

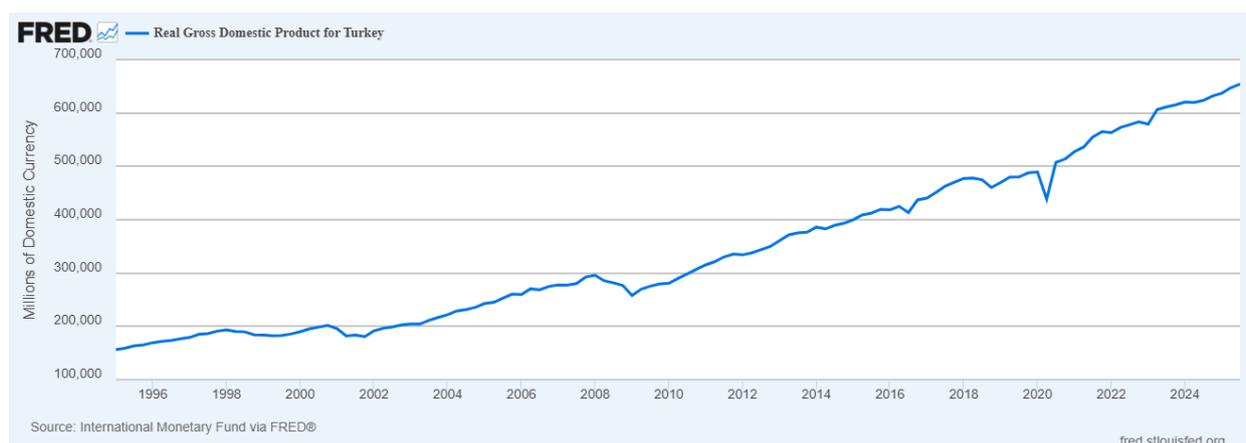
ECON 102 Complementary Notes

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This note gives beginner macro students a concise guide to how GDP and inflation are calculated at their level; step by step, with numeric examples. You'll also find practice questions at the end to test what you've learned and lock it in.

1 GDP and GDP calculation

Gross Domestic Product (GDP) is defined as the aggregate monetary value of all final goods and services produced within a specified economic region over a given time interval. We care about this object to monitor the state of the economy: whether we need stimulation for recessionary conditions. If yes, how much should policymakers stimulate? See how different the recessions in 2008 and 2020 are.



For instance, in the third quarter of 2025, the total value of goods and services produced in Türkiye amounted to 17.4 trillion lira. This figure represents a 41.6% increase relative to the third quarter of 2024. At this point, it is appropriate to pause and examine the plausibility of such a change. Is it reasonable to infer that real production increased by more than 40% over the course of a single year?

When we measure total production, we can only add up goods and services in terms of their monetary value. But money doesn't hold steady over time—its value slips. That slide is called inflation. Inflation means the same amount of money buys fewer goods and services than before. If you live in Turkey—whether you're a citizen or just an expat who's been here a year—you've almost certainly felt it: prices jump fast, and the cash in your pocket seems to shrink in real value day by day.

Imagine the following situation. I produced 5,000 pens for 100 lira each in a year. Next year, I again produced 5,000 pens, but this time, the price increased to 150 lira. My contribution to Turkish GDP went up from 500,000 lira to 750,000 lira. But did my production go up by 50%? No, right? It's only the prices that increased by 50%. So, when we calculate GDP, we want to get rid of these price effects. That's where "Real GDP" comes in.

We can define real GDP as the total monetary value, **at constant prices**, of final goods and services produced in a given region within a given period. We take the prices as constant across different periods to eliminate price effects.

