Chapter I: Gross Domestic Product

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2025-2026

GDP Accounting

- One of the basic questions economists are interested in, when analyzing a country, is how much is produced in that country in a given year
- The basic measure of this is a country's gross domestic product (GDP)
- The idea is simple: to record the value of everything that is produced in the country in a year and add it up
- GDP accounts can be constructed in three different (but equivalent) ways, based on measuring:
  1. production
  2. income
  3. expenditures

US GDP in 2017

Table: US GDP in 2017 according to the three methods (billions of dollars). Source: BEA.

Production		Income		Expenditure	
Agriculture	169	Employee Compensation	10,421	Consumption	13,321
Mining	269	Corporate Profits	1,807	Investment	3,368
Utilities	308	Proprietors' Income	1,501	Gov. Spending	3,374
Construction	781	Rental Income	730	Exports	2,350
Manufacturing	2,180	Depreciation	3,116	Imports	-2,929
Wholesale & Retail	2,261	Interest Income	768		
Transportation	609	Taxes	1,286		
Media	1,051	Statistical Discrep.	-143		
Finance & Insurance	1,466				
Real Estate	2,591				
Professional Services	2,426				
Education & Health	1,700				
Arts & Entertainment	805				
Other Services	416				
Government	2,454				
Total	**19,485**	**Total**	**19,485**	**Total**	**19,485**

GDP Accounting

- GDP can be measured in three equivalent ways:
  - production
  - income
  - expenditure
- Using the expenditure approach, GDP is given by:

$$Y = C + I + G + X - M$$

- Y: Gross Domestic Product
- C: Private consumption
- I: Investment
- G: Government purchases
- X: Exports
- M: Imports

- Key idea: whenever goods and services are produced, their value appears as someone's expenditure and someone's income.
- In the next slides, we build intuition through a series of examples for why:

Production = Income = Expenditure.

GDP Accounting

- João, who is self-employed, produces beer and sells it to Ana Maria for $1.
- Ana Maria drinks it.

GDP from the three approaches (in dollars)

Production		Income		Expenditure	
Beer production	1	João's income	1	Ana Maria's consumption	1

- Production: measures the value of the beer that was produced, which is $1 (Manufacturing)
- Income: how much income is derived from productive activities: João obtains $1 of income from selling the beer. (Proprietor's income: income from self-employment)
- Expenditure: The expenditure approach looks at what the production was used for. (Consumption)

Value Added

- Production typically takes place in several stages.

  Someone's output becomes somebody else's input.

- We want to measure the **value added** at the end of the production process, avoiding **double counting**.

The Sandwich Economy

- Alice owns a company that makes mayonnaise. She pays Bob $0.50 to mix eggs and oil all day.
- The company sells the mayo to Carol, who runs a sandwich shop, for $0.80.
- Carol uses the mayo to make a delicious sandwich, which she sells to Daniel for $1.
- Daniel eats the sandwich (and contributes nothing further to GDP).

GDP from the three approaches (in dollars)

Production		Income		Expenditure	
Manufacturing (mayo)	0.8	Wages (Bob)	0.5	Consumption (sandwich)	1.0
Services (sandwich shop)	0.2	Profits (Alice)	0.3		
		Proprietor income (Carol)	0.2		
Total	**1.0**	**Total**	**1.0**	**Total**	**1.0**

Avoiding Double Counting

- It would be a **mistake** to add the value of the mayonnaise to the value of the sandwich, because the mayonnaise was **used up** in making the sandwich.
- The **value added** by the sandwich shop is the difference between the final value of the sandwich ($1) and the value of the mayonnaise ($0.80):

$$\text{Value added (Carol)} = 1.00 - 0.80 = 0.20$$

- Calculating GDP this way ensures that the total value of output is **consistent across the three approaches**:

Production = Income = Expenditure = $1.00.

Forms of Investment

- Investment takes different forms — but all involve producing something that will help produce more in the future.

(a) **Equipment:** Elon builds a robot barista and sells it to a coffee shop for $1,000. The cost of producing it is made up of worker's wages of $600. The robot will make cappuccinos for years to come.

Production		Income		Expenditure	
Manufacturing (robot)	1,000	Wages	600	Investment (equipment)	1,000
		Profits	400		
Total	**1,000**	**Total**	**1,000**	**Total**	**1,000**

Forms of Investment (II)

- **(b) Inventories:** Caffeine Inc. produces 1,000 bags of coffee beans worth $30,000 but hasn't sold them yet. These beans are stored in the warehouse — an increase in inventories is also **investment**.

Why? Because the coffee beans will be sold or roasted later — they are goods that will help future production (coffee sales).

Production		Income		Expenditure	
Manufacturing (coffee beans)	30,000	Wages Profits	20,000 10,000	Investment (inventories)	30,000
Total	**30,000**	**Total**	**30,000**	**Total**	**30,000**

Inventories in the Next Period

Period $t+1$: Caffeine Inc. sells the previously produced coffee beans. There is **no new production**.

