

Macro Module 1: Implicit price deflator practice problems

(The attached PDF file has better formatting.)

- Know how to construct the implicit price deflator using the chain-linked method.
- Mathematical problems derive the implicit price deflator and real GDP in each year.

The final exam also asks qualitative questions about the CPI, the PPI, and the implicit price deflator.

** Exercise 1.1: Real GDP and the Implicit Price Deflator

A country makes bread and wine in 20X7 and 20X8, at the quantities and prices shown in the table below. The implicit price deflator in 20X7 is 100.

	20X7		20X8	
	Bread	Wine	Bread	Wine
Quantity	26,000	5,000	32,000	4,000
Price	4	10	5	20

Use the *average* prices in 20X7 and 20X8 as base prices (the chain-link method).

- What is nominal GDP in 20X7 and 20X8?
- What are the base prices of bread and wine for comparing 20X7 and 20X8?
- What is GDP in 20X7 and 20X8 at the base prices?
- What is the ratio of real GDP in 20X8 to real GDP in 20X7?
- What is real GDP in 20X7 and 20X8?
- What is the implicit price deflator in 20X8?
- How would the answers change if the implicit price deflator were 125 in 20X7 instead of 100?
- Explain the error in the following statement: "The price of bread rose 25% from 20X7 to 20X8, yet consumers bought more bread. The demand curve for bread must have changed from 20X7 to 20X8."
- Explain the error in the following statement: "Real GDP depends on the quantities of goods, not their prices. To determine if real GDP increased or decreased, we need the quantities of each good in the two years, not the prices of the goods in the two years."

Part A: Nominal GDP is quantity times price, using the nominal prices in each year.

- 20X7: $26,000 \times \$4 + 5,000 \times \$10 = \$154,000$
- 20X8: $32,000 \times \$5 + 4,000 \times \$20 = \$240,000$

Part B: The base prices for the chain link method are the average prices in each adjacent pair of years:

- Bread: $\frac{1}{2} \times (\$4.00 + \$5.00) = \$4.50$
- Wine: $\frac{1}{2} \times (\$10.00 + \$20.00) = \$15.00$

Part C: Base price GDP = quantity \times price using these base prices:

- 20X7: $26,000 \times \$4.50 + 5,000 \times \$15 = \$192,000$
- 20X8: $32,000 \times \$4.50 + 4,000 \times \$16 = \$204,000$

Part D: The ratio of real GDP in 20X8 to real GDP in 20X7 is $\$204,000 / \$192,000 = 1.063$

Part E: In 20X7, the implicit price deflator is one, so real GDP = nominal GDP = \$154,000.

In 20X8, real GDP = $\$154,000 \times 1.063 = \$163,625$

Question: What are the units of nominal GDP and real GDP?

Answer: Nominal GDP has units of current dollars. It does not depend on the way we measure inflation or the implicit price deflator. These units differ for each year, so it is hard to compare nominal GDP among years.

Real GDP depends on two items: the base units and the method of measuring inflation. Final exam problems use the chain-link method in the textbook to measure inflation. The base year affects the implicit price deflator; a final exam problem may give the implicit price deflator for one year and derive the deflator for the other year.

Real GDP has no natural units. Real GDP for 20X8 could be in 20X1 dollars, 20X5 dollars, or 20X9 dollars.

Part F: The implicit price deflator is $100 \times \text{nominal GDP} / \text{real GDP}$

$$= 100 \times \$240,000 / \$163,625 = 146.68$$

Part G: The differences are only in the units of measurement. Nominal GDP does not change and the price level is 25% higher, so real GDP is 20% lower each year and the implicit price deflator for 20X8 is 25% higher.

Part H: The nominal price of bread rose 25% and the price level rose 46.68%, so the real price of bread rose by a factor of $1.25 / 1.4668 = 0.852$. That is, the real price of bread declined 14.8%, and the quantity of bread bought rose $32,000 / 26,000 - 1 = 23\%$.

Take heed: An exam problem may ask for the change in the real price of a good after adjusting for inflation. Derive the implicit price deflator from all the goods in the economy, and then derive the change in the real price of the good.

Part I: The change in the real GDP is the weighted average change in the quantities of goods produced. The prices of goods give the weights.

**** Exercise 1.2: Real GDP**

A country produces the following quantities of bread and wine.

- 20X7: 200 loaves of bread and 300 flasks of wine at prices of \$4 per loaf and \$6 per flask.
- 20X8: 300 loaves of bread and 200 flasks of wine at prices of \$6 per loaf and Z per flask.

	20X7		20X8	
	Bread	Wine	Bread	Wine
Quantity	200	300	300	200
Price	4	6	6	Z

Using the chain-link method, real GDP does not change from 20X7 to 20X8.

- A. What are the average prices of bread and wine in 20X7-20X8?
- B. What are real GDP in 20X7 and 20X8?
- C. Assuming real GDP does not change, solve for Z.

Part A: The average price of bread is $\frac{1}{2} \times (4 + 6) = 5$ and the average price of wine is $\frac{1}{2} \times (6 + Z)$.

Part B: Use the average prices to compute real GDP:

- 20X7: $200 \times 5 + 300 \times \frac{1}{2} \times (Z + 6) = 1,900 + 150Z$
- 20X8: $300 \times 5 + 200 \times \frac{1}{2} \times (Z + 6) = 2,100 + 100Z$

Part C: Equating the two years gives $1,900 + 150Z = 2,100 + 100Z \Rightarrow 50Z = 200 \Rightarrow Z = 4$.

The figures in this exercise are symmetric, so the solution is easy. Final exam problems use other figures and might say that real GDP increases P% from 20X7 to 20X8. The solution method is the same.

**** Exercise 1.3: Inflation indices**

An economy produces only two goods: bread and muffins. Consumers buy bread vs muffins by their relative prices. From 2000 to 2010, the price of a loaf of bread increases from \$1 to \$2 and the price of a muffin increases from \$2 to \$3.

- Index Y measures inflation based on quantities in year 2000.
- Index Z measures inflation based on quantities in year 2010.

- A. Which good has an increase in its relative price?
- B. Which good has an increase in its equilibrium quantity?
- C. Which inflation index is higher, Y or Z?

Part A: In 2000, one loaf of bread can buy $\frac{1}{2}$ a muffin; in 2010, one loaf of bread can buy $\frac{2}{3}$ of a muffin. The relative price of bread have increased $\frac{2/3}{1/2} - 1 = 33.33\%$.

In 2000, one muffin can buy two loaves of bread; in 2010, one muffin can buy 1.5 loaves of bread. The relative price of bread has decreased $1.5 / 2 - 1 = 25.00\%$.

Alternatively, the absolute price of bread increased 100%, and the absolute price of muffins increased 66.7%, so the relative price of bread increased and the relative price of muffins decreased.

Part B: The demand curves for bread and muffin remain the same in real terms.

- The relative price of bread increases, so its equilibrium quantity decreases.
- The relative price of muffins decreases, so its equilibrium quantity increases.

Part C: The relative quantity of bread decreases from 2000 to 2010, and its relative price increases compared to muffins. The inflation index that puts more weight on bread gives the higher inflation rate. Index Y uses the 2000 relative quantities, so it puts more weight on bread.

Question: What does this illustration show?

Answer: An inflation index that uses quantities based on a market basket of goods at the beginning of the period overstates inflation (as the CPI does).