7 Valuing Impacts in Secondary Markets

In conducting CBAs of government policies, there is a natural tendency to list as many effects of the policies as one's imagination permits. For example, an improvement in public transportation in a particular city may increase bus usage and reduce car usage. It may also reduce downtown pollution and congestion. Further, it may subsequently reduce the demand for automobile repairs, parking places, and gasoline.

To assess these effects, one must first determine which of them occur in primary markets and which of them occur in secondary markets. Primary markets refer to markets that are directly affected by a policy (that is, the output and input markets discussed in Chapters 5 and 6), while secondary markets are markets that are indirectly affected. Changes in bus usage clearly occur in the primary market for public transportation. The reductions in pollution and congestion also can be thought of as occurring in that primary market, though these particular impacts are in the external, or missing, part of that market. Any effect that occurs in a primary market should be accounted for in a CBA. On the other hand, effects on the demand for auto repairs, parking places, and gasoline occur in secondary markets and, as will be seen, often can (and indeed should) be ignored in conducting CBA. This last group of effects is often referred to as *secondary, second-round, spillover, side, pecuniary*, or *indirect effects*.

While Chapters 5 and 6 examined the benefits and costs of government policies that occur in primary markets, this chapter focuses on policy impacts in secondary markets. As in those chapters, we distinguish between efficient and distorted markets. In addition, the chapter takes a brief look at the special implications of secondary market effects for local communities, as the benefits of such effects are often touted by advocates of local infrastructure projects such as sports stadiums and convention centers.

7.1 Valuing Benefits and Costs in Efficient Secondary Markets

7.1.1 *Complements and Substitutes*

Secondary market effects result because government policies affect the prices of goods in primary markets, and this, in turn, noticeably affects the demand for other goods. These latter goods are referred to as *complements to* and *substitutes for the good traded in the primary market*.

Consider the following example. Stocking a lake near a city with fish lowers the effective price of access to fishing grounds for the city's residents. They not only fish more often, but they also demand more bait and fishing equipment. We say that access

to fishing grounds and fishing equipment are complements because a decrease (increase) in the price of one will result in an increase (decrease) in the demand for the other. In contrast, fishing is a substitute for golfing because as the price of fishing goes down (up), the demand for golfing goes down (up).

If government policies affect the demand for goods in secondary markets, then prices in these secondary markets may or may not change as a result. We first discuss the simpler situation in which prices do not change. We then analyze the more complex situation in which prices do change in secondary markets.

7.1.2 *Efficient Secondary Market Effects without Price Changes*

Because most goods have substantial numbers of complements and substitutes, many government projects cause effects in large numbers of secondary markets. Accounting for all these effects would impose an enormous burden on analysts. Fortunately, however, such effects can often be ignored in CBA without substantially biasing the estimates of net benefits. When can we ignore secondary market effects? *We can, and indeed should, ignore impacts in undistorted secondary markets as long as the change in social surplus in the primary market resulting from a government project is measured and prices in the secondary markets do not change*. The reason for this is that in the absence of price adjustments in secondary markets in response to price changes in primary markets, impacts are typically fully measured as surplus changes in primary markets. Measuring the same effects in both markets will, therefore, result in double counting. Thus, for example, if prices of fishing equipment do not change, then the increased consumption of fishing equipment is not relevant to the CBA of a project that increases access to fishing grounds.

A closer look at the fishing example should make the rule for the treatment of secondary markets clearer. For simplicity, we assume that the price of fishing equals the marginal social cost of fishing and that this marginal social cost is constant. This, in turn, implies that no producer surplus or externalities exist in the primary market (e.g., highway congestion does not result because of increased travel to the newly stocked lake).

Figure 7.1(a) shows the market for "fishing days." Prior to the stocking of the nearby lake, the effective price of a day of fishing (largely the time costs of travel) was P_{F_0}, the travel cost to a lake that contains plentiful fish but is much further away. Once fishing is available at the nearby lake, the effective price falls to P_{F_1} and, as a consequence, the number of days spent fishing by local residents rises from q_{F_0} to q_{F_1}. The resulting increase in social surplus equals the area of trapezoid $P_{F_0}abP_{F_1}$, the gain in consumer surplus. We measure this gain in consumer surplus using the demand schedule for fishing, D_F. As is customary in textbooks, this demand schedule should be viewed as the relation between price and quantity that would exist in the primary market if the prices of all secondary goods were held constant. Later we discuss the importance of this assumption.

