Measuring Total Production and Income

Topic 5

Learning Objectives

- Discuss how to measure a society's economic output
- Define gross domestic product
- Measure gross domestic product
- Learn where differences in income and wealth originate.
- Develop a measure of income inequality – the Gini Coefficient – using the Lorenz Curve.

Revision

- Macroeconomics: the study of the economy as a whole, focusing on levels and changes in aggregate measures.
  - What causes recessions?
  - What is the government budget deficit?
  - How can problems in the housing market spread to the rest of the economy?
- The Circular Flow Diagram
- Concept of demand and supply
  - How various events affect price and quantity turned over

Gross Domestic Product

Gross domestic product is the market value of all final goods and services produced in a country within a certain time period.

GDP can be measured as:

- Total expenditure on domestically produced final goods
- Total income earned by domestically located factors of production
- Total output

How can all measure GDP?

- Expenditure equals income because every dollar a buyer spends becomes income to the seller.

Gross Domestic Product – Ctd.

Gross domestic product is the market value of all final goods and services produced in a country within a certain time period.

- GDP is a measure of production.
- Economist get a total measure of the value of all goods and services by assuming that each individual good and service is valued at its market price.
- The market price is the results of the interaction of consumer demand with producer cost.

Gross Domestic Product – Ctd.

Gross domestic product is the market value of all final goods and services produced in a country within a certain time period.

- If the people are willing to pay a certain amount for something, when they have alternatives, then the good must be worth that amount to them.
- Multiplying the market price of a good by the quantity produced gives us the value of the total amount produced.
- $GDP = (P_1 \times Q_1) + (P_2 \times Q_2) + (P_3 \times Q_3) + \cdots + (P_n \times Q_n)$

Gross Domestic Product – Ctd.

$$GDP = (P_1 \times Q_1) + (P_2 \times Q_2) + (P_3 \times Q_3) + \cdots + (P_n \times Q_n)$$

An Example:

Good	P	Q	(P x Q)
A	$30	900	
B	$100	200	
C	$50	500	
D	$25	750	
E	$75	400	
		GDP	

Expenditure Components of GDP

Decompose GDP into four components

- Consumption
- Investment
- Government Spending
- Net Exports

Then:

- GDP = C + I + G + NX

Expenditure Components of GDP – Ctd.

Consumption by households (C)

- The value of all goods and services bought by households.

- Durable goods: last a long time
  - Cars, home appliances
- Nondurable goods: last a short time
  - Food, clothing
- Services: intangible items purchased
  - Dry cleaning, air travel

Expenditure Components of GDP – Ctd.

Investment Expenditures by Businesses (I)

- Spending on capital, a physical asset used in future production

- Business fixed investment
  - Spending on plant and equipment
- Residential fixed investment
  - Spending by consumers and landlords on housing units (structures)
- Inventory investment
  - The change in the value of all firms' inventories

Expenditure Components of GDP – Ctd.

Government Spending (G)

- Includes all government spending on goods and services.
- Excludes transfer payments, such as unemployment insurance payments, because they do not represent spending on goods and services.

Expenditure Components of GDP – Ctd.

Net Exports (NX)

- The difference between exports and imports.

- Exports
  - The value of all goods and services sold to other countries
- Imports
  - The value of all goods and services purchased from other countries
- NX equals net spending from abroad on our goods and services.

Measuring Gross Domestic Product

GDP can be calculated using either one of the following approaches:

- Expenditure method
- Income method
- Value added method

Each method yields the same amount for GDP. Let’s look at an example…

Measuring Gross Domestic Product – Ctd.

During a given year in an abstract economy, the following activities occur:

1. A silver mining company pays its workers a total amount of $200,000 to mine 75 pounds of silver.
2. The silver is then sold to a jewelry manufacturer for $300,000.
3. The jewelry manufacturer pays its workers a total amount of $250,000 to make silver necklaces.
4. The jewelry manufacturer sells the jewelry directly to consumers for a total amount of $1,000,000.

Measuring Gross Domestic Product – Ctd.

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Expenditure Method

- Sum of all final goods and services produced
- Final goods are the ones that end up in the hands of the ultimate customer.

Measuring Gross Domestic Product – Ctd.

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Income Method

- All income is simultaneously income to the person who produced the good or service
- Income of workers: wages
- Income of firms: profits (revenue-cost)

Measuring Gross Domestic Product – Ctd.

