Lecture 2: Comparing GDP over Time

21 January 2020

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GDP across Time

- Economic History:
  - When was the United States most prosperous? (highest GDP)
  - How do changes in GDP over time correlate with other events?
- Have to be careful when we compare GDP across time
- Prices change (inflation)
- Need to “deflate” GDP to make them into comparable units (e.g., 2005 US dollars)
Prices

- Prices change a lot over time
- More subtle issues:
  - Not buying the same things at all times
Real versus Nominal GDP

- **Inflation** is the reduction in the purchasing power of the currency over time.
- Inflation can distort economic variables like GDP, so we have two versions of GDP: One is corrected for inflation, the other is not.
  - **Nominal GDP** values output using current prices. It is not corrected for inflation.
  - **Real GDP** values output using the prices of a *base year*. Real GDP is corrected for inflation.
The GDP Deflator

- The GDP deflator is a measure of the overall level of prices.

- Definition:

  \[
  \text{GDP deflator} = 100 \times \frac{\text{nominal GDP}}{\text{real GDP}}
  \]

- One way to measure the economy’s inflation rate is to compute the percentage increase in the GDP deflator from one year to the next.
### Computing GDP

<table>
<thead>
<tr>
<th></th>
<th>2007 (base yr)</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$P$</td>
<td>$Q$</td>
<td>$P$</td>
</tr>
<tr>
<td>Good A</td>
<td>$30$</td>
<td>900</td>
<td>$31$</td>
</tr>
<tr>
<td>Good B</td>
<td>$100$</td>
<td>192</td>
<td>$102$</td>
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</tbody>
</table>

Use the above data to solve these problems:

A. Compute nominal GDP in 2007.
B. Compute real GDP in 2008.
C. Compute the GDP deflator in 2009.
A. Compute nominal GDP in 2007.

$30 \times 900 + $100 \times 192 = $46,200

B. Compute real GDP in 2008.

$30 \times 1000 + $100 \times 200 = $50,000
## Compute the GDP deflator in 2009.

Nom GDP = $36 \times 1050 + $100 \times 205 = \text{58,300}

Real GDP = $30 \times 1050 + $100 \times 205 = \text{52,000}

GDP deflator = 100 \times \frac{\text{Nom GDP}}{\text{Real GDP}} = 100 \times \frac{\text{58,300}}{\text{52,000}} = 112.1
### Computing GDP

<table>
<thead>
<tr>
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<th>2012 (base yr)</th>
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<td>Good A</td>
<td>$50$</td>
<td>20</td>
<td>$60$</td>
<td>20</td>
<td>$80$</td>
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<tr>
<td>Good B</td>
<td>$100$</td>
<td>6</td>
<td>$100$</td>
<td>8</td>
<td>$90$</td>
</tr>
<tr>
<td>Good C</td>
<td>$80$</td>
<td>5</td>
<td>$75$</td>
<td>6</td>
<td>$100$</td>
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Use the above data to solve these problems:

A. Compute real GDP in 2012.
B. Compute real GDP in 2013.
C. Compute the GDP deflator in 2014.
### Computing GDP

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**A.** Compute real GDP in 2012.

\[ \$50 \times 20 + \$100 \times 6 + \$80 \times 5 = \$2000 \]

**B.** Compute real GDP in 2013.

\[ \$50 \times 20 + \$100 \times 8 + \$80 \times 6 = \$2280 \]
## Computing GDP

### 2012 (base yr) 2013 2014

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### C. Compute GDP deflator in 2014

Nominal: $80 \times 24 + 90 \times 10 + 86 \times 5 = 3250$

Real: $50 \times 24 + 100 \times 10 + 80 \times 5 = 2600$

GDP Deflator = 100 x Nominal / Real = 125
The Consumer Price Index (CPI)

- GDP Deflator includes the effect of investment goods, imports, exports and so on...
- Not closely tied to the prices that consumers face
- Use the Consumer Price Index
  - A measure of how much it costs to maintain your standard of living
How the CPI Is Calculated

1. *Fix the “basket.”*
   The Bureau of Labor Statistics (BLS) surveys consumers to determine what’s in the typical consumer’s “shopping basket.”

2. *Find the prices.*
   The BLS collects data on the prices of all the goods in the basket.

3. *Compute the basket’s cost.*
   Use the prices to compute the total cost of the basket.
How the CPI Is Calculated

4. **Choose a base year and compute the index.**
   The CPI in any year equals

   $$\text{CPI} = \frac{\text{cost of basket in current year}}{\text{cost of basket in base year}} \times 100$$

5. **Compute the inflation rate.**
   The percentage change in the CPI from the preceding period.

   $$\text{Inflation rate} = \left(\frac{\text{CPI this year} - \text{CPI last year}}{\text{CPI last year}}\right) \times 100\%$$
What’s in the CPI Basket?