Now consider the market for fishing equipment. The decline in the effective price of fishing days shifts the demand schedule for fishing equipment from D_{E_0} to D_{E_1} as shown in Figure 7.1(b). If the supply schedule is perfectly elastic – likely when the local market accounts for only a small fraction of regional or national demand – then the shift in demand will not increase the price of fishing equipment.

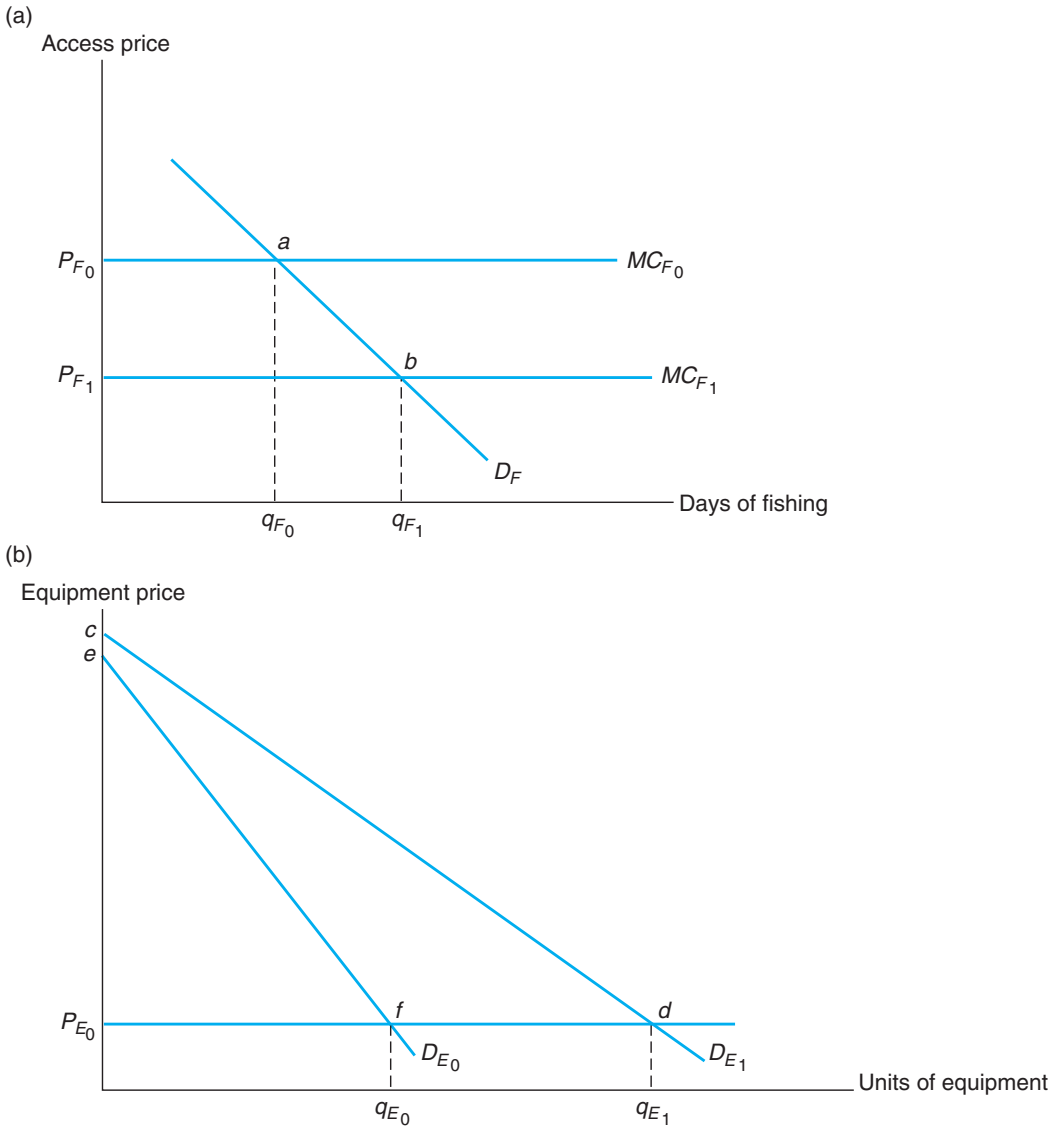

Figure 7.1(a) Primary market: market for fishing days.
Figure 7.1(b) Secondary market: market for fishing equipment (no price effect).

Does this shift in demand for fishing equipment represent a change in consumer welfare that should be counted in a CBA of the fish-stocking project? In other words, should the gap between the old and new demand schedules that is above the price line be counted as an additional increase in consumer surplus? It is tempting to treat the increase in consumer surplus from efP_{E_0} to cdP_{E_0} in panel (b) as an additional increase in social benefits that should be added to $P_{F_0}abP_{F_1}$ in panel (a), but this should *not* be done. As discussed next, doing so would result in double counting. As long as price does not change in the equipment market as a result of stocking the lake, the social surplus change in the fishing market measures the entire benefit from the stocking project.

To see this, first consider fishers who already own all the fishing equipment they need at the time the lake is stocked and, hence, presently contribute no demand to the market for fishing equipment. The value that these persons place on their existing fishing equipment will tend to increase as a result of stocking the nearby lake. However, because they are not in the market for new fishing equipment, the gap between the old and new demand schedules for new fishing equipment does not reflect this increase. Of course, these fishers' willingness to pay for fishing days will presumably be higher than it otherwise would have been because they will not have to make further expenditures for fishing equipment. However, any additional increase in consumer surplus that these fishers enjoy as a result of already owning fishing equipment at the time the nearby lake is stocked will already be reflected by the primary market demand schedule for fishing days, which will be further to the right than it otherwise would be. It cannot show up in the secondary market for fishing equipment.

