Lecture 2 Notes

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1. Gross Domestic Product
   (a) There are three major macroeconomic variables that measure the health of a national economy: total production, price level, and unemployment
   (b) The most commonly used measure of the total production or total income for the whole nation is a gross domestic product (GDP)
   (c) GDP is the sum of the market values of all final goods and services produced within a country during a specific period of time
   (d) There are four main parts of GDP:
      i. Market Value
         A. In summing the quantities of goods and services, market value is found by taking the sum of market price times market quantity of all products
         B. Mathematically, this is: $\sum_i P_i Q_i$, where P_i and Q_i are the price and quantity of a product i, respectively
      ii. Final Goods and Services
         A. Final products cannot be used to produce other products and end up with consumers (Ex. Cars and hamburgers)
         B. Intermediate products can be used to produce other products (Ex. bread and vegetables)
         C. The values of intermediate products are not included in GDP (because those values are included in finished products)
      iii. Produced Within a Country
         A. GDP includes products produced within a country even if they are produced by foreign firms and sold in foreign countries (Ex. Toyota Camry made in the US)
         B. GDP excludes products produced outside a country even if they are produced by domestic firms and sold in the US (Ex. BMW made in Germany and sold in the US)

C. Gross National Product (GNP) is the sum of the market values of all final goods and services produced by domestic firms during a specific period of time

D. GNP includes products produced by domestic firms even if they are produced outside of a country (EX. Ford Explorer made in Korea or the US)

E. GNP excludes products produced by foreign firms even if they are produced within a country (Ex. Toyota Camry made in the US or Japan)

iv. Specific Period of Time

A. GDP is normally calculated quarterly but is annualized by taking seasonal patterns into account from the quarterly GDP

B. This annualized GDP is called a seasonally adjusted annual GDP

C. GDP includes inventories, which are products that are produced but not sold in a given year

D. Increase in inventory increases GDP, and vice versa (Ex. Ford Mercury made in 2019 but sold in 2020 would be included in the 2019 GDP)

2. Measuring GDP

(a) The US Bureau of Economic Analysis (BEA) in the Department of Commerce measures GDP

(b) The BEA reports nominal GDP, real GDP, GDP deflator, growth rate, and other measures of income in the National Income and Product Accounts (NIPA) quarterly and annually

(c) GDP is measured in three approaches: expenditure, income, and value-added

(d) Finding GDP from a Modified Circular Flow Model:

i. A modified circular flow model is built by adding the government, financial market, and international market to a basic circular flow model

ii. The government earns tax revenue from firms and households and uses it to purchase goods or services from firms or provide transfer payments such as unemployment insurance and social security to households