Production		Income		Expenditure	
No new production	0	*No new income*	0	Consumption	30,000
				Investment (inventories)	-30,000
Total	**0**	**Total**	**0**	**Total**	**0**

Durables (I)

- The line between consumption and investment isn't always clear.
- A house produces "housing services" for years — that's why residential construction counts as investment.
- Similarly, a refrigerator, a TV, a car, or even a fancy pair of sneakers produces services over time.
- How does GDP accounting treat these durable goods?

Fun with Durables

- **(a) TV:** Panasonic builds a TV (at zero cost!) and sells it to Bob for $500.

Production		Income		Expenditure	
Manufacturing (TV)	500	Corporate profits	500	Consumption (durables)	500
Total	**500**	**Total**	**500**	**Total**	**500**

- **(b) Watching the TV:** Bob watches the TV he bought last year. Nothing new is produced:

Production	0	Income	0	Expenditure	0

Durables (II)

- **(c) House:** A property developer builds a house (at zero cost) and sells it to Claire for $100,000.

Production		Income		Expenditure	
Construction (house)	100,000	Corporate profits	100,000	Investment (residential)	100,000
Total	**100,000**	**Total**	**100,000**	**Total**	**100,000**

- **(d) Living in the house:** Claire enjoys the house she bought last year. Imputed rent (what it would cost to rent) is $7,000/year:

Production		Income		Expenditure	
Housing services	7,000	Imputed owner income	7,000	Consumption	7,000

Conceptual point: TVs and houses are produced once but enjoyed for a long time.

- TVs → treated as "consumed at purchase".
- Houses → treated as "investment", with housing services measured each year.

Foreign Production and GDP

Imports

- GDP includes everything produced **within the country**.
- Goods produced abroad are **not included in GDP**, even if residents consume them.

Car Adventure

- Andy wants a supercar. The manufacturer buys parts from Japan for $10, uses half in production, and sells the car to Andy for $20. No other costs.

Production		Income		Expenditure	
Car Manufacturing	15	Corporate profits	15	Consumption	20
				Investment (inventory)	5
				Imports	-10
Total	**15**	**Total**	**15**	**Total**	**15**

Foreign Production and GDP

Exports

- GDP includes goods **produced domestically**.
- If they are sold to **foreign residents**, they count as **exports**.

Example: Pastéis Go International

- A bakery in Lisbon produces boxes of pastéis de nata worth $10.
- The boxes are shipped to a café in Berlin.
- The buyer is a **foreign resident**.

Production		Income		Expenditure	
Bakery production	10	Wages and profits	10	Exports	10
Total	**10**	**Total**	**10**	**Total**	**10**

Do Imports Really "Subtract" from GDP?

A common media/political claim:

"When net exports are negative, that is, when a country runs a trade deficit by importing more than it exports, this subtracts from growth" — Peter Navarro (former top White House trade advisor).

Economist's clarification:

- The GDP identity $Y = C + I + G + (X - M)$ includes $(X - M)$ for accounting, not causation.
- Imports are first included in $C, I,$ or G, then subtracted to exclude foreign production.
- As a result, imports do not reduce GDP — they ensure GDP counts only **domestic** production.

The Government in GDP

- The government is a major producer of goods and services.
- Many services are provided directly (education, defense, etc.), so there is **no market price**.
- To include them in GDP, they are valued at their **cost of production**.

Example: The Government as a Producer

1. Public Education

Production		Income		Expenditure	
Public Education	85,000	Wages	85,000	Government	85,000

2. Public Concert

Production		Income		Expenditure	
Public Concert	85,000	Wages	65,000	Government	85,000
		Rental income	20,000		
Total	**85,000**	**Total**	**85,000**	**Total**	**85,000**

Note: GDP is the same in both examples—even though one service is highly valued (education) and the other (concert) is not.

Taxes

VAT

- Joao sells lemonade for $10, including $1 VAT.
- He pays $6 to workers, keeps $3 as profit.
- Government collects $1 VAT.

