CHAPTER 4

3. A country imports 3 billion barrels of crude oil per year and domestically produces another 3 billion barrels of crude oil per year. The world price of crude oil is $90 per barrel. Assuming linear schedules, economists estimate the price elasticity of domestic supply to be 0.25 and the price elasticity of domestic demand to be 0.1 at the current equilibrium.

- **a. Consider the changes in social surplus that would result from imposition of a $30 per barrel import fee on crude oil that would involve annual administrative costs of $250 million. Assume that the world price will not change as a result of the country imposing the import fee, but that the domestic price will increase by $30 per barrel. Also assume that only producers, consumers, and taxpayers within the country have standing. Determine the quantity consumed, the quantity produced domestically, and the quantity imported after the imposition of the import fee. Then estimate the annual social net benefits of the import fee.**
- **b. Economists have estimated that the marginal excess burden of taxation in the country is 0.25 (see Chapter 3). Re-estimate the social net benefits assuming that 20 percent of the increase in producer surplus is realized as tax revenue under the existing tax system. In answering this question, assume that increases in tax revenues less the cost of administrating the import fee are used to reduce domestic taxes.**
- **c. The reduction in the country's demand for imports may affect the world price of crude oil. Assuming that the import fee reduces the world price from $90 to $80 per barrel, and thus, the after-tax domestic price is $80 + $30 = $110 per barrel, a net increase in domestic price of $20 per barrel, repeat the analysis done in parts a and b.**

3.a. The imposition of the import fee would have the following effect on the domestic market:

Change in quantity consumed: $-.1 = (\Delta q/\Delta p)(p/q)$

$\Delta q = (-.1)\Delta p(q/p)$

$\Delta q = (-.1)(\$30)(6 \text{ billion})/(\$90)$

$\Delta q = -.2$ billion

Change in domestic supply: $.25 = (\Delta q/\Delta p)(p/q)$

$\Delta q = (.25)\Delta p(q/p)$

$\Delta q = (.25)(\$30)(3 \text{ billion})/(\$90)$

$\Delta q = .25$ billion

Thus, after imposition of the fee, domestic consumption will fall to 5.8 billion barrels per year, domestic production will rise to 3.25 billion barrels per year, and imports will fall to 2.55 billion barrels per year (5.8 billion - 3.25 billion).

The changes in surplus to producers, consumers, and tax-payers is as follows:

Change in domestic producer surplus:

A. Surplus from additional .25 billion barrels produced
Revenue = (.25 billion)($120) = $30 billion/year
Production costs (area under supply schedule) =
(.5)($120-$90)(.25 billion) + ($90)(.25 billion) = $26.25 billion/year
Net change in surplus from new production =
$30 billion/year-$26.25 billion/year = $3.75 billion/year

B. Surplus from higher prices on original production =
($120-$90)(3 billion) = $90 billion/year

Total change in producer surplus =
$3.75 billion + $90 billion = $93.75 billion/year

Change in consumer surplus:

C. "Deadweight loss" from reduced consumption =
(.5)($120-$90)(.2 billion) = $3 billion/year

D. Additional payments on quantity still consumed =
($120-$90)(5.8 billion) = $174 billion/year

Total change in consumer surplus =
(-$3 billion) + (-$174 billion) = -$177 billion/year

Change in tax revenues:

E. Import fee applied to new import level:
($30)(2.55 billion) = $76.5 billion/year

F. Administrative costs
-$.25 billion/year

Total change in tax revenues =
$76.5 billion - $.25 billion = $76.25 billion/year

CBA from country's perspective:

Costs:	
Change in consumer surplus	-$177.00 billion/yr
Benefits:	
Change in domestic producer surplus	$93.75 billion/yr
Net gain to tax-payers	$76.25 billion/yr
Net benefits:	-$7.00 billion/yr

The import fee would have negative net benefits of $7 billion/year and therefore does not pass the CBA test.

Notice that over half of the loss in consumer surplus is offset by an increase in producer surplus. Note also that we can base our decision on only one year if we assume that none of the parameter values will change over time. If any of the parameters changed over time, then we would have to extend the analysis to multiple periods. This would be the case, for example, if we thought that the estimated elasticities were appropriate for the short-run, but not for the longer-run because producers and consumers would be better able to adjust to higher prices as time passed because they would have more opportunities to change their capital stocks.

3.b. Assuming 20 percent of producer surplus is collected as taxes, the costs and benefits are:

Change in consumer surplus:	-$177.00 billion
After tax change in producer surplus:	$75.00 billion
Net gain to taxpayers	$95.00 billion
Net gain to taxpayers times METB	$23.75 billion
Net benefits	$16.75 billion

Not only do tax-payers enjoy reductions in tax payments, but the reduction in tax payments results in a reduction in deadweight loss. To calculate this latter benefit, we multiply the fiscal change by the METB. Taking account of the METB in this case makes an important difference: the tax would not pass the net benefits test if METB is zero (implicitly assumed in part a), but would pass the net benefits test if the METB is .25.