1.1 An example

Consider a tiny economy that produces three *final* items: Coffee (a good), Haircuts (a service), and Education (a service). We observe quantities (Q) and prices (P) in two years:

Item	Year 1		Year 2	
	Q_1	P_1	Q_2	P_2
Coffee	100	2	120	3
Haircuts	50	8	60	10
Education	20	20	24	25

Nominal GDP (current prices) Nominal GDP uses *this year's* prices:

$$GDP_1^N = (100 \cdot 2) + (50 \cdot 8) + (20 \cdot 20) = 200 + 400 + 400 = 1000$$

$$GDP_2^N = (120 \cdot 3) + (60 \cdot 10) + (24 \cdot 25) = 360 + 600 + 600 = 1560$$

Nominal GDP growth:

$$\frac{1560 - 1000}{1000} = 56\%$$

If you stop here, it *looks* like "the economy grew by 56%." But prices also changed, so this mixes **more items** with **more expensive items**.

Real GDP (constant prices, base year = Year 1) Real GDP holds prices fixed at the base year (Year 1 prices) and only lets quantities change.

$$GDP_1^R = 1000 \quad GDP_2^R = (120 \cdot 2) + (60 \cdot 8) + (24 \cdot 20) = 240 + 480 + 480 = 1200$$

Real GDP growth:

$$\frac{1200 - 1000}{1000} = 20\%$$

So: **56% nominal growth** vs. **20% real growth**. The gap is basically: “prices did a lot of the work.” Remember that one of the main targets of the economic policy is “*stable prices*.” Therefore, we also care about how much the change in the price level is.

2 Inflation and inflation calculation

Inflation literally means expansion. Think of inflating a balloon. Search for “cosmic inflation” and you’ll see it described as a theory of exponential expansion of space. The whole cosmos has been stretching ever since, like a balloon being blown up—at least, that’s the story according to modern cosmology.

In our context, inflation is the change in the overall **price level**. Not every price moves the same way (coffee can jump while education barely moves), so we build a single summary number using a **basket**.

2.1 Step 1: Build the consumption basket (base year = Year 1)

The idea: “What did households buy in Year 1?” Use those base-year spending shares as weights.

Year 1 spending by item:

$$\text{Coffee: } 100 \cdot 2 = 200$$

$$\text{Haircuts: } 50 \cdot 8 = 400$$

$$\text{Education: } 20 \cdot 20 = 400$$

Total Year 1 spending:

$$200 + 400 + 400 = 1000$$

So, the **consumption basket** is:

$$w_{\text{coffee}} = \frac{200}{1000} = 0.2, \quad w_{\text{haircuts}} = \frac{400}{1000} = 0.4, \quad w_{\text{education}} = \frac{400}{1000} = 0.4$$

They sum to 1 (as they should): $0.2 + 0.4 + 0.4 = 1$.

Consumer Price Index (CPI)

To measure inflation, economists construct a **Consumer Price Index (CPI)**. The CPI tracks how the cost of a fixed consumption basket changes over time.

Formally, the CPI in year t is defined as:

$$\text{CPI}_t = \frac{\text{Cost of the base-year consumption basket at year } t \text{ prices}}{\text{Cost of the base-year consumption basket at base-year prices}} \times 100$$

Why do we set the base year CPI equal to 100? The CPI is an *index*, not a price measured in lira, dollars, or euros. By convention, we choose one year as the **base year** and normalize its CPI to 100:

$$\text{CPI}_{\text{base year}} = 100$$

This normalization serves three purposes: (1) It gives the index a clear reference point. (2) It makes inflation rates easy to interpret. (3) It avoids units, so we only focus on percentage changes.

For example, if $\text{CPI}_2 = 130$, this means that:

The same basket of goods and services that cost 100 units in the base year now costs 130 units.

In other words, the overall price level has increased by 30% relative to the base year.

Key intuition Setting the base year CPI to 100 does *not* mean prices were “100 lira.” It simply defines a benchmark. All other CPI values are interpreted relative to this benchmark.

Once the CPI is constructed, inflation between two years is calculated as:

$$\pi_t = \frac{\text{CPI}_t - \text{CPI}_{t-1}}{\text{CPI}_{t-1}}$$

This gives the percentage change in the overall price level from one year to the next.