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Value Added Method

- Value added refers to the value of output minus the value of the intermediate goods used to produce that output

Or

- Revenue – cost of intermediate goods

Limitations of GDP

Major problems in getting an accurate figure for GDP as a measure of total production:

- The sale of used goods:
  - Goods that were produced in a previous period were already counted toward GDP.
- Non-market production:
  - The creation of goods and services that are not sold through a market.
- Underground economy/ black-market:
  - Goods and services sold and bought but not reported to the authorities.

Nominal vs. Real GDP

- GDP is the value of all final goods and services produced.
- **Nominal GDP** measures these values using current prices.

$$NGDP_t = \left(Q_{A_t} \times P_{A_t}\right) + \left(Q_{B_t} \times P_{B_t}\right)$$

- **Real GDP** measures these values using the prices of a base year.

$$RGDP_t = \left(Q_{A_t} \times P_{A_b}\right) + \left(Q_{B_t} \times P_{B_b}\right)$$

Nominal vs. Real GDP – Ctd.

An Example:

Good	Q_{2000}	P_{2000}	Q_{2010}	P_{2010}
A	100	50,000	120	60,000
B	500,000	10	400,000	20

$$NGDP_t = \left(Q_{A_t} \times P_{A_t}\right) + \left(Q_{B_t} \times P_{B_t}\right)$$

$$RGDP_t = \left(Q_{A_t} \times P_{A_b}\right) + \left(Q_{B_t} \times P_{B_b}\right)$$

GDP	2000	2010
Nominal		
Real (b=2000)		

Inflation and the Accuracy of GDP

- As the prior example illustrates, changes in price and quantity distort the purchasing power of money.
- Changes in **nominal GDP** can be due to:
  - Changes in prices
  - Changes in quantities of output produced
- Changes in **real GDP** can only be due to changes in quantities because real GDP is constructed using constant base-year prices.
- These observable distortions are caused by inflation.

Inflation and the Accuracy of GDP – Ctd.

- Inflation rate refers to the percentage increase in the overall level of prices.
- Measures of the price level:
  - GDP Deflator
  - Consumer Price Index (CPI)

GDP Deflator

- Calculating the price level using the formula of the GDP Deflator means to hold the prices of the base year fixed.
- $GDP\ Deflator =$

$$\frac{\left(Q_{A_t} \times P_{A_t}\right) + \left(Q_{B_t} \times P_{B_t}\right) + \ \ldots + \left(Q_{n_t} \times P_{n_t}\right)}{\left(Q_{A_t} \times P_{A_b}\right) + \left(Q_{B_t} \times P_{B_b}\right) + \cdots + \left(Q_{n_t} \times P_{n_b}\right)} \times 100$$

Then:

- $GDP\ Deflator = \frac{NGDP}{RGDP} \times 100$

GDP Deflator – Ctd.

An Example:

Good	Q_{2000}	P_{2000}	Q_{2010}	P_{2010}
A	100	50,000	120	60,000
B	500,000	10	400,000	20

GDP	2000	2010
Nominal	10,000,000	15,200,000
Real (b=2000)	10,000,000	10,000,000
GDP Deflator		

- $NGDP_t = \left(Q_{A_t} \times P_{A_t}\right) + \left(Q_{B_t} \times P_{B_t}\right)$
- $RGDP_t = \left(Q_{A_t} \times P_{A_b}\right) + \left(Q_{B_t} \times P_{B_b}\right)$
- $GDP\ Deflator = \frac{NGDP}{RGDP} \times 100$

Consumer Price Index

- Calculating the price level using the formula of the CPI means to hold the quantities of the base year fixed.

- $CPI = \frac{\left(Q_{A_b} \times P_{A_t}\right) + \left(Q_{B_b} \times P_{B_t}\right) + \ldots + \left(Q_{n_b} \times P_{n_t}\right)}{\left(Q_{A_b} \times P_{A_b}\right) + \left(Q_{B_b} \times P_{B_b}\right) + \cdots + \left(Q_{n_b} \times P_{n_b}\right)} \times 100$

Then:

- $CPI = \frac{Cost\ of\ Basket_t}{Cost\ of\ Basket_b} \times 100$

Consumer Price Index – Ctd.