Production		Income		Expenditure	
Lemonade sold	10	Wages	6	Private Consumption	10
		Profits	3		
		Taxes	1		
Total	**10**	**Total**	**10**	**Total**	**10**

Depreciation

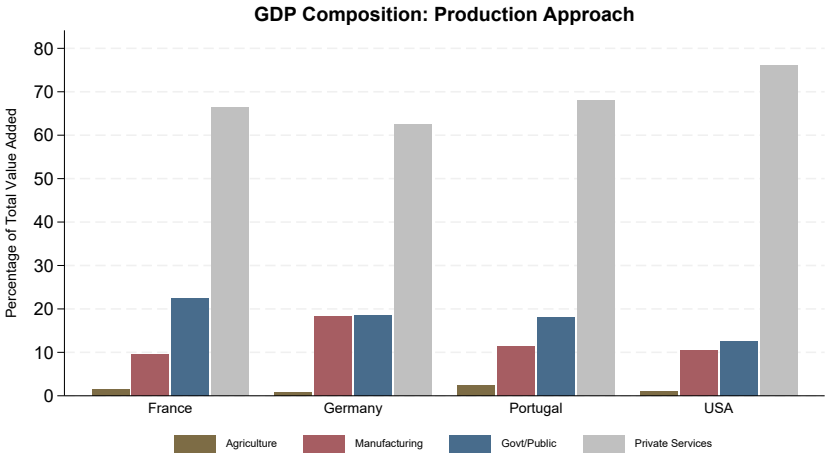
Example: Coffee Beans Production

- A firm produces coffee worth $100 this period.
- It pays $60 in wages.
- Depreciation of the machines producing the coffee: $20.

Production		Income		Expenditure	
Coffee beans output	100	Wages	60	Consumption	100
		Net profits	20		
		Depreciation	20		
Total	**100**	**Total**	**100**	**Total**	**100**

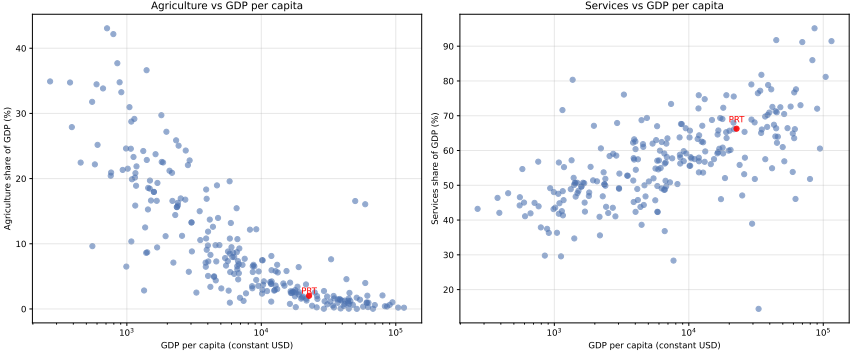
Interpretation: Production = 100 = wages + gross profits=consumption
Gross profits = net profits + depreciation = 20 + 20 = 40

GDP Composition



Sources: BEA (USA), Statistics Portugal, Eurostat (Germany, France)

GDP Composition



Source: World Bank, 2024

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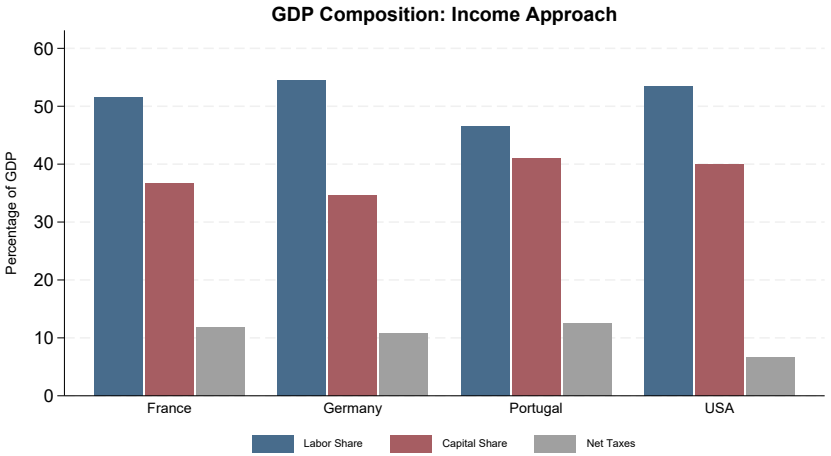

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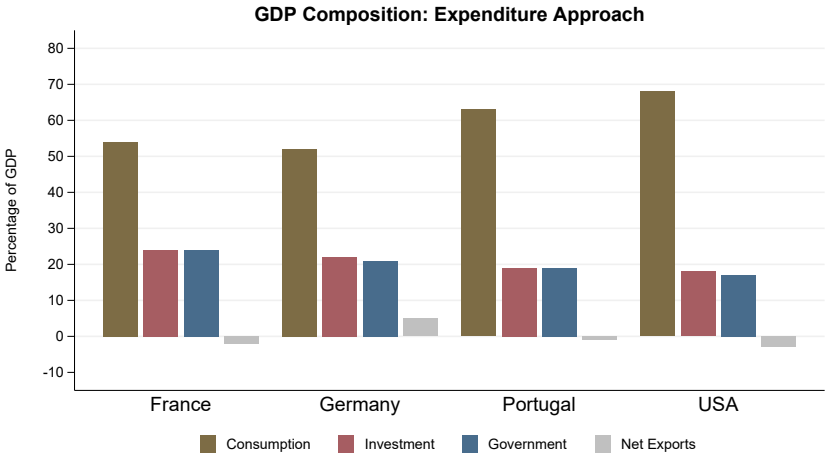

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Making Comparisons: Nominal vs. Real GDP

- We often want to compare GDP levels not just shares:
  - Across **time** (e.g., 2017 vs. 2025)
  - Across **countries** (e.g., Portugal vs. Denmark)
- But: GDP is measured in local currency (€, $, ¥...), and prices differ across space and time.
- So the same amount of money can buy **more or less stuff**.

