Elements of Macroeconomics Spring 2024

Week 4

6 Working with Growth rates

6.1 Calculating Growth rates

Growth rates are percentage changes of variables over time:

$$\text{Growth Rate in \%} = \frac{X_t - X_{t-1}}{X_{t-1}} * 100$$

For instance, GDP in Q4 2022 was 26,132.458 Billion US$ while in Q3 2022 it was 25,723.941 (https://fred.stlouisfed.org/series/GDP). To calculate the growth rate, we use:

$$\text{Growth Rate in \%} = \frac{26,132.458 - 25,723.941}{25,723.941} * 100 = 1.588\%$$

6.2 Annualizing growth rates

We often have monthly or quarterly growth rates. How do we **annualize** them, eg convert into a yearly growth rate? We multiply them multiple times:

$$\text{Annualized Growth Rate in \%} = \left((\frac{X_t}{X_{t-1}})^{q/n} - 1 \right) * 100$$

where:

- q: number of periods that fit in a year, i.e., 12 periods for monthly
- n: number of periods covered in the calculation

Example 1: quarterly inflation is 0.5%. What is annualized inflation? For this we multiply (1 + 0.5%) with itself as often as there are quarters in a year and subtract 1.

$$(1 + 0.5\%) * (1 + 0.5\%) * (1 + 0.5\%) * (1 + 0.5\%) - 1 = (1 + 0.5\%)^4 - 1 = 2.015\%$$

Example 2: Similarly, when we have data for longer than a year. Eg GDP growth between 5 quarters was 3.5%. What is the annualized growth rate? Again, we multiply (1 + 3.5%) with itself as often as there are 5 quarters in a year (4/5).

$$(1 + 3.5\%)^{4/5} - 1 = 2.79\%$$

7 National Accounting

7.1 Gross National Product, National Income, Personal Income, Disposable Income

Sometimes it is useful to apply other concepts other than GDP as well.

Gross NATIONAL Product While GDP looked at **domestic** production, eg within the country's borders, GNP looks at **national** production, eg production from the country's residents and firms!

For instance, if GM (a US company) produces cars in Mexico, the production counts as GDP of Mexico and GNP of the US.

National Income For GDP we said it is *gross* and we do not care about depreciation. For national income we do!

$$\text{National Income} = \text{GDP - Depreciation of Capital}$$

Personal Income Personal income can be seen as **gross** income of households. It covers all gross payments the households receive, eg all gross wages, dividends, transfer payments. In practice, we use

$$\text{Personal Income} = \text{National Income - Corporation savings + government transfers and bonds interests}$$

Disposable Personal Income Disposable personal income is the amount households can actually spend or save. For this, we subtract taxes from personal income.

$$\text{Disposable Personal Income} = \text{Personal Income - Taxes}$$

Question 1 (textbook 3.4)

Suppose the information in the following table is for a simple economy that produces only four goods and services: shoes, hamburgers, shirts, and cotton. Assume that all the cotton is used in the production of shirts.

	2009		2018		2019	
Product	Quantity	Price	Quantity	Price	Quantity	Price
Shoes	90	$50.00	100	$60.00	100	$65.00
Hamburgers	75	2.00	100	2.00	120	2.25
Shirts	50	30.00	50	25.00	65	25.00
Cotton	100	0.80	800	0.60	120	0.70

a. Use the information in the table to calculate real GDP for 2018 and 2019, assuming that the base year is 2009.

b. What is the growth rate of real GDP during 2019?

c. What is the annualized growth rate from 2009 to 2018?

8 Inflation

Inflation rate is the percentage change in the price level.

The Consumer Price Index (CPI)

- The CPI is a weighted average of a basket of goods using current prices!
- The CPI market basket illustrates the consumption basket of an urban family of four.

Note: Comparison Inflation, nominal and real GDP

- **CPI**: *fixed* basket to *current* prices
- **nominal GDP**: *current* final goods/services to *current* prices
- **real GDP**: *current* final goods/services to *fixed* prices

		Jan-20		Jul-20	
Product	CPI weight	Quantity	Price	Quantity	Price
Pizza	20	30	10	35	8
Cars	40	50	200	55	205
Bread	30	20	5	25	6
Beer (Imports)	10	10	7	50	14

Example Calculate nominal GDP, real GDP, annual growth rates for nominal and real GDP, GDP deflator, CPI, Inflation rate. Compare and explain the differences in GDP deflator and Inflation rate.

