Problem Set 1.
Solutions

Chapter 1 problem 3

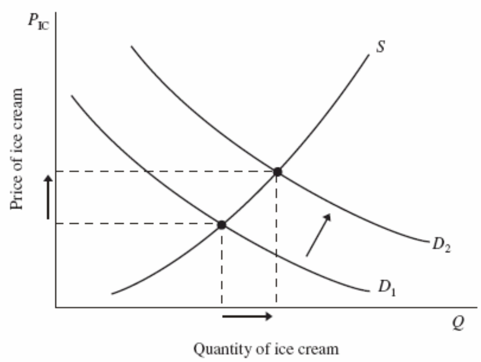
3. We can use a simple variant of the supply-and-demand model for pizza to answer this question. Assume that the quantity of ice cream demanded depends not only on the price of ice cream and income, but also on the price of frozen yogurt:

$$Q^d = D(P_{IC}, P_{FY}, Y).$$

We expect that demand for ice cream rises when the price of frozen yogurt rises, because ice cream and frozen yogurt are substitutes. That is, when the price of frozen yogurt goes up, I consume less of it and, instead, fulfill more of my frozen dessert urges through the consumption of ice cream.

The next part of the model is the supply function for ice cream, $Q^s = S(P_{IC})$. Finally, in equilibrium, supply must equal demand, so that $Q^s = Q^d$. Y and P_{FY} are the exogenous variables, and Q and P_{IC} are the endogenous variables. Figure 1–1 uses this model to show that a fall in the price of frozen yogurt results in an inward shift of the demand curve for ice cream. The new equilibrium has a lower price and quantity of ice cream.

Figure 1–1



Chapter 2 problems 6, 7 and 9

6. a. i. Nominal GDP is the total value of goods and services measured at current prices. Therefore,

$$\begin{aligned}
\text{Nominal GDP}_{2000} &= (P^{2000}_{\text{cars}} \times Q^{2000}_{\text{cars}}) + (P^{2000}_{\text{bread}} \times Q^{2000}_{\text{bread}}) \\
&= (\$50{,}000 \times 100) + (\$10 \times 500{,}000) \\
&= \$5{,}000{,}000 + \$5{,}000{,}000 \\
&= \$10{,}000{,}000. \\
\text{Nominal GDP}_{2010} &= (P^{2010}_{\text{cars}} \times Q^{2010}_{\text{cars}}) + (P^{2010}_{\text{bread}} \times Q^{2010}_{\text{bread}}) \\
&= (\$60{,}000 \times 120) + (\$20 \times 400{,}000) \\
&= \$7{,}200{,}000 + \$8{,}000{,}000 \\
&= \$15{,}200{,}000.
\end{aligned}$$

ii. Real GDP is the total value of goods and services measured at constant prices. Therefore, to calculate real GDP in 2010 (with base year 2000), multiply the quantities purchased in the year 2010 by the 2000 prices:

$$\begin{aligned}
\text{Real GDP}_{2010} &= (P^{2000}_{\text{cars}} \times Q^{2010}_{\text{cars}}) + (P^{2000}_{\text{bread}} \times Q^{2010}_{\text{bread}}) \\
&= (\$50{,}000 \times 120) + (\$10 \times 400{,}000) \\
&= \$6{,}000{,}000 + \$4{,}000{,}000 \\
&= \$10{,}000{,}000.
\end{aligned}$$

Real GDP for 2000 is calculated by multiplying the quantities in 2000 by the prices in 2000. Since the base year is 2000, real GDP_{2000} equals nominal GDP_{2000}, which is \$10,000,000. Hence, real GDP stayed the same between 2000 and 2010.

iii. The implicit price deflator for GDP compares the current prices of all goods and services produced to the prices of the same goods and services in a base year. It is calculated as follows:

$$\text{Implicit Price Deflator}_{2010} = \frac{\text{Nominal GDP}_{2010}}{\text{Real GDP}_{2010}}.$$

Using the values for Nominal GDP_{2010} and real GDP_{2010} calculated above:

$$\begin{aligned}
\text{Implicit Price Deflator}_{2010} &= \frac{\$15{,}200{,}000}{\$10{,}000{,}000} \\
&= 1.52.
\end{aligned}$$

This calculation reveals that prices of the goods produced in the year 2010 increased by 52 percent compared to the prices that the goods in the economy sold for in 2000. (Because 2000 is the base year, the value for the implicit price deflator for the year 2000 is 1.0 because nominal and real GDP are the same for the base year.)

