Econ 402
Fall 2007

Problem Set #1
Suggested solutions

2. Coal producer, steel producer, and consumers.
   (a) (i) Product approach: Coal producer produces 15 million tons of coal at \$5/ton, which adds
   \$75 million to GDP. The steel producer produces 10 million tons of steel at \$20/ton, which is worth \$200 million. The steel producer pays \$125 million for 25 million tons of coal at \$5/ton. The steel producer's value added is therefore \$75 million. GDP is equal to
   \$75 million + \$75 million = \$150 million.
   (ii) Expenditure approach: Consumers buy 8 million tons of steel at \$20/ton, so consumption is \$160 million. There is no investment and no government spending. Exports are 2 million tons of steel at \$20/ton, which is worth \$40 million. Imports are 10 million tons of coal at \$5/ton, which is worth \$50 million. Net exports are therefore equal to \$40 million –
   \$50 million = –\$10 million. GDP is therefore equal to \$160 million + (–\$10 million) =
   \$150 million.
   (iii) Income approach: The coal producer pays \$50 million in wages and the steel producer pays \$40 million in wages, so total wages in the economy equal \$90 million. The coal producer receives \$75 million in revenue for selling 15 million tons at \$15/ton. The coal producer pays \$50 million in wages, so the coal producer's profits are \$25 million. The steel producer receives \$200 million in revenue for selling 10 million tons of steel at \$20/ton. The steel producer pays \$40 million in wages and pays \$125 million for the 25 million tons of
   coal that it needs to produce steel. The steel producer's profits are therefore equal to
   \$200 million – \$40 million – \$125 million = \$35 million. Total profit income in the economy is therefore \$25 million + \$35 million = \$60 million. GDP therefore is equal to wage income (\$90 million) plus profit income (\$60 million). GDP is therefore \$150 million.

   (b) There are no net factor payments from abroad in this example. Therefore, the current account surplus is equal to net exports, which is equal to (–\$10 million).

   (c) As originally formulated, GNP is equal to GDP, which is equal to \$150 million. Alternatively, if foreigners receive \$25 million in coal industry profits as income, then net factor payments from abroad are (–\$25 million), so GNP is equal to \$125 million.

4. Price and quantity data are given as the following.

Year 1

Good	**Quantity**	**Price**
Computers	20	\$1,000
Bread	10,000	\$1.00

Year 2

Good	**Quantity**	**Price**
Computers	25	\$1,500
Bread	12,000	\$1.10

(a) Year 1 nominal GDP $= 20 \times \$1{,}000 + 10{,}000 \times \$1.00 = \$30{,}000$.

Year 2 nominal GDP $= 25 \times \$1{,}500 + 12{,}000 \times \$1.10 = \$50{,}700$.

With year 1 as the base year, we need to value both years' production at year 1 prices. In the base year, year 1, real GDP equals nominal GDP equals \$30,000. In year 2, we need to value year 2's output at year 1 prices. Year 2 real GDP $= 25 \times \$1{,}000 + 12{,}000 \times \$1.00 = \$37{,}000$. The percentage change in real GDP equals (\$37,000 – \$30,000)/\$30,000 = 23.33%.

We next calculate chain-weighted real GDP. At year 1 prices, the ratio of year 2 real GDP to year 1 real GDP equals g_1 = (\$37,000/\$30,000) = 1.2333. We must next compute real GDP using year 2 prices. Year 2 GDP valued at year 2 prices equals year 2 nominal GDP = \$50,700. Year 1 GDP valued at year 2 prices equals (20 × \$1,500 + 10,000 × \$1.10) = \$41,000. The ratio of year 2 GDP at year 2 prices to year 1 GDP at year 2 prices equals g_2 = (\$50,700/\$41,000) = 1.2367. The chain-weighted ratio of real GDP in the two years therefore is equal to $g_c = \sqrt{g_1 g_2} = 1.23496$. The percentage change chain-weighted real GDP from year 1 to year 2 is therefore approximately 23.5%.

If we (arbitrarily) designate year 1 as the base year, then year 1 chain-weighted GDP equals nominal GDP equals \$30,000. Year 2 chain-weighted real GDP is equal to (1.23496 × \$30,000) = \$37,048.75.