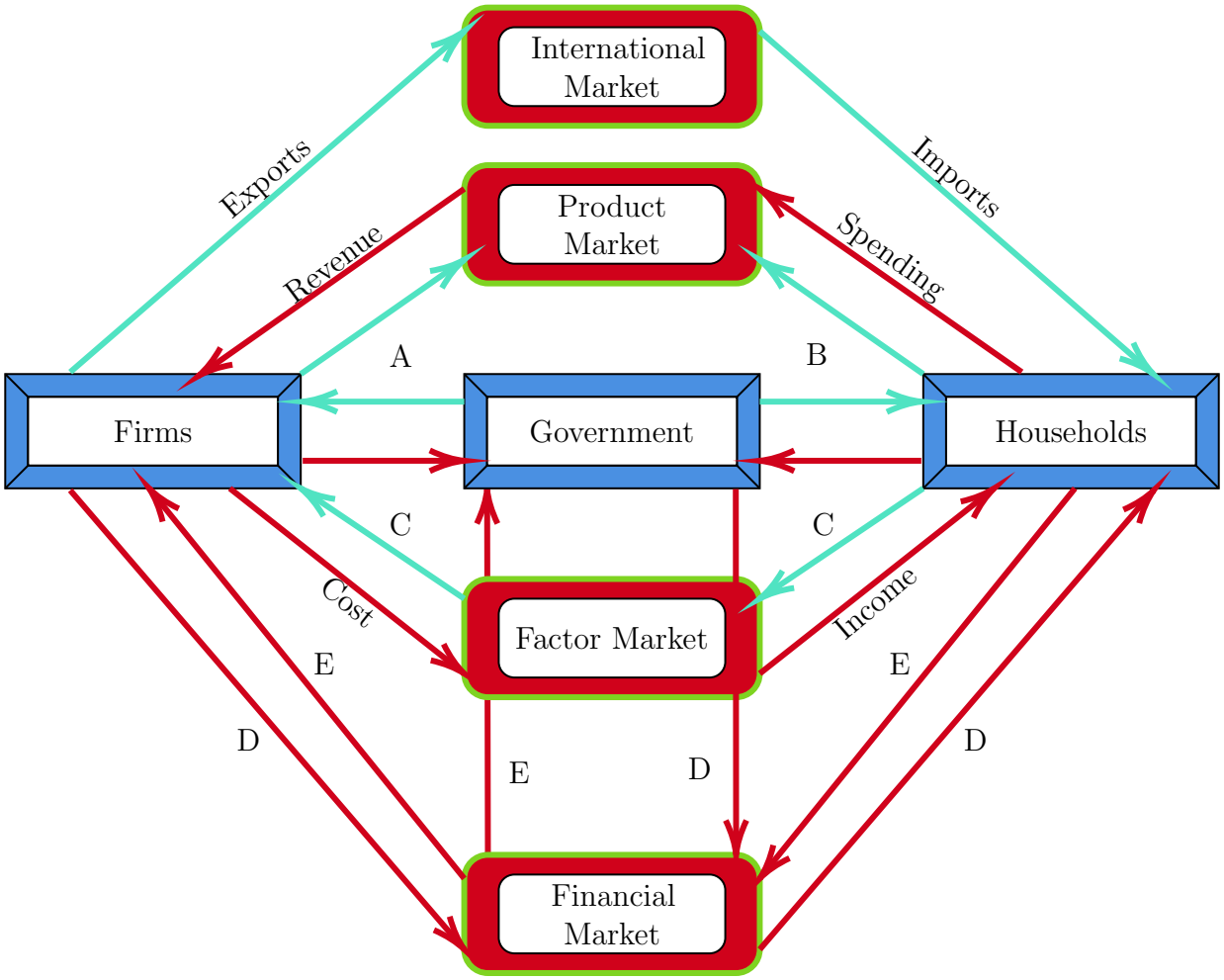
iii. In the international market, foreign buyers purchase domestic goods or services, and domestic buyers purchase foreign goods or services

iv. A modified circular flow model shows that the expenditure, income, and the value-added are equal to one another

v. The sum of the market values of all final goods and services is calculated by the expenditure on goods and services by households, firms, government, and foreign consumers

vi. Total income consists of wage for labor, rent for capital and natural resources, profit for entrepreneurs, interest for savers, and tax for government

vii. Value-added is the sum of the value of final products, minus the value of intermediate products



Legend
A. Goods, Services, and Government Purchases
B. Goods, Services, and Transfer Payments
C. Tax Inputs
D. Saving (Receiving Interest)
E. Borrowing (Paying Interest)

Figure 1: An Example Modified Circular Flow Model

3. Expenditure Approach

   (a) GDP can be measured by the sum of the expenditure on goods and services by households, firms, government, and foreign buyers

   (b) Consumption is a household's expenditure on goods or services

(c) Durable goods last more than three years (Ex. Cars), while non-durable goods last less than three years (Ex. Food)

(d) Investment is a firm's expenditure on goods and services that consist of non-residential fixed investment, residential fixed investment, and change in inventories

   i. Non-residential fixed investment is spending on buildings, machineries, tools, warehouses, and intellectual property

   ii. Residential fixed investment is a household's spending on newly built houses, which is the only spending by households among investments

   iii. Change in inventories is change in goods and services that are made in that year, but not sold the same year

      A. Increase in inventories occurs when new goods and services are produced but not sold the same year

      B. Decrease in inventories occurs when old goods and services are sold in the same year

      C. Planned investment is higher than actual investment with increase in inventories, and lower than actual investment with decrease in inventories, with the exception of investment in financial assets, such as stocks, bonds, and mutual funds, as they do not count as part of investments (because firms are not directly buying goods or services in return)

(e) Government purchases are a government's expenditure

   i. State and local government purchases include spending on education, health and hospitals, police and corrections, and highways and roads

   ii. Federal government purchases include defense, transportation, education, housing, law enforcement, and interest on payments of government debt

   iii. Exception: GDP does not include transfer payments (social security, unemployment insurance, and other welfare payments) because the government does not receive goods in return