An Example:

Good	Q_{2000}	P_{2000}	Q_{2010}	P_{2010}
A	100	50,000	120	60,000
B	500,000	10	400,000	20

GDP	2000	2010
$Cost\ of\ Basket_b$		
$Cost\ of\ Basket_t$		
CPI		

- $Cost\ of\ Basket_b = \left(Q_{A_b} \times P_{A_b}\right) + \left(Q_{B_b} \times P_{B_b}\right) + \cdots + \left(Q_{n_b} \times P_{n_b}\right)$
- $Cost\ of\ Basket_t = \left(Q_{A_b} \times P_{A_t}\right) + \left(Q_{B_b} \times P_{B_t}\right) + \ldots + \left(Q_{n_b} \times P_{n_t}\right)$
- $CPI = \frac{Cost\ of\ Basket_t}{Cost\ of\ Basket_b} \times 100$

GDP vs. GNP

- Gross Domestic Product (GDP)
  - The total market value of all final goods and services produced domestically over a certain period of time.
  - For example: The income you make working in the CHN is counted towards CHN GDP.
- Gross National Product (GNP)
  - The total market value of all goods and services produced by nationals over a certain period of time.
  - For example: The income I make working in the CHN is counted towards Germany's GNP.

GDP vs. National Income

- Gross Domestic Product (GDP)
  - The total market value of all final goods and services produced domestically over a certain period of time.
- National Income
  - For the production of goods and services, machinery, equipment, and buildings wear out and eventually have to be replaced.
  - Depreciation: the consumption of fixed capital
  - National Income = GDP - Depreciation

GDP vs. GDP per Capita

- Is GDP a good proxy for standards of living?

Country	2017	2018	2019	2020
CHN	12310409370894.20	13894817549380.30	14279937467431.00	14722730697890.10
DEU	3681732583768.50	3975347237442.99	3888326788627.44	3846413928653.71

Source: The World Bank, World Development Indicator Database (WDI). 2022. https://databank.worldbank.org/source/world-development-indicators

- Does that mean that people living in the China have an average living standard that is greater than in Germany?
- Thus, to have a useful measure, we need to look at income per person.

GDP vs. GDP per Capita

- GDP per capita shows how much income is available per person if it were equally spread across the entire population.

Country	2017	2018	2019	2020
CHN	8816.99	9905.34	10143.84	10434.78
DEU	44542.30	47950.18	46794.90	46208.43

Source: The World Bank, World Development Indicator Database (WDI). 2022. https://databank.worldbank.org/source/world-development-indicators

- $GDP\ per\ capita = \frac{GDP}{Population}$

Limitations of GDP

Major problems in getting an accurate figure for GDP as a measure of total well-being:

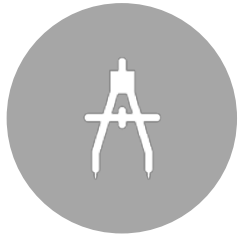
- Omitting Leisure
- Omitting negative effects of production
- Not adjusted for crime/social problems
- Not adjusted for inequality

Income and Wealth Inequality

REAL ESTATE AGENT

Earns $40,000 annually

Owns an apartment



ARCHITECT

Earns $80,000 annually

Owns a house

TAILOR

Earns $20,000 annually

Rents a studio apartment

BUSINESS CONSULTANT

Earns $200,000 annually

Owns a country estate

HIGH SCHOOL TEACHER

Earns $60,000 annually

Owns a town house

Where Differences Come From

- In a free market based system
  - A household's capacity to consume goods and services is limited by its access to money
  - A household's access to money is in turn limited by its wealth and income
- Wealth and income depend upon
  - The results of decisions by individuals
  - The results of socio-economic factors beyond the control of individuals

Determinants of Income

- **Income**: the flow of money earned during a period of time.
- Most households earn the majority of their income by supplying labor to firms
- Among other factors, the wage rate of a worker depends on
  - Natural talent
  - Ability
  - Acquired skills
  - Effort
- **Compensating differentials** refer to the differences in labor market wage rates due to differences in working conditions.

Determinants of Wealth

- **Wealth**: the current stock of valuable assets owned at a point in time
- The amount of wealth depends primarily upon
  - accumulated savings (or debts)
  - previous inheritance

Income Inequality - GINI

- Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution.