Making Comparisons across time

The Country of Snackistan

Snackistan produces only two things: burgers and yoga classes. Between 2023 and 2024, prices doubled, but production didn't change.

2017		2018	
Burger Manufacturing (50 balls, 10 dinar each)	500	Burger Manufacturing (50 balls, 20 dinar each)	1,000
Yoga Instruction (10 classes, 100 dinar each)	1,000	Yoga Instruction (10 classes, 200 dinar each)	2,000
Total	**1,500**	**Total**	**3,000**

nominal GDP (in dinars) doubled, but Snackistan didn't cook more burgers or stretch more yoga. **Prices doubled $\rightarrow$ Real GDP stayed the same.**

The Country of Expandia

Expandia produces only two goods: wheat and computers. Prices and quantities change differently between 2017 and 2018.

2017		2018	
Agriculture (10 tons of wheat, $50 each)	500	Agriculture (11 tons of wheat, $60 each)	660
Manufacturing (1 computer, $1,000 each)	1,000	Manufacturing (2 computers, $600 each)	1,200
Total	**1,500**	**Total**	**1,860**

GDP rose from $1,500 to $1,860 — but how much more stuff did Expandia actually produce?

Making Comparisons across time

When Prices and Quantities Both Change

In the previous example:

- Wheat output rose by **10%** (10 → 11 tons)
- Computer output doubled (**+100%**)
- Prices changed differently across goods

Question: How do we measure the growth of total production when both quantities and prices move in different directions?

Hint: Use a base year to keep prices fixed!

Making Comparisons across time

Alternative 1: Measuring Real GDP with Base-Year Prices

We can measure 2018 production using 2017 prices.

2018, valued at 2017 prices	
Agriculture (11 tons of wheat, $50 each)	550
Manufacturing (2 computers, $1,000 each)	2,000
Total Real GDP (2018)	**2,550**

$$\text{Growth in real GDP} = \frac{2,550}{1,500} - 1 = 70\%$$

Expandia got richer in real terms — people have more stuff, not just higher prices.

Making Comparisons across time

Alternative 2: Measuring Real GDP with Final-Year Prices

We can also measure 2017 production using 2018 prices.

2017, valued at 2018 prices	
Agriculture (10 tons of wheat, $60 each)	600
Manufacturing (1 computer, $600 each)	600
Total Real GDP (2017)	**1,200**

$$\text{Growth in real GDP} = \frac{1,860}{1,200} - 1 = 55\%$$

Measured at 2018 prices, growth looks smaller because computer prices fell.

Making Comparisons across time

Real GDP with Chained Prices

- The base-year and current-year price methods can give very different results.
- The **chained method** combines both approaches.
- Idea:
  1. Start from a base year (say 2017).
  2. Compute growth between consecutive years twice:
     - once using initial-year prices,
     - once using final-year prices.
  3. Take an average the two growth rates.
  4. "Chain" this growth forward year by year.

$$2017 \xrightarrow{\text{avg } g_{2018}} 2018 \xrightarrow{\text{avg } g_{2019}} 2019$$

Making Comparisons across time

Real GDP with Chained Prices (Formulas)

$$g_t^I = \frac{\sum_i p_{i,t-1} q_{i,t}}{\sum_i p_{i,t-1} q_{i,t-1}} - 1 \qquad \text{(growth at initial-year prices)}$$

$$g_t^F = \frac{\sum_i p_{i,t} q_{i,t}}{\sum_i p_{i,t} q_{i,t-1}} - 1 \qquad \text{(growth at final-year prices)}$$