Now consider individuals who do not own fishing equipment at the time the lake is stocked but are now induced to make such purchases. The gap between the two demand schedules in Figure 7.1(b) accurately reveals the increased value that these persons place on fishing equipment. That is, these people are now willing to pay more for fishing equipment, and indeed they will buy more fishing equipment. It is the only way they can fully realize surplus gains from the stocking project, but having to make this expenditure is not an additional benefit from the stocking project. Just like the fishers who already own fishing equipment, the increase in consumer surplus that these persons receive from the stocking project is fully captured by the consumer surplus measured using the primary market demand schedule for fishing days. This includes any consumer surplus that they receive from their purchases of fishing equipment. Thus, counting the gap between the two demand schedules in panel (b) as benefits and also counting the increase in consumer surplus shown in panel (a) as benefits would result in counting the same benefits twice.

Persons who do not own fishing equipment at the time the lake is stocked would have been even better off if, like the current owners of fishing equipment, they did not have to buy new equipment in order to take advantage of the newly stocked lake. Thus, everything else being equal, WTP for fishing days is presumably greater among those who already own fishing equipment than among those who must purchase it. The increase in consumer surplus that results from the stocking project for both groups, even if different from one another, will be fully reflected in the primary market demand schedule for fishing days.

It is important to stress that secondary market effects can be ignored only if social surplus in the primary market is measured directly. As discussed in greater detail in Chapter 15, in situations in which cost–benefit analysts are unable to measure social surplus changes in primary markets, they may infer them instead from the demand shifts in secondary markets. For example, imagine that analysts have no information about the demand schedule for fishing days, but they do know how the demand schedule for fishing equipment will change. With no direct measure of the benefits from stocking the lake, they might measure the difference between the social surplus in the fishing equipment market after the project (based on demand schedule D_{E_1}) and the social surplus in the equipment market prior to the project (based on demand schedule D_{E_0}). They would then

apply some sort of scaling factor to correct for the underestimation that would result because not all the consumer surplus from fishing will be reflected in the equipment market. (As already indicated, because some fishers will use old equipment and collect their own bait, their surplus will not appear in the equipment market. Moreover, equipment and bait comprise only some of the inputs to fishing.)