2.2 Step 2: Compute CPI (cost of the same basket over time)

We keep the basket quantities fixed at Year 1 quantities (Q_1), and ask: *How much would the Year 1 basket cost at Year 2 prices?*

Cost of the Year 1 basket at Year 1 prices:

$$\text{Cost}_1 = (100 \cdot 2) + (50 \cdot 8) + (20 \cdot 20) = 1000$$

Cost of the *same* basket at Year 2 prices:

$$\text{Cost}_2 = (100 \cdot 3) + (50 \cdot 10) + (20 \cdot 25) = 300 + 500 + 500 = 1300$$

Define CPI with Year 1 as 100:

$$\text{CPI}_1 = 100, \quad \text{CPI}_2 = \frac{1300}{1000} \cdot 100 = 130$$

So, inflation from Year 1 to Year 2 is:

$$\pi = \frac{130 - 100}{100} = 30\%$$

Interpretation: “The typical Year 1 shopping cart became 30% more expensive in Year 2.”

2.3 Why do we hold quantities or prices constant?

At this point, notice something important. When we calculate **real GDP**, we deliberately hold *prices constant*. We do this to answer a very specific question:

“How much more did the economy produce?”

By fixing prices at the base year level, any change in real GDP comes *only* from changes in quantities. This allows us to talk about economic growth without being confused by inflation.

When we calculate **inflation**, we also hold something constant — but not prices. Instead, we hold the *consumption basket* constant. Here the question is different:

“How much more expensive did the same basket of goods and services become?”

By fixing quantities and letting prices change, we isolate movements in the overall price level.

So the logic is symmetric:

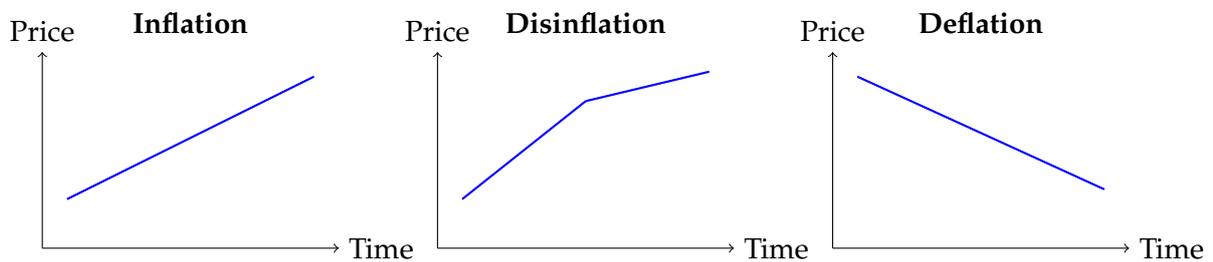
- For **GDP**, we hold prices fixed to measure **changes in production**.
- For **inflation**, we hold quantities fixed to measure **changes in prices**.

2.4 Inflation, Disinflation, and Deflation: A Summary

- **Inflation:** Prices are increasing over time. The cost of the same consumption basket goes up.
- **Disinflation:** Prices are still increasing, but *more slowly*. Inflation is positive, but declining.
- **Deflation:** Prices are decreasing over time. The same basket becomes cheaper.

The key object is the **price level** (for example, CPI). What matters is whether the price level is going *up*, *up more slowly*, or *down*.