9 Labor Market

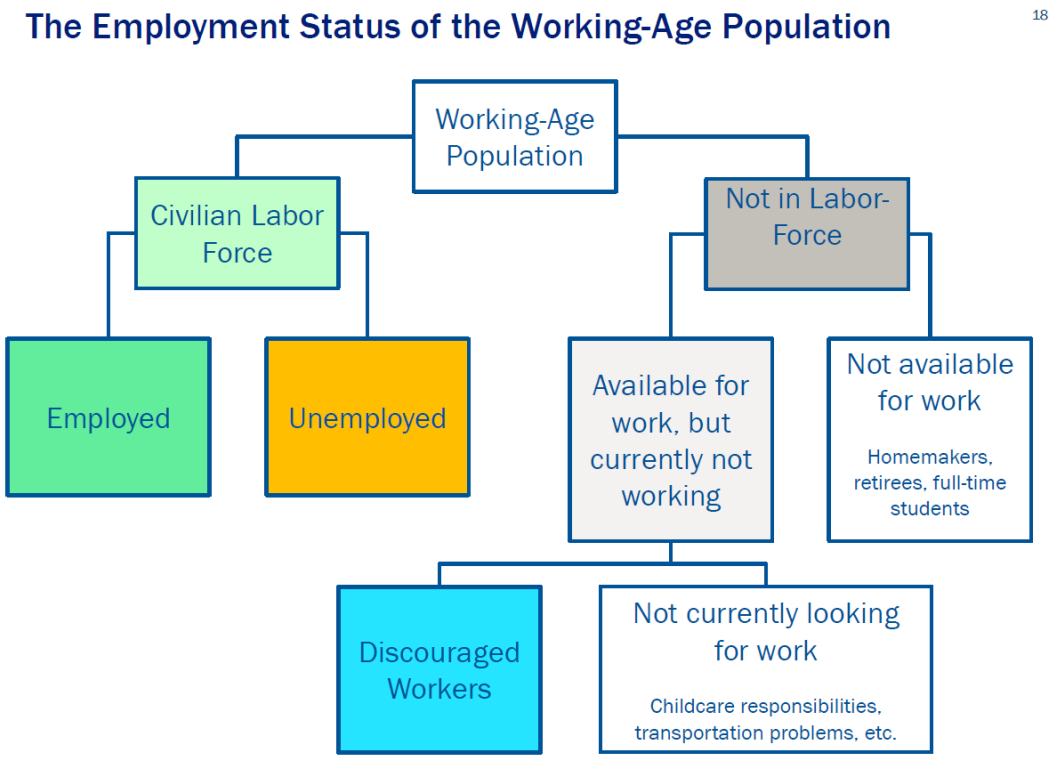
Review concepts:

- **Working Age Population**: Every US citizen above 16
- **Employed**: Worked 1+ hours in reference week (or were temporarily away from job)
- **Unemployed**: If not currently at work but available for work and has actively looked for work during past four (4) weeks
- **Civilian Labor Force**: Employed + Unemployed
- **Discouraged Workers/Marginally Attached**: Not actively looking for jobs, but would have time
- **Unemployment Rate U3**

$$\text{Unemployment Rate U3} = \frac{\text{Number of Unemployed}}{\text{Number Labor Force}}$$

- **Unemployment Rate U6**

$$\text{Unemployment Rate U6} = \frac{\text{Number of Unemployed + Marginally attached + involuntary part-time}}{\text{Number Labor Force}}$$



	2025 (In Millions)	2030 (In Millions)
Total Population	**120**	**140**
Working-age population	**110**	**130**
Number of adults neither working, nor looking for work	**10**	
Number of adults employed	**80**	
Number of adults unemployed		**25**

Question

- How many individuals are unemployed in 2025?
- What is the labor force participation rate in 2025?
- What is the unemployment rate in 2025?
- Assume the unemployment rate remains constant from 2025 to 2030. How many individuals are employed in 2030?
- How many adults are neither working nor looking for work in 2030?