(f) Net export is the export minus import (or foreign buyers' expenditure on domestic goods and services minus domestic buyers' expenditure on foreign goods and services)

   i. Export must be included in GDP because it includes goods and services produced within a country

   ii. Import must be excluded from GDP because it includes goods and services produced outside of a country

   iii. Trade surplus occurs when there is a positive net export, or when export is greater than import. On the other hand, trade deficit occurs when there is a negative net export, or when import is greater than export. Trade balance occurs when the export equals the input

(g) The GDP Equation

   i. GDP (Y) = Consumption (C) + Investment (I) + Government purchases (G) + Net Export (NX)

ii. This shows that the value of total production is equal to total expenditure by households, firms, governments, and foreign buyers

4. Income Approach

   (a) GDP can also be measured by the sum of income earned by workers, land and property owners, managers, savers (financial asset owners), and government

   (b) Total income, which is called Gross Domestic Income (GDI), consists of wages for workers, rents for land and property owners, profits for firm owners, interests for financial asset owners, taxes for the government, and statistical discrepancy ($GDP - GDI$)

   (c) GDI = Total income = Wage + Rent + Profit + Interest + Tax + Statistical Discrepancy

   (d) Depreciation (consumption of capital) is the decline in value of capital in the NIPA account

   (e) Statistical discrepancy refers to the difference between GDP and GDI due to measurement errors

5. Value-Added Approach

   (a) GDP can also be measured by the sum of value-added by all firms that produce final goods and services

   (b) The value-added is the market value firms add to goods and services and is calculated by subtracting the prices of intermediate goods and services from prices of final goods and services

   (c) In the calculation of GDP, we use the sum of value-added to avoid double counting (just like we use the sum of the market values of all final goods and services, not including intermediate goods and services)

6. Different GDP Measures

   (a) Nominal GDP

      i. The sum of the market values of all final goods and services evaluated at the current year prices

      ii. Mathematically calculated as $\sum_i P_{it}Q_{it}$, where P_{it} is the price of a product i at year t and Q_{it} is the quantity of a product i at year t

      iii. Nominal GDP reflects both the change in price level and change in quantity produced over time

      iv. The problem of nominal GDP is that it does not take into account the change in price level over time

   (b) Real GDP

i. The sum of the market values of all final goods and services evaluated at the base year prices

ii. Mathematically calculated as $\sum_i P_{ib}Q_{it}$, where P_{ib} is the price of a product i at the base year and Q_{it} is the quantity produced at year t

iii. Real GDP reflects only the change in quantity over time but controls the change in price level

iv. Real GDP adjusts Nominal GDP for the price change

v. Inflation is an increase in price level over time, while deflation is a decrease in price level over time

(c)

	Inflation	Deflation
Before base year	RGDP > NGDP	RGDP < NGDP
Base year	RGDP = NGDP	RGDP = NGDP
After base year	RGDP < NGDP	RGDP > NGDP

7. Limitations of GDP

(a) Not a perfect measure of well-being

i. GDP does not perfectly measure the well-being (quality of life) of the society

ii. Economists develop a life satisfaction index that incorporates literacy rates, life expectancy, and child mortality to better measure the quality of life

(b) Exclusion of some economic activities

i. Goods and services that are not traded in a market include leisure and home production

ii. Goods and services that are not reported to the government include those in the black market and grey market

A. Black Market — Goods and services illegally produced to avoid taxes and/or government regulations (Ex. Restricted weapons, human organs, etc.)

B. Grey Market — Goods and services that are legally produced, but not reported to the government (Ex. Mowing someone's lawn, Babysitting, etc.)

iii. Leisure, which is a non-labor activity, is supposed to be included in GDP because it increases GDP by improving productivity, but lowers GDP by reducing work hours

iv. Home production, or goods and services that are produced and consumed within a household, are not included in GDP

(c) Negative externalities

i. Negative externality occurs when a third party, which is not involved in market transactions (so neither a buyer nor seller), is negatively affected by economic activities

ii. Negative externality such as pollution generates external costs such as bad health effects

iii. It should be included in GDP, because it lowers it

iv. To take into account external cost, Green GDP is calculated as $GDP-$ external cost