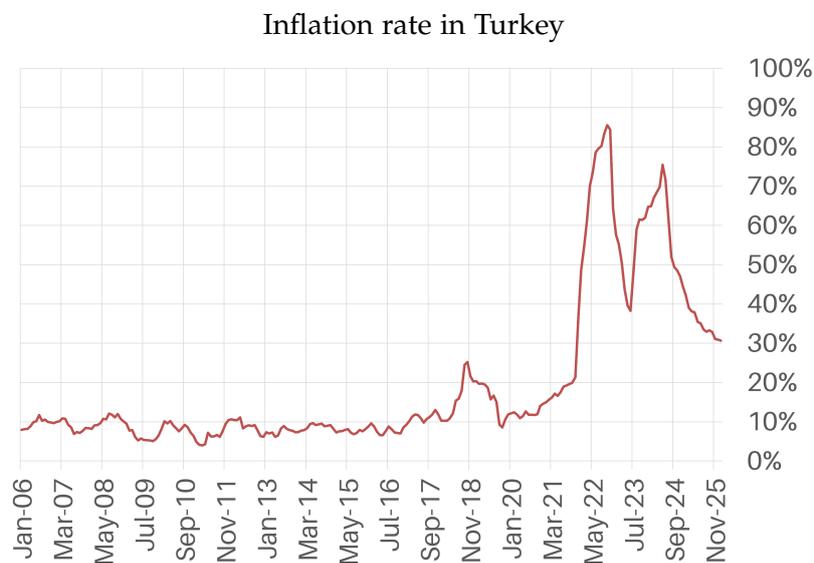
Visual intuition



What students often confuse (important!)

- Disinflation is *not* deflation.
- Lower inflation does *not* mean lower prices.
- Prices can be rising even when inflation is falling.

What is currently happening in Turkey?



3 Exercise questions

Exercise 1: One good, two years (warm-up)

An economy produces only one final good: *Potato*.

	Year 1	Year 2
Q	100	120
P	5	6

1. Calculate nominal GDP in each year.
2. Calculate real GDP in Year 2 using Year 1 as the base year.
3. Calculate nominal GDP growth.
4. Calculate real GDP growth.
5. Explain in one sentence why nominal and real GDP growth differ.

Exercise 2: One good, three years (changing base year)

The same economy has now been producing potatoes for three years:

	Year 1	Year 2	Year 3
Q	100	120	130
P	5	6	8

1. Calculate nominal GDP in all three years.
2. Calculate real GDP in all three years using Year 1 as the base year.
3. Recalculate real GDP using Year 2 as the base year.
4. Does the *growth rate* of real GDP depend on the choice of the base year?
5. Why do we still need to pick a base year?

Exercise 3: Two goods, two years

Now the economy produces two final goods: *Coffee* and *Haircuts*.

	Year 1		Year 2	
Item	Q_1	P_1	Q_2	P_2
Coffee	100	2	120	3
Haircuts	50	8	60	10

1. Calculate nominal GDP in each year.
2. Calculate real GDP in Year 2 using Year 1 as the base year.
3. Compute nominal and real GDP growth.
4. Which good contributes more to real GDP growth? Explain briefly.

Exercise 4: Two goods, three years (inflation vs. production)

	Year 1		Year 2		Year 3	
Item	Q	P	Q	P	Q	P
Coffee	100	2	110	3	120	4
Haircuts	50	10	55	12	60	15

1. Calculate nominal GDP in all three years.
2. Calculate real GDP using Year 1 as the base year.
3. Calculate real GDP growth from Year 1 to Year 2, and from Year 2 to Year 3.
4. In which period does inflation seem more important than quantity growth?

Exercise 5: Inflation with a fixed basket

Using the data from Exercise 4, take Year 1 as the base year.

1. Compute Year 1 expenditure shares for Coffee and Haircuts.
2. Using Year 1 quantities as the basket, compute the cost of the basket in Years 1, 2, and 3.
3. Construct a price index with Year 1 = 100.
4. Calculate inflation between Year 1–2 and Year 2–3.
5. Compare inflation across the two periods. In which year do prices rise faster?

Exercise 6: Three goods, three years (full problem)

An economy produces one good and two services: *Bread*, *Transport*, and *Education*.

Item	Year 1		Year 2		Year 3	
	Q	P	Q	P	Q	P
Bread	200	2	220	3	240	4
Transport	100	5	110	6	120	8
Education	20	20	22	22	24	25

1. Calculate nominal GDP in all three years.
2. Calculate real GDP using Year 1 as the base year.
3. Compute real GDP growth for each year.
4. Construct the consumption basket using Year 1.
5. Calculate inflation between Year 1–2 and Year 2–3.
6. Can nominal GDP growth be high when real GDP growth is low? Use your numbers to explain.