Country	2016	2017	2018	2019
CHN	42.83	43.25	44.08	43.65
DEU	31.95	32.16	33.54	31.65

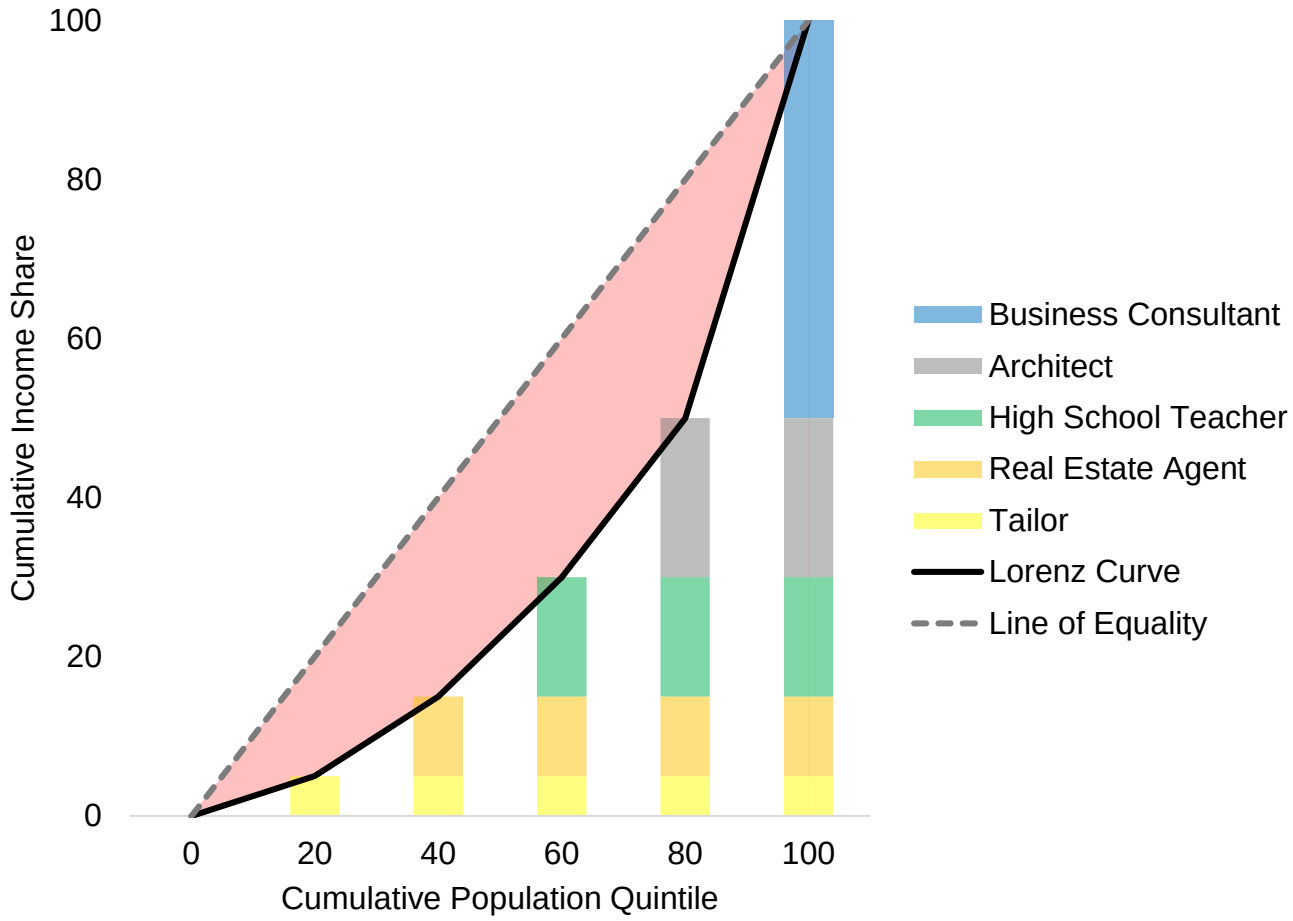
Source: UNU-WIDER, World Income Inequality Database (WIID). Version 31 May 2021. https://doi.org/10.35188/UNU-WIDER/WIID-310521