(d) No consideration of equity

i. GDP considers the size of goods and services (efficiency), but does not care about the allocation of the goods and services (equity)

ii. Economic growth, which is an increase in the production of goods and services, may generate income inequality or inequity in a country

(e) Crime and other social problems

i. Higher GDP may cause higher crime rates and more social problems, such as high divorce rate, drug addiction, or racial issues, but these are not taken into account in GDP

8. Economic Growth vs. Business Cycle

(a) Economic growth is a long run increase in the production of goods and services in the economy or a long run increase in the average standard of living over time

(b) Business cycle is a short run fluctuation of the production of goods and services in the economy or a short run fluctuation of the average standard of living, as announced by the National Bureau of Economic Research (NBER)

(c) Business cycles range from 6 to 10 years, while economic growth usually occurs after greater than 10 years (usually 50-100 years)

9. Measure of Average Standard of Living

(a) Nominal GDP shows the change in price level and the change in quantity produced

(b) Real GDP adjusts nominal GDP for change in price level by fixing the price level at a base year

(c) Real GDP per capita adjusts real GDP for the difference in population among countries

(d) RGDP Per Capita: $\frac{RGDP}{Population}$

(e) RGDP per capita is used to compare economic growth across countries and over time because it adjusts for change in price level over time and difference in population across countries

10. Measures of Economic Growth over time

(a) There are two measures of economic growth over time: growth rate and time to double income

(b) Growth Rate (g)

i. An annual growth rate is the percentage change in real GDP per capita from year to year

ii. Measured as $g = \frac{Y_t - Y_{t-1}}{Y_{t-1}} \cdot 100$, where g is the annual growth rate, Y_t is a real GDP per capita in year t, and Y_{t-1} is a real GDP per capita in year $t-1$

iii. An average annual growth rate is the average annual percentage change in real GDP per capita from year 0 to year t

iv. Two ways to calculate average annual growth rate: accurate and approximate

A. Annual average growth rate is measured using an accurate method as $g = 100\left(e^{\frac{1}{t}\ln\left(\frac{Y_t}{Y_0}\right)} - 1\right) = 100\left(\sqrt[t]{\frac{Y_t}{Y_0}} - 1\right)$, where Y_t is the real GDP per capita in a final year, Y_0 is a real GDP per capita in an initial year, and g is an average annual growth rate

B. The above formula is derived from $Y_t = Y_0(1+g)^t$

C. The approximate annual average growth rate can be found using $\frac{1}{t}\sum_{n=1}^{t} g_t$, where g_t is an annual growth rate in percent

D. The approximate method can only be used when you know the annual growth rate for each year

(c) Time to double income

i. Time to double income can be measured in two ways: accurate and approximate

A. Time to double income (T) can be measured by using an accurate method: $\frac{\ln(2)}{\ln(1+g)}$, where g is an average annual growth rate (as a decimal)

B. The above formula is derived from $2Y_0 = Y_0(1+g)^t$

C. The time to double income can be approximated by using $T = \frac{70}{g}$, where g is an average annual growth rate, in percent. This is called the rule of seventy

11. Economic Growth Models

(a) Economic growth models are developed to explain the sources of economic growth and policy implications

(b) There are two major categories of economic growth models: Exogenous and Endogenous

(c) Solow Model (Exogenous Growth Model)

i. Developed by Robert Solow in 1950, and modified later

ii. Major sources of economic growth in the Solow model are accumulation of physical capital and technological advancement

iii. Uses the aggregate production function: $y = f$(physical capital, human capital, natural resources), where y is a real GDP per capita (labor productivity or average income) and f() is a technology

iv. Labor productivity (real GDP per capita) is determined by physical capital, human capital, natural resources, and technology

v. Physical capital is itself a product but is also used as an input to produce other products (Ex. Tools, Equipment, etc.)

vi. Investment in physical capital comes from saving

vii. Human capital is the knowledge, skill, and ability of workers and managers, through education, training, and experience, which is different from labor in that labor is measured by hours of work

viii. Knowledge generates a positive externality, which occurs when the market transactions positively affect a third party

ix. Natural resources include renewables that can be reproduced, such as trees, electricity, and water, and non-renewables that can not be reproduced, such as coal, oil, gold, and natural gas

x. Technology is something that changes inputs to outputs and generates a positive externality