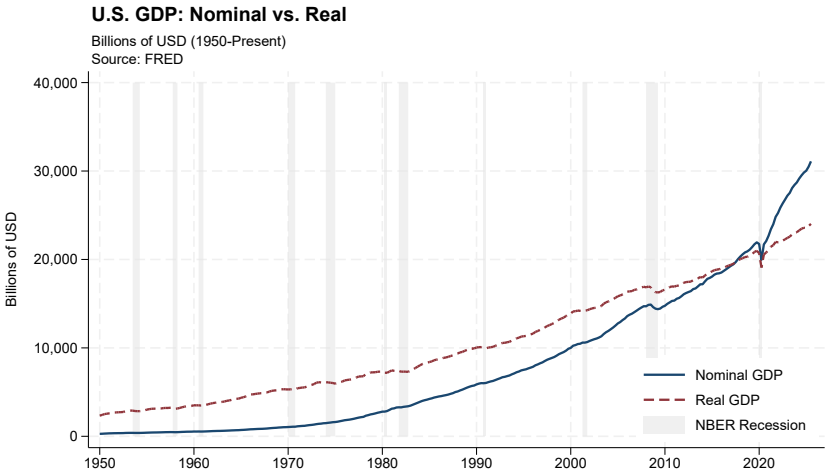
$$g_t = \sqrt{(1+g_t^I)(1+g_t^F)} - 1 \qquad \text{(geometric average growth)}$$

$$Y_t = Y_{t-1}(1+g_t) \qquad \text{(chain forward real GDP)}$$

Intuition

The geometric average ensures a balanced measure between initial and final price weighting. Chaining allows comparison across many years without fixing prices from a distant base year.

Making Comparisons across time



Comparing GDP Across Countries

- Suppose we want to compare GDP between the US and Mexico in 2018:

Country	GDP	Population	GDP per capita
United States	20.5 trillion $	327 million	62,700 $ per person
Mexico	23.5 trillion pesos	127 million	185,000 pesos per person

- Can we say Mexicans produced more output per person than U.S residents? Not yet — the currencies are different!

Using Market Exchange Rates

- One way to compare GDP is using the market exchange rate (MER):

$$\text{GDP in USD} = \text{GDP in local currency} \times \text{Exchange rate (USD/local)}$$

- For Mexico in 2018: 23.5trillion pesos $\times\ 0.051 USD/peso \simeq 1.2$trillion USD.
- Converted per capita: 1.2trillion USD $\div\ 127$million people $\simeq 9,500$USD per person.
- Problems with market rates:
  - Exchange rates fluctuate daily and may not reflect domestic prices.
  - Non-traded goods (housing, services) are cheaper in developing countries, so MER underestimates real living standards.

Takeaway

Market exchange rates give a currency-based comparison, but do not capture what people can actually buy.

Using Purchasing Power Parity (PPP)

- PPP adjusts for differences in the cost of living:

$$\text{GDP in Foreign Country at PPP} = \sum_i p_i^{\text{US}} \cdot q_i^{\text{foreign}}$$

  where p_i^{US} is the US price of good i, q_i^{foreign} is the foreign quantity.

- For Mexico, PPP-adjusted per capita GDP $\approx$ 18,000 USD, almost double the market-rate conversion.

Intuition

PPP measures what residents could actually buy if they lived in the US. Market exchange rates only tell you the currency value, not purchasing power.

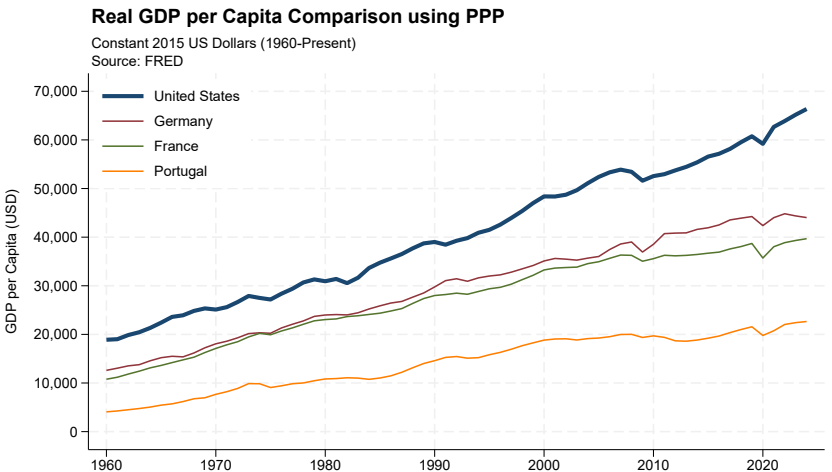
PPP Exchange Rates and the Big Mac Index

- The PPP exchange rate is the rate that makes GDP at market exchange and GDP at PPP coincide:

$$\text{PPP exchange rate} = \frac{\text{GDP in dollars at PPP}}{\text{GDP in local currency}}$$

- Fun illustration: **The Big Mac Index**.
  - Compare the price of a Big Mac in the US and abroad.
  - Example: if a Big Mac costs $5 in the US and 50 pesos in Mexico, the implied PPP exchange rate is 1 USD = 10 pesos.
  - A playful way to see which currencies are "overvalued" or "undervalued."