Measuring Income Inequality

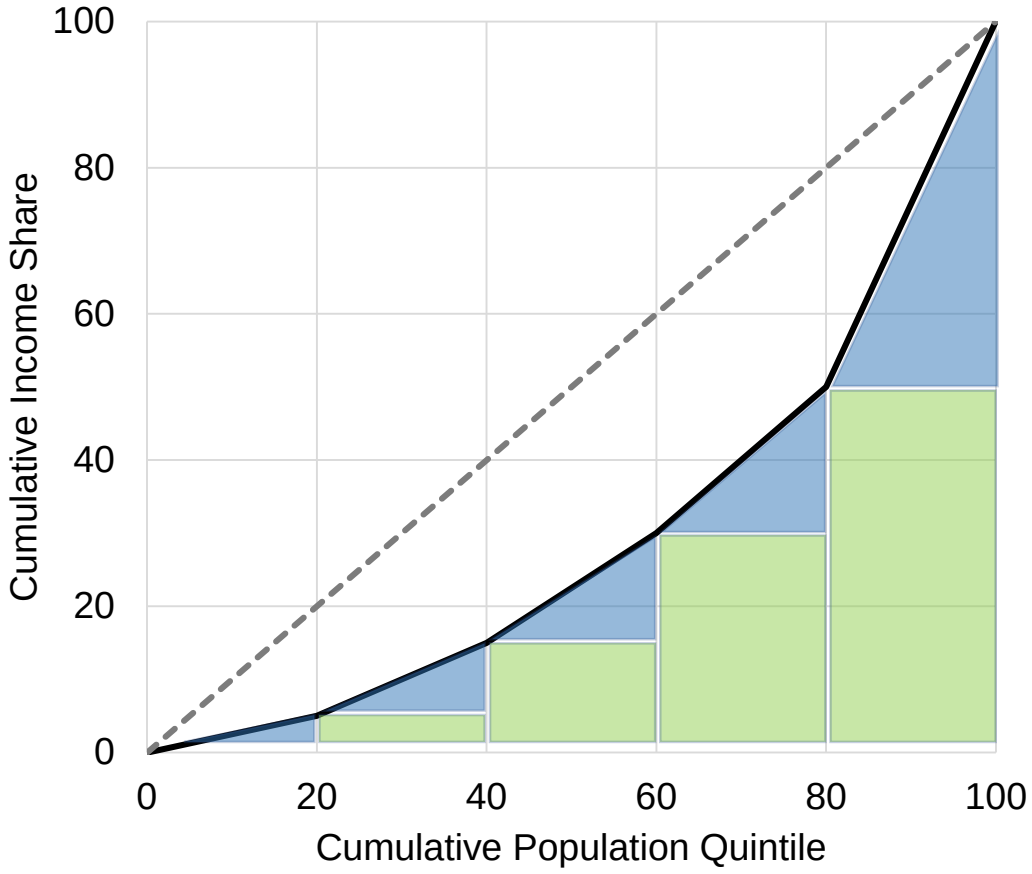
- GINI-Coefficient
  - a measure of income inequality constructed from a Lorenz curve and a line of income equality
- Lorenz Curve
  - plots the cumulative fraction of total income by cumulative population percentile, ordered from lowest income to highest income
- Line of Income Equality
  - plots the cumulative fraction of total income by cumulative population percentile, but every individual earns the same income

The Lorenz Curve

Population Quintile	Income ($)	Income Share (%)	Cum. Income Share (%)
Tailor	20,000	5	5
Real Estate Agent	40,000	10	15
High School Teacher	60,000	15	30
Architect	80,000	20	50
Business Consultant	200,000	50	100
Total Income	400,000		



The GINI-Coefficient



$$GINI = \frac{Area\ between\ Line\ of\ Equality\ and\ Lorenz\ Curve}{Area\ below\ Line\ of\ Equality}$$