(d) Aggregate Production Function

i. Labor productivity increases at a decreasing rate, as the economy accumulates more physical capital

ii. The marginal product of physical capital is the increase in production as a result of increase in physical capital by one more unit, which is the slope of the aggregate production function at each point

iii. The marginal product of physical capital declines as the economy accumulates more physical capital

iv. This is called diminishing marginal product (returns) to capital

v. Two implications of diminishing returns:

A. Steady-state is a situation where the economy stops accumualting capital or where marginal return to capital = marginal cost to capital (depreciation)

B. Catch-up effect (convergence)

- Poor countries have a higher return to capital than richer countries because they have a lower physical capital and real GDP per capita
- Poor countries try to accumulate more capital and have higher growth rates than rich countries
- Real GDP per capita across countries will eventually be equalized because poor countries will catch up with rich countries

vi. Strong catch-up effect (convergence) in high income countries: strong negative relationship between initial real GDP per capita and average annual growth rate

vii. Weak catch-up effect (convergence) in all countries whose data is available: weak negative relationship with outliers such as Colombia, Niger, and Congo

(e) Aggregate Production Function with Technological Advance

i. $y = Af$(physical capital, human capital, natural resources), where A is the technological change

ii. Without the technological change (y_0), the economy stops growing at the steady state (B) due to diminishing returns

iii. Technological advance will shift the aggregate production curve from y_0 to y_1 (curve looks like a steeper root curve)

iv. The economy will delay the steady state from B to D

v. This will lead to sustainable economic growth

vi. In the Solow Model, technological advancement occurs exogenously outside the model through random scientific discoveries (thus it is called an exogenous model)

vii. Policy implications of the Solow Model

A. Poor countries need to accumulate physical capital and advance their technologies through foreign aids such as direct or portfolio investments

- Foreign Direct Investment — Rich countries directly build or purchase facilities in poor countries
- Foreign Portfolio Investment — Rich countries buy financial assets in poor countries

viii. Limitations of the Solow Model

A. There are still poor countries, even with foreign aides (Ex. Haiti, Zimbabwe, etc.)

B. There are still countries with high growth rates, even without foreign aid (Ex. China, India, etc.)

C. To explain sources of economic growth, other than physical capital accumulation and technological advancement in these countries, new economic growth model called endogenous growth models were developed

(f) Endogenous Growth Model (developed by Paul Romer)

i. In this model, technological advancement occurs endogenously inside the model through efficient institutions

ii. Efficient institutions facilitate capital accumulation, technological advancement, and economic growth

iii. Aggregate production function with institutions: $y = Af$(physical capital, human capital, natural resources, institutions)

iv. Without efficient institutions, the economy stops growing at B (steady state) with the aggregate production function of y_0

v. With efficient institutions, the aggregate production function will shift up to y_1, with a higher Y-intercept, and the economy stops growing at D (steady state)

vi. Efficient institutions not only help the economy to have higher capital accumulation, but also to develop better technology and have higher economic growth, even without foreign aid

vii. This explains any countries with high growth rates, even without foreign aid, and any countries with low growth rates, even with foreign aid

viii. There are seven major efficient institutions that facilitate capital accumulation, technological advancement, and economic growth:

A. Private property rights

- Provides consumers with an incentive to pay for products and provide producers with an incentive to develop new technology and lower the cost (Ex. US has better property rights than China)

B. Political stability and rule of law

- Firms have more incentive to invest money in countries with polticial stability and countries that follow laws, rather than invest in poltically unstable countries (Ex. US and European countries are more stable than countries in Africa and Latin America)

C. Competitive market

- Has many buyers and sellers, sellers have no market power, there are no barriers to entry and exit, facilitates competition, and lowers cost of production, which results in maximum efficiency and economic growth

D. Free trade

- Specialization and free trade make countries have more products available for consumption with transfer of technology

E. Free flow of funds

- A foreign portfolio investment helps poor countries to develop only without barriers to flow of funds

F. Efficient taxes

- Taxes normally generate tax revenue to the government and deadweight loss to the society
- Efficient taxes are taxes that maximize tax revenue, but minimize deadweight loss

G. Stable price

- Firms have stronger incentive to invest their money in countries with stable price level due to predictable profits, rather than countries with significant change in price level