(b) To calculate the implicit GDP deflator, we divide nominal GDP by real GDP, and then multiply by 100 to express as an index number. With year 1 as the base year, base year nominal GDP equals base year real GDP, so the base year implicit GDP deflator is 100. For the year 2, the implicit GDP deflator is (\$50,700/\$37,000) × 100 = 137.0. The percentage change in the deflator is equal to 37.0%.

With chain weighting, and the base year set at year 1, the year 1 GDP deflator equals (\$30,000/\$30,000) × 100 = 100. The chain-weighted deflator for year 2 is now equal to (\$50,700/\$37,048.75) × 100 = 136.85. The percentage change in the chain-weighted deflator equals 36.85%.

(c) We next consider the possibility that year 2 computers are twice as productive as year 1 computers. As one possibility, let us define a "computer" as a year 1 computer. In this case,
the 25 computers produced in year 2 are the equivalent of 50 year 1 computers. Each year 1 computer now sells for $750 in year 2. We now revise the original data as:

Year 1

Good	Quantity	Price
Year 1 Computers	20	$1,000
Bread	10,000	$1.00

Year 2

Good	Quantity	Price
Year 1 Computers	50	$750
Bread	12,000	$1.10

First, note that the change in the definition of a "computer" does not affect the calculations of nominal GDP. We next compute real GDP with year 1 as the base year. Year 2 real GDP in year 1 prices is now $50 \times \$1{,}000 + 12{,}000 \times \$1.00 = \$62{,}000.$ The percentage change in real GDP is equal to ($62,000 – $30,000)/$30,000 = 106.7%.

We next revise the calculation of chain-weighted real GDP. From above, g_1 equals ($62,000/$30,000) = 206.67. The value of year 1 GDP at year 2 prices equals $26,000. Therefore, g_2 equals ($50,700/$26,000) = 1.95. 200.75. The percentage change chain-weighted real GDP from year 1 to year 2 is therefore 100.75%.

If we (arbitrarily) designate year 1 as the base year, then year 1 chain-weighted GDP equals nominal GDP equals $30,000. Year 2 chain-weighted real GDP is equal to (2.0075 × $30,000) = $60,225. The chain-weighted deflator for year 1 is automatically 100. The chain-weighted deflator for year 2 equals ($50,700/$60,225) × 100 = 84.18. The percentage rate of change of the chain-weighted deflator equals −15.8%.

When there is no quality change, the difference between using year 1 as the base year and using chain weighting is relatively small. Factoring in the increased performance of year 2 computers, the production of computers rises dramatically while its relative price falls. Compared with earlier practices, chain weighting provides a smaller estimate of the increase in production and a smaller estimate of the reduction in prices. This difference is due to the fact that the relative price of the good that increases most in quantity (computers) is much higher in year 1. Therefore, the use of historical prices puts more weight on the increase in quality-adjusted computer output.

9. $S^p - 1 = CA + D$

(a) By definition:

$$S^p = Y^d - C = Y + NFP + TR + INT - T - C$$

Next, recall that $Y = C + I + G + NX$. Substitute into the equation above and subtract I to obtain:

$$\begin{aligned} S^p - I &= C + I + G + NX + NFP + INT - T - C - I \\ &= (NX + NFP) + (G + INT + TR - T) \\ &= CA + D \end{aligned}$$

(b) Private saving, which is not used to finance domestic investment, is either lent to the domestic government to finance its deficit (D), or is lent to foreigners (CA).

11. Assume the following:

$$D = 10$$
$$INT = 5$$
$$T = 40$$
$$G = 30$$
$$C = 80$$
$$NFP = 10$$
$$CA = -5$$
$$S = 20$$

(a)

$$\begin{aligned} Y^d &= S^p + C \\ &= S + D + C \\ &= 20 + 10 + 80 = 110 \end{aligned}$$

(b)

$$D = G + TR + INT - T$$
$$TR = D - G - INT + T = 10 - 30 - 5 + 40 = 15$$

(c)

$$S = GNP - C - G$$
$$GNP = S + C + G = 20 + 80 + 30 = 130$$

(d)

$$GDP = GNP - NFP = 130 - 10 = 120$$

(e)

$$\text{Government Surplus} = S^g = -D = -10$$

(f)

$$CA = NX + NFP$$
$$NX = CA - NFP = -5 - 10 = -15$$

(g)

$$GDP = C + I + G + NX$$
$$I = GDP - C - G - NX = 120 - 80 - 30 + 15 = 25$$