7.1.3 *Efficient Secondary Market Effects with Price Changes*[1]

The situation is more complex when the supply schedule in the secondary market is upward-sloping. To see this, we examine the effect of stocking the lake on the demand for golfing. In Figure 7.2, panel (a) once again shows the demand for fishing days, while panel (b) now shows the demand for golfing days. As before, the reduction in the price of fishing days from P_{F_0} to P_{F_1} as a result of stocking the lake causes an increase in social surplus equal to the area $P_{F_0}abP_{F_1}$ (for the moment ignore demand schedules D_{F_1} and D^*).

As fishing and golf are presumed to be substitutes, a reduction in the price of fishing days from P_{F_0} to P_{F_1} would cause the demand for golfing to fall. Thus, the demand schedule for golfing in panel (b) would shift to the left from D_{G_0} to D_{G_1}. As previously emphasized, by itself this shift does not represent a change in consumer surplus that is not already fully accounted for in measuring the change in consumer surplus in the primary market. Golfers are obviously not made worse off by stocking the lake, although some may now place a lower valuation on golf. Instead, by itself, the shift in demand merely indicates that in the absence of golf, the consumer surplus gains from stocking the lake would have been even larger. The existence of golf is reflected in the location of D_{F_0}, the demand schedule for fishing days, which is farther to the left than it would have been if golf were not available as a substitute for fishing.

The shift of demand from D_{G_0} to D_{G_1}, however, causes the fees for golf course use to fall from P_{G_0} to P_{G_1}. This, in turn, results in an increase in consumer surplus, one represented by the area $P_{G_0}efP_{G_1}$, which has not previously been taken into account. Note that the consumer surplus resulting from a reduction in price is measured relative to the new demand schedule, which gives marginal valuations of golf after the decline in the price of fishing. In addition, the fall in golfing fees also causes a reduction in producer surplus equal to area $P_{G_0}gfP_{G_1}$. As the reduction in producer surplus exceeds the increase in consumer surplus, a net loss in social surplus equal to the area of triangle *efg* results.[2]

Should this loss in social surplus in the golfing market be subtracted from the social surplus gain in the fishing market in measuring net gains from the project? It is frequently unnecessary to do so. The reason is that the increase in consumer surplus gain in the fishing market is often, in practice, likely to be measured as the area $P_{F_0}acP_{F_1}$ rather than as the area $P_{F_0}abP_{F_1}$. If measured in this way, the increase in consumer surplus in the fishing market would be understated by the triangular area *abc*, but this triangle closely approximates triangle *efg*, the net loss in social surplus in the golfing market.

To see why the consumer surplus gain in the fishing market is often, in practice, measured as the area $P_{F_0}acP_{F_1}$ rather than as the area $P_{F_0}abP_{F_1}$, one must recognize that our fishing story does not end with the shift in the demand schedule in the secondary