Comparing GDP Across Countries



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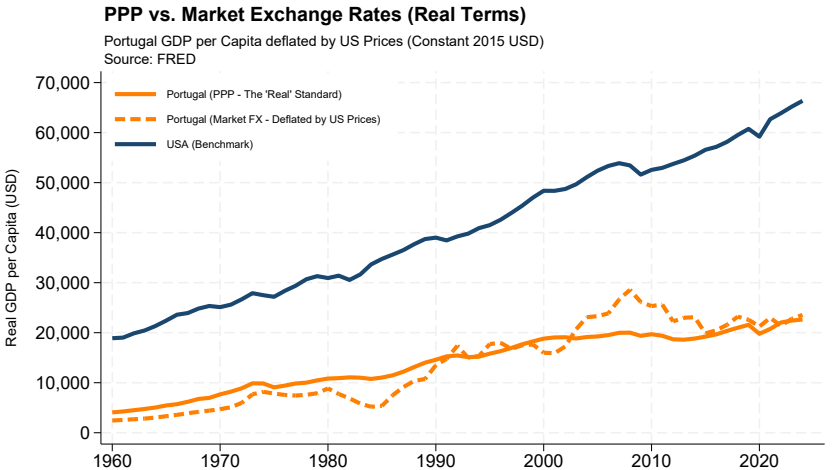


Beyond GDP — Measuring Development

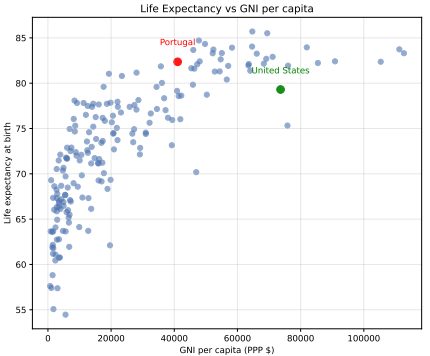
- GDP is a powerful indicator of economic activity, but it does not capture everything we care about.
- Economic **development** involves more than production and income:
  - Health and life expectancy
  - Education and literacy
  - Access to opportunities and basic services
- Now, we discuss alternative ways to measure well-being and living standards.

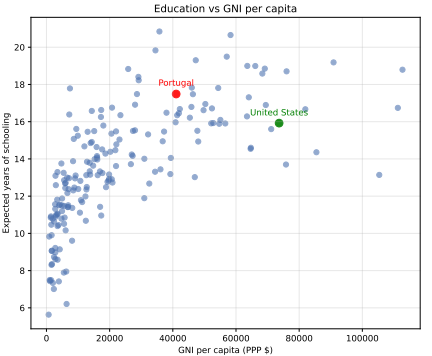
The Human Development Index (HDI)

- Created by the United Nations Development Programme (UNDP).
- Combines three key dimensions of human well-being:
  1. **Health:** measured by life expectancy at birth.
  2. **Education:** measured by average and expected years of schooling.
  3. **Income:** measured by GNI per capita (PPP adjusted).
- Each dimension is normalized between 0 and 1, and the HDI is their geometric mean:

$$\text{HDI} = \left(I_{\text{health}} \cdot I_{\text{education}} \cdot I_{\text{income}}\right)^{1/3}$$

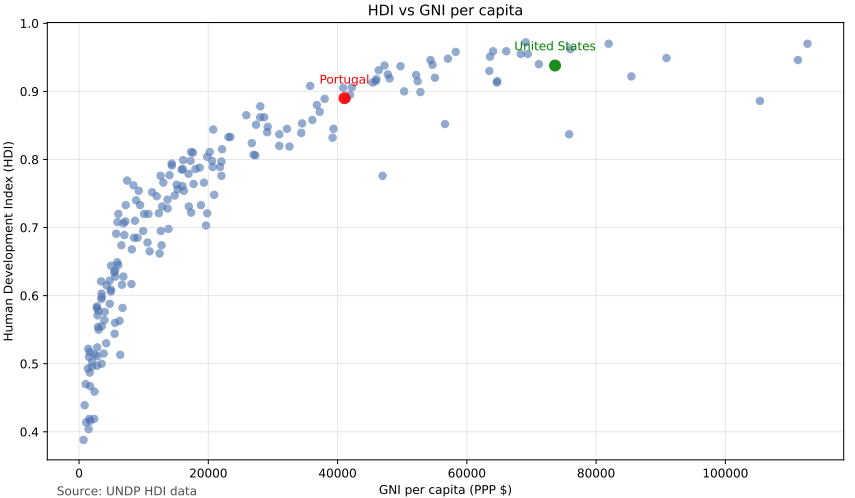
The Human Development Index (HDI)





Source: UNDP HDI data

The Human Development Index (HDI)



The Human Development Index (HDI)

- One unsatisfying aspect of the HDI is that the scaling and weighting of the various factors is arbitrary.
  - What exactly is the HDI measuring?
  - Why convert variables into indices?
  - Why equal weights on the three factors?

