	65.9
Year 2 = base year	58.4	100	71.2
Chain-weighting	100	168.5	68.5

- Price deflator measure depends on
- base year for RGDP, and
- whether RGDP is calculated using chain-weighting
- Consequently, inflation rate of price deflator is also sensitive to these

Figure 2: Inflation using CPI and GDP deflator



Measurement Problems

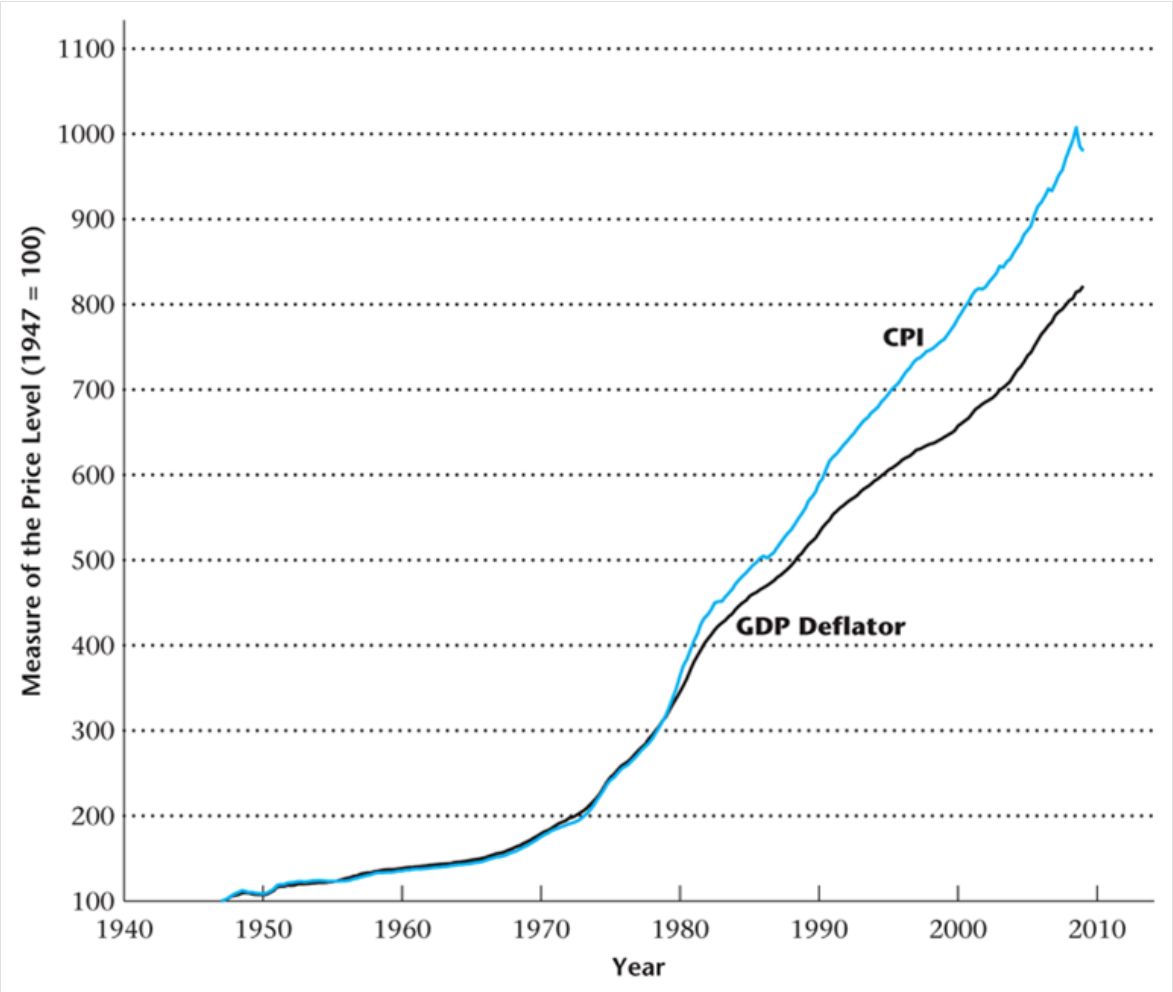
- Laspeyres Indices (CPI)
  Fixed basket of goods
  Overstates price increases since it ignores substitution of households
- Paasche Indices (GDP Deflator)
  Changing basket of goods
  Understates price increases since it ignores reduction in welfare as a result of substitution
- Following problems
  1. Relative prices changes
  2. Quality of goods change over time
  3. How to take into account of new goods
- Example: Computers (hardware and software)
- Use Chain-weighting or Fisher Index - rolling base period

$$Fisher = \sqrt{Paasche \times Laspeyres}$$

Measurement Problems (cont.)

- 1995 Boskin commission review how CPI is measured
- Upward bias in CPI inflation (1.1 %)
- If uncorrected it would be: Social security, health, defense, bias!
- Bureau Labor Statistics (BLS) implemented changes.

Figure 3: Price Level, CPI vs. GDP deflator



Problems in Measuring Real GDP and the Price Level

- The relative prices of goods change over time $\rightarrow$ a problem for CPI measurement.
- The quality of goods and services changes over time.
- New goods and services are introduced, and some goods and services become obsolete.

House Prices and GDP Measurement

- As a result of incentive problems in the mortgage market, the relative price of houses may have exceeded its true economic value prior to 2006.
- The relative price of housing fell dramatically beginning in 2006.
- This over-valuation of new houses may have exaggerated the value added in GDP accounted for by housing construction $\rightarrow$ an upward bias of perhaps 1.2%

Figure 4: The Relative Price of Housing in the United States

Stocks vs. Flows

- Flows is a rate per unit time (mph)
- Stock existence of some object in a point of time (total miles)
- National Savings is a flow while national wealth is a stock.
- Different type of savings (depends on agents)
- Private disposable Income (Y^d)

$$Y^d = Y + NFP + TR + INT - T$$

NFP = Net Factor Payments, TR = Transfers from Govt to Private sector, INT=interest on govt debt, T = Taxes

- Private savings (S^p)is then:

$$S^p = Y^d - C = Y + NFP + TR + INT - T - C$$

Stocks vs. Flows (cont.)

- Government savings (S^g):

$$S^g = T - TR - INT - G$$

- If $S^g < 0$ then it is a deficit.
- National savings:

$$S = S^p + S^g = Y + NFP - C - G$$

but Y = C + I + G + NX so substitute into S:

$$\begin{aligned} S &= S^p + S^g = C + I + G + NX + NFP - C - G \\ S &= I + NX + NFP \end{aligned}$$

- Current Account (CA) = NFP + NX so that:

$$S = I + CA$$

Stocks vs. Flows (cont.)

- Investment adds to the nation's capital stock:
  $K_t = (1 - \delta)K_{t-1} + I_{t-1}$
- Quantity of claims on foreigners in existence in the US is a stock:
  $B_t = (1 - \delta)K_{t-1} + CA_{t-1}$

Labor Market Measurement

- 3 Groups
  1. employed
  2. unemployed
  3. none of the above
- Labor force = (1) + (2)
- unemployment rate

$$\text{Unemployment rate} = \frac{\text{Number unemployed}}{\text{Labor force}}$$

- Participation rate

$$\text{Participation rate} = \frac{\text{Labor force}}{\text{Total working age population}}$$

- UR is a measure of labor market tightness

Labor Market Measurement (cont.)

- Sometimes UR is not a good measure... why?
- Caveat Emptor
  1. discouraged workers
  2. intensive margin of search