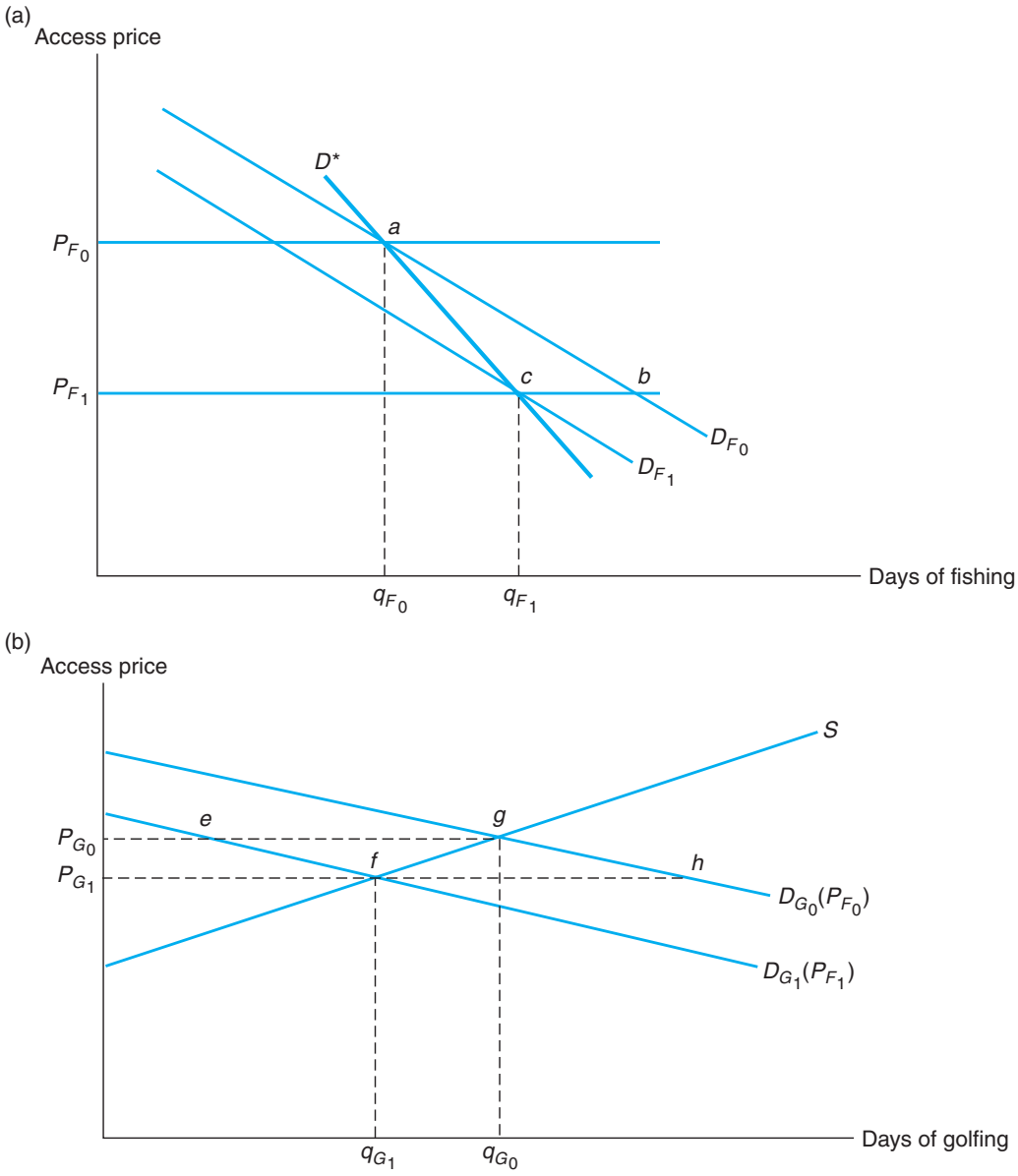

Figure 7.2(a) Primary market: market for fishing days.
Figure 7.2(b) Secondary market: market for golfing days (price effects).

market. If golf and fishing are substitutes, the reduction in golf course fees will cause some people to switch from fishing to golf, and the demand for fishing days will fall. This is shown in panel (a) as a leftward shift in the demand schedule for fishing days from D_{F_0} to D_{F_1}. Because prices in the market for fishing days are unaffected given that the supply of fishing days is perfectly elastic, by itself, this shift does not cause any further changes in social surplus. Note, however, that by drawing a line between the original and the final equilibrium points in Figure 7.2(a) – that is, between points *a* and *c* – one can derive a special type of demand schedule, *D**.