iv. The consumer price index (CPI) measures the level of prices in the economy. The CPI is called a fixed-weight index because it uses a fixed basket of goods over time to weight prices. If the base year is 2000, the CPI in 2010 is an average of prices in 2010, but weighted by the composition of goods produced in 2000. The CPI_{2010} is calculated as follows:

$$\begin{aligned}
\text{CPI}_{2010} &= \frac{(P^{2010}_{\text{cars}} \times Q^{2000}_{\text{cars}}) + (P^{2010}_{\text{bread}} \times Q^{2000}_{\text{bread}})}{(P^{2000}_{\text{cars}} \times Q^{2000}_{\text{cars}}) + (P^{2000}_{\text{bread}} \times Q^{2000}_{\text{bread}})} \\
&= \frac{(\$60{,}000 \times 100) + (\$20 \times 500{,}000)}{(\$50{,}000 \times 100) + (\$10 \times 500{,}000)} \\
&= \frac{\$16{,}000{,}000}{\$10{,}000{,}000} \\
&= 1.6.
\end{aligned}$$

This calculation shows that the price of goods purchased in 2010 increased by 60 percent compared to the prices these goods would have sold for in 2000. The CPI for 2000, the base year, equals 1.0.

b. The implicit price deflator is a Paasche index because it is computed with a changing basket of goods; the CPI is a Laspeyres index because it is computed with a fixed basket of goods. From (5.a.iii), the implicit price deflator for the year 2010 is 1.52, which indicates that prices rose by 52 percent from what they were in the year 2000. From (5.a.iv.), the CPI for the year 2010 is 1.6, which indicates that prices rose by 60 percent from what they were in the year 2000.

If prices of all goods rose by, say, 50 percent, then one could say unambiguously that the price level rose by 50 percent. Yet, in our example, relative prices have changed. The price of cars rose by 20 percent; the price of bread rose by 100 percent, making bread relatively more expensive.

As the discrepancy between the CPI and the implicit price deflator illustrates, the change in the price level depends on how the goods' prices are weighted. The CPI weights the price of goods by the quantities purchased in the year 2000. The implicit price deflator weights the price of goods by the quantities purchased in the year 2010. The quantity of bread consumed was higher in 2000 than in 2010, so the CPI places a higher weight on bread. Since the price of bread increased relatively more than the price of cars, the CPI shows a larger increase in the price level.

c. There is no clear-cut answer to this question. Ideally, one wants a measure of the price level that accurately captures the cost of living. As a good becomes relatively more expensive, people buy less of it and more of other goods. In this example, consumers bought less bread and more cars. An index with fixed weights, such as the CPI, overestimates the change in the cost of living because it does not take into account that people can substitute less expensive goods for the ones that become more expensive. On the other hand, an index with changing weights, such as the GDP deflator, underestimates the change in the cost of living because it does not take into account that these induced substitutions make people less well off.

7. a. The consumer price index uses the consumption bundle in year 1 to figure out how much weight to put on the price of a given good:

$$\begin{aligned} CPI^2 &= \frac{(P^2_{red} \times Q^1_{red}) + (P^2_{green} \times Q^1_{green})}{(P^1_{red} \times Q^1_{red}) + (P^1_{green} \times Q^1_{green})} \\ &= \frac{(\$2 \times 10) + (\$1 \times 0)}{(\$1 \times 10) + (\$2 \times 0)} \\ &= 2. \end{aligned}$$

According to the CPI, prices have doubled.

b. Nominal spending is the total value of output produced in each year. In year 1 and year 2, Abby buys 10 apples for $1 each, so her nominal spending remains constant at $10. For example,

$$\begin{aligned} \text{Nominal Spending}_2 &= (P^2_{red} \times Q^2_{red}) + (P^2_{green} \times Q^2_{green}) \\ &= (\$2 \times 0) + (\$1 \times 10) \\ &= \$10. \end{aligned}$$

c. Real spending is the total value of output produced in each year valued at the prices prevailing in year 1. In year 1, the base year, her real spending equals her nominal spending of $10. In year 2, she consumes 10 green apples that are each valued at their year 1 price of $2, so her real spending is $20. That is,

$$\begin{aligned}\text{Real Spending}_2 &= (P^1_{\text{red}} \times Q^2_{\text{red}}) + (P^1_{\text{green}} \times Q^2_{\text{green}}) \\ &= (\$1 \times 0) + (\$2 \times 10) \\ &= \$20.\end{aligned}$$

Hence, Abby's real spending rises from $10 to $20.