(g) Policy Implications of the Endogenous Growth Model

i. More efficient institutions are supported

12. Price Level

(a) Both income and price level normally rise over time

(b) If income and price level rise at the same rate, there is no change in purchasing power (ability to buy products) of consumers, because the real value of income does not change

(c) If price level rises at a faster rate than income, the purchasing power of consumers will decline because the real value of income declines

(d) If price level rises at a slower rate than income, the purchasing power of consumers will increase, because the real value of income increases

(e) Price level may be different across places even with the same income

13. Different measures of price level

(a) The cost of living for a country is measured by the price level, which is a weighted average price of goods and services produced within a country

(b) More weight is given to goods and services with a higher portion of expenditure, while less weight is given to goods and services with lower portion of expenditure

(c) Three major measures of price level:

i. GDP deflator

A. GDP deflator $= \frac{NGDP}{RGDP} \cdot 100$

B. It reflects only the change in price level because nominal GDP reflects both change in quantity and change in price level, while real GDP reflects only the change in quantity

C. This is the broadest measure of price level for a country because it reflects a weighted price for goods and services spent by households, firms, government, and foreigners

D. It is 100 at the base year, because $NGDP = RGDP$ at the base year

E.

	Inflation	Deflation
Before base year	GDP Deflator < 100	GDP Deflator > 100
Base year	GDP Deflator $= 100$	GDP Deflator $= 100$
After base year	GDP Deflator > 100	GDP Deflator < 100

ii. Producer price index (PPI)

A. A weighted average price of all the final goods and services produced in the economy and spent by firms, such as machinery, equipment, tools, intellectual property, adn so on

B. Excludes the prices of goods and services spent by government and households

C. A predictor of consumer price index

D. CPI follows pattern changes in PPI

iii. Consumer price index (CPI)

A. A weighted average of a market basket of consumer goods and services spent by typical urban consumers

B. The most commonly used price level for tracking changes in the cost of living in the US because it reflects the prices experienced by consumers

C. Typical urban households include all urban consumers, urban wage earners, and clerical workers (93% of the US population)

D. Ex. Professionals, Self-employed, etc.

E. Exception: People living in rural areas, people in the armed forces, etc.

F. The market basket is a group of expenditure items spent by typical urban households in a base year (current base year is 1982-84)

G. It is fixed at the base year to capture only the change in price level over time

H. Classified into more than 200 categories and arranged into 8 major groups, which include housing, transportation, food and beverages, medical care, education and communication, recreation, apparel, and other goods and services

I. Government subsidies and sales and excise taxes are included in the market basket

J. The market basket excludes investment items (stocks, bonds, real estate, and life insurance), houses, antiques, collectibles, gambling losses, fines, cash gifts, child support, alimony, interest costs, illegal products, transfer payments, and income tax

K. CPI is measured in $CPI = \frac{Expenditure_t}{Expenditure_b} \cdot 100$

L. $Expenditure_t$ is the expenditure in a current year ($\sum_i P_{it}Q_{ib}$, where P_{it} is the price of a product i at year t, and Q_{ib} is the quantity of product i at a base year)

M. $Expenditure_b$ is the expenditure in a base year ($\sum_i P_{ib}Q_{ib}$, where P_{ib} is the price of a product i in a base year)

N. Market basket is fixed at a base year, but prices change over time

O. At the base year, $CPI = 100$ because $Expenditure_t = Expenditure_b$

P.

	Inflation	Deflation
Before base year	CPI $<$ 100	CPI $>$ 100
Base year	CPI $=$ 100	CPI $=$ 100
After base year	CPI $>$ 100	CPI $<$ 100

14. Change in Price Level

(a) Inflation rate is a year-to-year percentage change in price level over time

(b) Calculated as $\frac{P_t - P_{t-1}}{P_{t-1}} \cdot 100$, where P_t is the price level at year t and P_{t-1} is the price level at year $t-1$

(c) Inflation occurs if the rate is positive, and deflation occurs if the rate is negative

(d) There are two different inflation measures by using CPI: headline and core

i. Headline — A change in CPI for the entire market basket of the average urban consumer

ii. Core — A change in CPI for the market basket, excluding food and energy

(e) Including them in the calculation of CPI may over or under estimate the real change in overall prices

(f) Excluding them may miss a large part of income of consumers