Beyond GDP: Jones & Klenow (2016)

- Jones & Klenow propose a **welfare measure** similar in spirit to the HDI but grounded in **utility theory**.
- They aim to include aspects of life that GDP misses, focusing on:
  - **Consumption** – what people actually enjoy, not just produce,
  - **Leisure and nonmarket production** – time spent outside work counts too,
  - **Life expectancy** – how long people live,
  - **Inequality** – differences in consumption across people.

Individual Utility in Jones & Klenow (2016)

- Each individual derives utility from:
  - **Consumption** (c): goods and services enjoyed,
  - **Leisure** (ℓ): time not spent working,
  - **Life status** (a): alive ($a = 1$) or dead ($a = 0$).
- Utility is modeled as:

$$u(c, \ell, a) = \left(\bar{u} + \frac{c^{1-\sigma}}{1-\sigma} - \theta(1-\ell)^2 \right) a$$

- Key parameters:
  - $\bar{u}$: baseline utility from being alive,
  - σ: risk aversion (how much people dislike inequality and uncertainty),
  - θ: importance of leisure.
- Being dead gives utility 0 by convention.

The Experiment: Comparing Portugal to the U.S.

- Imagine a person — let's call him **Pat the Alien** — who must choose where to live for a year:
  1. As a random resident in **Portugal**,
  2. As a random resident in the **United States**
- When choosing, Pat the Alien does not know which individual they will be:
  - a banker in Chiado or a waiter in Alfama,
  - a surfer in Ericeira or a stressed consultant in Lisbon,
  - alive or dead.
- In other words, Pat chooses under **uncertainty**.
- We need a way to quantify which country would be preferred: expected utility.

Expected Utility Across Individuals

- Pat the Alien knows the possible outcomes in each country (consumption, leisure, life expectancy) but not which one he will experience.
- Examples:
  - Ana or João in Portugal,
  - Mike or Diane in the U.S.
- Pat will prefer the country that gives the **highest expected utility**:

$$U = \mathbb{E}\Big[(\bar{u} + \frac{c^{1-\sigma}}{1-\sigma} - \theta(1-\ell)^2)a\Big] = \frac{1}{N}\sum_{i=1}^{N}(\bar{u} + \frac{c_i^{1-\sigma}}{1-\sigma} - \theta(1-\ell_i)^2)a_i$$

- This is a simple application of **expected utility theory**: uncertain outcomes are evaluated by weighting each possible utility by its probability.

The Role of Risk Aversion (σ) in Utility

- In expected utility theory, people's attitudes toward risk are captured by the **concavity of the utility function**.
- We use concavity in models to capture the idea that **most people dislike uncertainty** and therefore Pat the alien would prefer countries with lower inequality.
- Mathematically, holding leisure (ℓ) and life status (a) constant, utility is a function of consumption c:

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}$$

Pat the Alien and Risky Choices

- Suppose there are two people in Portugal: one rich (c_{rich}) and one poor (c_{poor}).
- Pat the Alien could end up in either situation with probability $1/2$.
- Pat is **risk averse** if he prefers a the average consumption over facing uncertainty:

$$u\left(\frac{c_{\text{rich}} + c_{\text{poor}}}{2}\right) > \frac{u(c_{\text{rich}}) + u(c_{\text{poor}})}{2}$$

Concavity and Marginal Utility

- The concavity of the utility function is controlled by σ:
  - High $\sigma \longrightarrow$ very concave: Pat strongly dislikes inequality and risk.
  - Low $\sigma \longrightarrow$ almost linear: Pat is less sensitive to differences across states.

How Do We Choose σ in Practice?

- People have different attitudes towards risk $\rightarrow$ we pick σ to represent an average individual: Pat.
- Empirical methods:
  - Investment choices: how much risk vs. average return are people willing to bear?
  - Insurance decisions: willingness to pay for smoothing consumption across uncertain states.
- Estimates range from $\sigma \approx 1$ (mildly risk averse) to $\sigma \approx 10$ (very risk averse).
- When choosing where Pat want to live, σ determines how much Pat cares about inequality:
  - High $\sigma \rightarrow$ unequal country looks risky: egalitarian countries become more attractive to Pat
  - Low $\sigma \rightarrow$ countries with higher expected income are more attractive

The Value of Life Expectancy ($\bar{u}$)

- Pat the Alien does not know is he will be dead or alive.
- Suppose Pat's age is randomly drawn from 0 to 100:
  - If his age exceeds life expectancy in the country, he is dead $\longrightarrow$ utility = 0
  - If he is alive $\longrightarrow$ utility = $\bar{u} + \frac{c^{1-\sigma}}{1-\sigma} - \theta(1-\ell)^2$
- Everyone alive gets the baseline utility $\bar{u}$ in addition to consumption and leisure utility.