d. The implicit price deflator is calculated by dividing Abby's nominal spending in year 2 by her real spending that year:

$$\begin{aligned}\text{Implicit Price Deflator}_2 &= \frac{\text{Nominal Spending}_2}{\text{Real Spending}_2} \\ &= \frac{\$10}{\$20} \\ &= 0.5.\end{aligned}$$

Thus, the implicit price deflator suggests that prices have fallen by half. The reason for this is that the deflator estimates how much Abby values her apples using prices prevailing in year 1. From this perspective green apples appear very valuable. In year 2, when Abby consumes 10 green apples, it appears that her consumption has increased because the deflator values green apples more highly than red apples. The only way she could still be spending $10 on a higher consumption bundle is if the price of the good she was consuming feel.

e. If Abby thinks of red apples and green apples as perfect substitutes, then the cost of living in this economy has not changed—in either year it costs $10 to consume 10 apples. According to the CPI, however, the cost of living has doubled. This is because the CPI only takes into account the fact that the red apple price has doubled; the CPI ignores the fall in the price of green apples because they were not in the consumption bundle in year 1. In contrast to the CPI, the implicit price deflator estimates the cost of living has halved. Thus, the CPI, a Laspeyres index, overstates the increase in the cost of living and the deflator, a Paasche index, understates it. This chapter of the text discusses the difference between Laspeyres and Paasche indices in more detail.

9. As Senator Robert Kennedy pointed out, GDP is an imperfect measure of economic performance or well-being. In addition to the left-out items that Kennedy cited, GDP also ignores the imputed rent on durable goods such as cars, refrigerators, and lawnmowers; many services and products produced as part of household activity, such as cooking and cleaning; and the value of goods produced and sold in illegal activities, such as the drug trade. These imperfections in the measurement of GDP do not necessarily reduce its usefulness. As long as these measurement problems stay constant over time, then GDP is useful in comparing economic activity from year to year. Moreover, a large GDP allows us to afford better medical care for our children, newer books for their education, and more toys for their play.

Additional Exercises

Define the production function as: $F(K,L) = AK^{\alpha}L^{\beta}$, where *A* is a measure of productivity, *K* is total capital stock of the economy and *L* is the total available labor in the economy.

i) Find the marginal product of capital.

$$MPK = \alpha AK^{(\alpha-1)}L^{\beta}$$

ii) Find the marginal product of labor

$$MPL = \beta AK^{\alpha}L^{(1-\beta)}$$

iii) Show that if α + β > 1, then the function is increasing returns to scale.
iv) Show that if α + β < 1, then the function is decreasing returns to scale.
v) Show that if α + β = 1, then the function is constant returns to scale.

$$F(zK, zL)$$
$$A(zK)^{\alpha}(zL)^{\beta}$$
$$A(z)^{\alpha}(K)^{\alpha}(z)^{\beta}(L)^{\beta}$$
$$z^{(\alpha+\beta)}AK^{\alpha}L^{\beta}$$
$$z^{(\alpha+\beta)}F(K,L)$$
$$z^{(\alpha+\beta)}Y$$
$$\therefore F(zK, zL) = z^{(\alpha+\beta)}Y$$

If α + β > 1, then $z^{(\alpha+\beta)} > z$, which implies that $z^{(\alpha+\beta)}Y > zY$: IRS

If α + β < 1, then $z^{(\alpha+\beta)} < z$, which implies that $z^{(\alpha+\beta)}Y < zY$: DRS

If α + β = 1, then $z^{(\alpha+\beta)} = z$, which implies that $z^{(\alpha+\beta)}Y = zY$: CRS

vi) Transform the current production function that relates levels of productivity, capital, and labor into one that relates growth rates of productivity, capital, and labor.

$$Y = AK^{\alpha}L^{\beta}$$

$$\ln(Y) = \ln\left(AK^{\alpha}L^{\beta}\right) = \ln(A) + \ln\left(K^{\alpha}\right) + \ln\left(L^{\beta}\right) = \ln(A) + \ln(A) + \beta\ln(L)$$

$$\frac{\partial \ln(Y)}{\partial t} = \frac{\partial \ln(A)}{\partial t} + \frac{\partial \ln(K)}{\partial t} + \frac{\partial \beta \ln(L)}{\partial t}$$

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \alpha\left(\frac{\dot{K}}{K}\right) + \beta\left(\frac{\dot{L}}{L}\right)$$

$$\hat{Y} = \hat{A} + \alpha\hat{K} + \beta\hat{L}$$