Solutions

9.1 National Accounting Exercise 1

a)

$$GDP^{2018} = \sum_i q_i^{2018} * p_i^{2009} = 100 * \$50 + 100 * \$2 + 50 * \$30 = \$6700$$
$$GDP^{2019} = \sum_i q_i^{2019} * p_i^{2009} = 100 * \$50 + 120 * \$2 + 65 * \$30 = \$7190$$

b)

$$\begin{aligned}\text{Growth Rate in \%} &= \frac{X_t - X_{t-1}}{X_{t-1}} * 100 \\ &= \frac{\$6700 - \$7190}{\$7190} * 100 = 7.313\%\end{aligned}$$

c)

$$GDP^{2009} = \sum_i q_i^{2009} * p_i^{2009} = 90 * \$50 + 75 * \$2 + 50 * \$30 = \$6150$$
$$\text{Annualized Growth Rate in \%} = \Big((\frac{X_t}{X_{t-1}})^{q/n} - 1\Big) * 100 = \Big((\frac{\$6750}{\$6150})^{1/9} - 1\Big) * 100 = 0.956\%$$

9.2 Inflation Example

GDP:

$$\text{nom GDP}^{Jan} = \sum_i q_i^{Jan} * p_i^{Jan} = 30 * \$10 + 50 * \$200 + 20 * \$5 = \$10400$$
$$\text{nom GDP}^{Jul} = \sum_i q_i^{Jul} * p_i^{Jul} = 35 * \$8 + 55 * \$205 + 25 * \$6 = \$11705$$
$$\text{real GDP}^{Jan} = \text{nom GDP}^{Jan} = \$10400$$
$$\text{real GDP}^{Jul} = \sum_i q_i^{Jul} * p_i^{Jan} = 35 * \$10 + 55 * \$200 + 25 * \$5 = \$11475$$
$$\text{nominal GDP Growth Rate in \%} = \frac{X_t - X_{t-1}}{X_{t-1}} * 100 = \frac{\$11705 - \$10400}{\$10400} * 100 = 12.55\%$$
$$\begin{aligned}\text{Annualized nominal GDP Growth Rate in \%} &= \Big((\frac{X_t}{X_{t-1}})^{q/n} - 1\Big) * 100 \\ &= \Big((\frac{\$11705}{\$10400})^{2/1} - 1\Big) * 100 = 26.67\%\end{aligned}$$
$$\begin{aligned}\text{Annualized real GDP Growth Rate in \%} &= \Big((\frac{X_t}{X_{t-1}})^{q/n} - 1\Big) * 100 \\ &= \Big((\frac{\$11475}{\$10400})^{2/1} - 1\Big) * 100 = 21.74\%\end{aligned}$$
$$\text{GDP Deflator}^{Jan} = \frac{\text{nom GDP}}{\text{real GDP}} * 100 = \frac{\$10400}{\$10400} * 100 = 1$$
$$\text{GDP Deflator}^{Jul} = \frac{\text{nom GDP}}{\text{real GDP}} * 100 = \frac{\$11705}{\$11475} * 100 = 0.98$$

Inflation

$$\text{CPI}^{Jan} = \sum_i \text{weight}_i * p_i^{Jan} = 0.2 * \$10 + 0.4 * \$200 + 0.3 * \$5 + 0.1 * \$14 = \$84.2$$

$$\text{CPI}^{Jul} = \sum_i \text{weight}_i * p_i^{Jul} = 0.2 * \$8 + 0.4 * \$205 + 0.3 * \$6 + 0.1 * \$14 = \$86.8$$

$$\text{Inflation} = \frac{\text{CPI}^{Jul} - \text{CPI}^{Jan}}{\text{CPI}^{Jan}} = 3.09\%$$

9.3 Labor Market Exercise

Define:

- UE = Unemployed
- Emp = Employed
- WAP = Working age Population
- NWNL = Neither working nor looking
- LFPR = Labor Force Participation Rate

a)

$$UE = WAP - NWNL = 100 - 10 - 80 = 20$$

b)

$$LFRP = \frac{LF}{WAP} = \frac{80 + 20}{110} = 90.9\%$$

c)

$$\text{UE rate} = \frac{UE}{LF} = \frac{20}{100} = 20\%$$

d)

$$\text{UE rate} = \frac{25}{LF} = 20\% \implies LF = 125$$
$$LF = 125 = 25 + EMP \implies EMP = 100$$

e)

$$WAP = NWNL + UE + EMP$$
$$130 = NWNL + 100 + 25 \implies NWNL = 5$$