The Value of Leisure and Non-Market Production (θ)

- People can spend their time in different ways:
  - Market work $\rightarrow$ counted in GDP
  - Non-market activities $\rightarrow$ not counted in GDP (cleaning, cooking, childcare)
  - Pure leisure $\rightarrow$ reading, watching TV, surfing, etc.
- In our utility function, ℓ is the fraction of time spent on non-market and leisure activities.
- The parameter θ captures how much people value non-market activities (or dislike market work).
- How can we measure θ?
  - Look at trade-offs people make between consumption and free time
  - Use choices like labor force participation, retirement age, weekly work hours, holidays
  - Higher $\theta \rightarrow$ people work less, enjoy more leisure and non-market activities
- By matching observed time allocation between market and non-market activities, we can estimate θ.

Comparing Living Standards Across Countries: Intuition

- We want a metric that tells us **how much better or worse life is in Portugal vs. the U.S.** in an intuitive way.
- Expected utility is great for theory, but utiles are abstract. Students, policymakers, and citizens care about consumption, leisure, and life expectancy in **familiar units**.
- Enter λ^{PT}: a **consumption scaling factor** for the U.S. that makes a random resident just as happy as in Portugal:

$$\frac{1}{N}\sum_{i=1}^{n} u(\lambda^{PT} c_i^{US}, \ell_i^{US}, a_i^{US}) = U^{PT}$$

- Intuition:
  - $\lambda^{PT} > 1$: You need more U.S. consumption to match Portugal $\longrightarrow$ Portugal is "better" in welfare terms.
  - $\lambda^{PT} < 1$: Portuguese residents need more consumption to match the U.S. $\longrightarrow$ U.S. is "better".

Comparing Living Standards Across Countries: Computation

- Step 1: Compute the expected utility in Portugal:

$$U^{PT} = \frac{1}{N}\sum_{i=1}^{N} u(c_i^{PT}, \ell_i^{PT}, a_i^{PT})$$

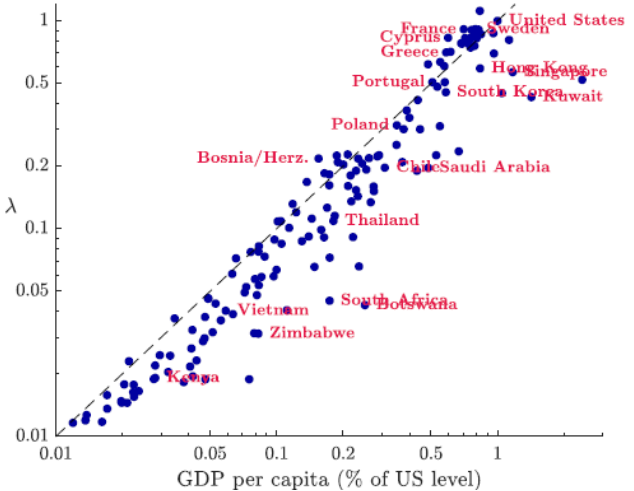
- Step 2: Solve for λ^{PT} in:

$$U^{PT} = \frac{1}{N}\sum_{i=1}^{N} u(\lambda^{PT} c_i^{US}, \ell_i^{US}, a_i^{US})$$

- Step 3: Interpret λ:
  - $\lambda^{PT} = 1.2 \rightarrow$ Portugal provides the same welfare as the U.S. with 20% higher consumption.
  - $\lambda^{PT} = 0.9 \rightarrow$ Portugal provides the same welfare as the U.S. with 10% lower consumption.

- Example: Suppose the expected utility in Portugal is 10.5 utiles and in the U.S. it is 11 utiles. Solving for λ^{PT} gives $\lambda = 0.95 \rightarrow$ Portugal is slightly worse off in equivalent U.S. consumption terms.

Results: Welfare (λ) vs. GDP per Capita



Relative GDP and welfare. Source: Jones and Klenow (2016).

HDI vs. Jones & Klenow (2016)

- **HDI:**
  - Simple composite index of life expectancy, education, and income
  - Assumptions are mostly implicit or not clearly listed
  - No clear rationale for how components are weighted
  - Provides a single number, but it is hard to know what it really means or how it was constructed
- **Jones & Klenow (2016):**
  - Grounded in utility theory—parameters explicitly defined
  - Incorporates consumption, leisure, life expectancy, and inequality
  - Assumptions are explicit: if you disagree, you can modify the model
  - Provides a number (λ) that is interpretable and based on the model structure

Takeaways for Economic Research

- Models are simplifications of reality, just like a map is a simplification of geography
- Explicit assumptions make progress possible:
  - We know what drives results
  - We can test alternative assumptions
  - We can propose improvements and extensions
- If you see a missing feature in current research:
  - Try writing a model that incorporates it
  - Analyze whether it makes a difference
  - This is the essence of research in economics: theory + data + clear assumptions