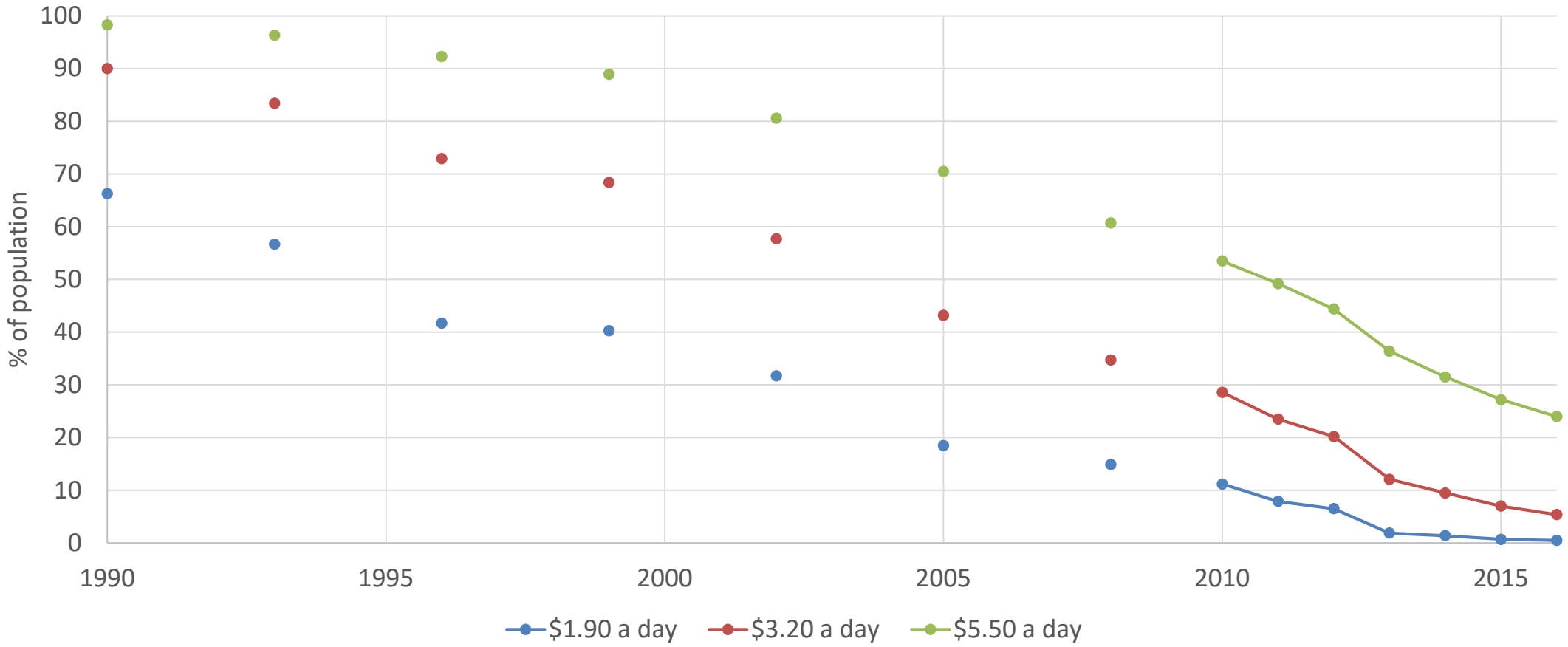
	0-20	20-40	40-60	60-80	80-100
Triangular areas	50	100	150	200	500
Rectangular areas		100	300	600	1000
Sum	50	200	450	800	1500

$$GINI = \frac{5000 - 3000}{5000} = 0.4$$

Poverty

- **Poverty** is the condition of having very limited access to goods and services
- **Poverty Thresholds** are levels below which the household is deemed to be living in poverty.
  - In China :
    - Rural poverty: 2,300CNY per year (ca. $1.00 a day)
    - Poverty: 4,000CNY per year (ca. $1.70 a day)
  - In Germany:
    - Single household: 781.00€ net income per month (ca. $28 a day)
  - World Bank:
    - $1.90 a day – international poverty line
    - $3.20 a day – lower middle income class poverty line
    - $5.50 a day – upper middle income class poverty line
- **Poverty Rate** refers to the % of the population living below the poverty line.

Poverty – Ctd.



Source: The World Bank, World Development Indicator Database (WDI). 2022. https://databank.worldbank.org/source/world-development-indicators

Summary

- The national accounting system is based in the circular flow characteristics of economic activity.
- Economic activity is measured by GDP.
- GDP is the market value of all final goods and services produced in a country within a certain time period.
- Thus, everyone’s expenditure must be someone else’s income.
- Accordingly, GDP can be calculated using the income, expenditure, and value-added approach.
- GDP as a measure is often criticized for not accurately measuring improvements in quality of life and living standards, but despite this criticism, it is still a good proxy measure for many things.
- Income Inequality can be measured by the GINI coefficient using the Lorenz curve.
- Poverty is the condition of having very limited access to goods and services.