3.c. The following changes in quantities result:

Change in quantity consumed: $-.1 = (\Delta q/\Delta p)(p/q)$

$\Delta q = (-.1)\Delta p(q/p)$

$\Delta q = (-.1)(\$20)(6 \text{ billion})/(\$90)$

$\Delta q = -.133$ billion

Change in domestic supply: $.25 = (\Delta q/\Delta p)(p/q)$

$\Delta q = (.25)\Delta p(q/p)$

$\Delta q = (.25)(\$20)(3 \text{ billion})/(\$90)$

$\Delta q = .167$ billion

Thus, after the tax, 5.867 billion barrels are consumed, 3.167 billion barrels are domestically produced, and 2.7 billion barrels are imported.

Consumer surplus loss =

(.5)(.134 billion)($110-$90) + (5.867 billion)($110-$90) = $118.68 billion/year

Producer surplus gain =

(.25 billion)($120) - [(.5)(.25 billion)($120-$90) + (.25 billion)($90)] + (3 billion)(120-$90)

= (.5)(.167 billion)($110-$90) + (3 billion)($110-$90)

= $61.67 billion/year

Net taxpayer gain =

($30)(2.7 billion) - $.25 billion = $80.75 billion/yr.

If the METB is assumed to be zero, then net benefits are $23.74 billion per year.

Assuming that 20 percent of producer surplus is transferred to the government through the existing tax system and the METB is 0.25, the net social benefits are:

(49.34) + (80.75+12.33) + (0.25)(80.75+12.33) – 118.68 = $47.01 billion/year.

CHAPTER 5

2. Recall exercise 3 from Chapter 4 in which a country imposes an import fee on the crude oil it imports. Assume that prior to the imposition of the import fee, the country annually consumed 900 million short tons of coal, all domestically mined, at a price of $66 per short ton. How would the CBA of the import fee change if, after imposition of the import fee, the following circumstances are assumed to result from energy consumers switching from crude oil to coal?

- **a. Annual consumption of coal rises by 40 million short tons, but the price of coal remains unchanged.**
- **b. Annual consumption of coal rises by 40 million short tons and the price of coal rises to $69 per short ton. In answering this question, assume that the prices of other goods, including coal, were not held constant in estimating the demand schedule for crude oil.**
- **c. Annual consumption of coal rises by 40 million short tons and the price of coal rises to $69 per short ton. In answering this question, assume that the prices of other goods, including coal, were held constant in estimating the demand schedule for crude oil. Also assume that the demand schedule for coal is completely inelastic.**

d. The market price of coal underestimates its marginal social cost by $15 per short ton because the coal mined in the country has a high sulphur content that produces smog when burned. In answering this question, assume that, as in question 2.a, the annual consumption of coal rises by 40 million short tons, but the price of coal remains unchanged.

2.a. As long as the secondary market for coal is undistorted and its price does not change, the increased consumption of coal is irrelevant to estimation of changes in social surplus in the primary (crude oil) market.

2.b. Since it was assumed that the price of other goods, including coal, were not held constant in estimating the primary market (crude oil) demand schedule, the crude oil demand curve can be viewed as an equilibrium demand curve. Consequently, there is no need to consider changes in the secondary market for coal.

2.c. If price rises in the secondary (coal) market and the prices of other goods were held constant in estimating the demand schedule in the primary (crude oil) market, then this demand schedule does not capture all the changes in social surplus. Hence, in principle, it is necessary to subtract the change in social surplus in the coal market from the estimated social surplus in the crude oil market.

The price rise in the domestic crude oil market can be thought of as causing an outward shift in the demand for coal. The change in social surplus in the coal market would be measured relative to the shifted demand schedule.

We can calculate the gain in producer surplus in the coal market as (.5)(40 million)($69-$66)+(900 million)(($69-$66) = $2,760 million/year, because we have two points on the supply schedule ($66, 900 million) and ($69, 940 million), which allow us to calculate the area of the relevant trapezoid as a triangle above the added production and a rectangle above the previous production.

By assuming perfectly inelastic demand for coal, we can calculate the loss in consumer surplus as: (940 million)($69-$66) = $2,820 million/year.

Note that this amount would be slightly larger if we had assumed somewhat more realistically that the demand curve had a negative slope.

Thus, the net benefits of the import fee as measured in the crude oil market should be reduced by: $2,820 million - $2,760 million = $60 million/year.

Notice that this amount is extremely small relative to the net benefits that occur in the primary market (see question 3 in Chapter 4). Thus, knowing the effect of the import fee in the secondary market for coal is unlikely to change our conclusions about whether the fee should be implemented.

2.d. If the market for coal is distorted with an externality, then a relevant social surplus change occurs even if price does not change. In this case, the social surplus loss in this secondary market would be (40 million short tons)($15 externality per short ton) = $0.60 billion/per year.

Note that all of the analyses in the answers to question 3 in Chapter 4 and to this question assume that there are no externalities in the primary (crude oil) market. If there were an externality in this market, then the import fee would generate additional benefits because total crude oil consumption falls. Of course, the switch to coal might very well involve an even larger social surplus loss due to environmental externalities.