- Housing: 42.0%
- Transportation: 16.7%
- Food & Beverages: 14.8%
- Medical care: 6.5%
- Recreation: 6.5%
- Education and communication: 6.4%
- Apparel: 3.7%
- Other: 3.5%
Example: Compute CPI

- Basket: 5 units of beef, 15 of corn and 10 of rice
- Compute CPI in each year
- Compute the inflation rate in 2018 and 2019

<table>
<thead>
<tr>
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<th>2015 (base)</th>
<th>2018</th>
<th>2019</th>
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<tbody>
<tr>
<td>Beef</td>
<td>$3</td>
<td>$2</td>
<td>$2</td>
</tr>
<tr>
<td>Corn</td>
<td>$1</td>
<td>$2</td>
<td>$2</td>
</tr>
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<td>Rice</td>
<td>$2</td>
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Example: Compute CPI

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- First, compute cost of basket in each year:
  - 2015: $3 \times 5 + $1 \times 15 + $2 \times 10 = $50
  - 2016: $2 \times 5 + $2 \times 15 + $2 \times 10 = $60
  - 2017: $2 \times 5 + $2 \times 15 + $5 \times 10 = $90

- CPI:
  - 2015: 100 (base), 2016: $100 \times \frac{60}{50} = 120$, 2017: $100 \times \frac{90}{50} = 180$
Example: Compute CPI

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- **CPI:**
  - 2015: 100
  - 2016: 120
  - 2017: 180

- **Inflation Rates:**
  - 2016: \((120 - 100)/100 = 20\%\)
  - 2017: \((180 - 120)/120 = 50\%\)
**Correcting Variables for Inflation:**
Comparing Dollar Figures from Different Times

<table>
<thead>
<tr>
<th>Amount in today’s dollars</th>
<th>Amount in year $T$ dollars</th>
<th>Price level today</th>
<th>Price level in year $T$</th>
</tr>
</thead>
</table>

\[
\text{Amount in today’s dollars} = \frac{\text{Amount in year } T \times \text{ Price level today}}{\text{Price level in year } T}
\]

MEASURING THE COST OF LIVING
Example: US GDP over time

Comparing “Average Wealth” over Time

- Want to eliminate two things that affect GDP to make it a measure of “average wealth”
  
  1) Inflation: use real variables instead of nominal
  
  2) Population Growth: do everything in “per capita” terms

- Even better than per capita is “per working age person” for a measure of productivity
Brief Summary of World GDP Growth, pre-1850
Industrial Revolution

- In the UK, change in industrial practice
- Use machines, canals and replaceable parts to speed up production
- Industrialized manufacturing instead of artisan manufacturing (“mass production”)
- Adoption of these practices was very asymmetric around the world
What Caused US Growth?

- US society changed over this long period of time
- US government pursued many types of policies
- What effect did they have on growth?
Female Labor Force Participation Rate

Definition: The fraction of the adult, female population in the workforce.

Why might this matter?

- Higher female labor force participation means more people are working

- More people working means more gets produced
Female Labor Force Participation Rate

Labor Force Participation Rate - Women (LNS113000002)

Shaded areas indicate US recessions.
2012 research.stlouisfed.org
Government Spending as a Fraction of GDP

Why might this matter?

- Governments are typically less efficient producers of goods and services than private entities
- Less incentive to minimize costs
Government Spending as a Fraction of GDP

Shaded areas indicate US recessions.
2012 research.stlouisfed.org
Fraction of US Labor Force in Manufacturing

Why might this matter?

- Fewer tangible goods being produced domestically

- Huge inter-industry reallocation
  - People moving into other sectors (services, information, etc.)
Fraction of US Labor Force in Manufacturing

Shaded areas indicate US recessions.
2010 research.stlouisfed.org
Exports as a Fraction of GDP

Why might this matter?

- Openness to trade is very important in many countries

- Running huge trade deficits with the rest of the world
  - Has a direct, negative effect on GDP
Exports as a Fraction of GDP

BOPXGS/GDP*4

Shaded areas indicate US recessions.
2012 research.stlouisfed.org
Top Marginal Income Tax Rate

Marginal Income Tax: The federal income tax rate on the income of the highest wage earners

Why might this matter?

- “Job Creators” argument
  - High income individuals are typically business owners and investors who hire the majority of the workforce

- Higher tax rates reduce incentives to work
Top Marginal Income Tax Rate

Today: 35%
Growth Experience of the US

We see huge variation across time in all of these policies and outcomes (and many others).

Prediction: US growth rates should move greatly with these things.

Thought experiment: Suppose in 1875 someone was asked how US real GDP per working age person would evolve over time, and she guessed it would always grow by 2%.

By how much would she be wrong?
Growth Experience of the United States: 1875-2010
Growth Experience of the US

In this part of the course (until Midterm 1) we will focus on long run growth

In the second part we will focus on episodes of recessions and depressions
Note on the Severity of Recessions
Note on the Severity of Recessions

Of course, the effects of recessions vary widely across the population!
Summary

- US economy has remarkably stable 2% real per capita growth
  - Surprisingly invariant to policy

- For this reason, US is a useful benchmark to compare to other countries

- Growth being stable is *far from ordinary*, as we’ll see in many other examples
Next Class

- Growth over the long run
- Section 6.1 reading and homework