This demand schedule, which is sometimes called an *observed* or *equilibrium demand schedule*,[3] indicates what the demand for fishing days will be once prices in other markets, including the market for golfing days, have fully adjusted to the change in prices in the market for fishing days. Thus, D^* differs from the demand schedules D_{F_0} and D_{F_1}, which indicate the number of fishing days demanded at each price for fishing days, *holding the prices of all other goods constant*. As it is frequently difficult statistically to hold the prices of secondary goods constant while estimating the relation between price and quantity demanded in a primary market, empirically estimated demand schedules – the ones actually observed and available for use in a CBA – often more closely resemble equilibrium demand schedules such as D^* than "textbook-style" demand schedules such as D_{F_0} and D_{F_1}.[4]

Thus, the equilibrium demand schedule, D^*, is the one that is often used in practice to obtain a measure of the increase in social surplus resulting from the reduction in the price of fishing days. If so, however, the resulting measure, $P_{F_0}acP_{F_1}$, understates the true measure of the gain in social surplus in the primary market, $P_{F_0}abP_{F_1}$, by the triangular area *abc*. However, as previously suggested, area *abc* provides a good approximation of area *efg* in panel (b),[5] the area that should be subtracted from the social surplus gain in the primary market, area $P_{F_0}abP_{F_1}$, to obtain an accurate measure of the overall net gains from stocking the lake. In other words, area *abc* represents part of the benefits from the fish-stocking project and area *efg* an approximately offsetting cost of the project. Hence, by using the equilibrium demand schedule to measure the change in social surplus in the primary market for fishing, we incorporate social surplus changes that occur in the secondary market for golfing days, as well as those that occur in the market for fishing days. We do not have to obtain separate measures of the surplus changes that occur in secondary markets.[6]

This is important because it illustrates an important general point: by using an equilibrium demand schedule for the primary market – the type of demand schedule that is often empirically estimated, and thus available – one can capture the effects of policy interventions in both the primary market in which they were initiated *and* in all secondary markets. Thus, we can restate our earlier rule concerning project impacts in secondary markets: *we should ignore effects in undistorted secondary markets, regardless of whether there are price changes, if we are measuring benefits in the primary market using empirically measured demand schedules that were estimated without holding prices in secondary markets constant.*

7.2 Valuing Benefits and Costs in Distorted Secondary Markets

Unfortunately, the use of equilibrium demand schedules in primary markets misses some of the relevant effects that occur in distorted secondary markets – that is, in secondary markets in which prices do not equal social marginal costs. To see why, examine Figure 7.3, a slightly altered version of Figure 7.1(b). This new figure is based on the assumption that because of negative externalities, the market price of fishing equipment,

P_{F_0}, underestimates the marginal social cost by x cents. (Think of the equipment as lead sinkers, some of which eventually end up in the lake, where they poison ducks and other wildlife. The x cents would then represent the value of the expected loss of wildlife from the sale of another sinker.) In this case, the expansion of consumption involves a social surplus loss equal to x times $q_{E_1} - q_{E_0}$, which is represented in Figure 7.3 by the shaded rectangle. This loss, which is not reflected at all by market demand or supply schedules in the fishing market, should be subtracted from the benefits occurring in that market in order to obtain an accurate measure of net gains from the program.

Although the marginal social cost curve is drawn horizontal in Figure 7.3 for simplicity, actual schedules in distorted markets could be more complex. For example, congestion on roads may increase at an increasing rate, causing the marginal social cost curve to slope upward non-linearly. Indeed, immediately prior to traffic gridlock (sometimes called "breakdown"), the marginal social cost approaches infinity. In such situations, changes in the primary market that result in demand increases (decreases) in the secondary market can lead to substantial increases (decreases) in social costs in the secondary market, which should be counted in a CBA.

Another type of distortion in secondary markets is imposed by the presence of taxes. For example, Figure 7.4 illustrates local produce markets for beef and chicken, which are substitutes for one another. For simplicity, the supply schedules in both markets are assumed to be perfectly elastic. In the absence of any taxes on these products, the price of beef (the primary good) would be P_B and the price of chicken (the secondary good) would be P_C.

For the purposes of our illustration, let us assume that chicken is currently subject to a tax of t_C cents per pound, but beef is not presently taxed. In this situation, the existing demand schedules for beef and chicken are represented by D_{B_0} and D_{C_0}, respectively. As panel (b) of Figure 7.4 indicates, the tax on chicken provides the government

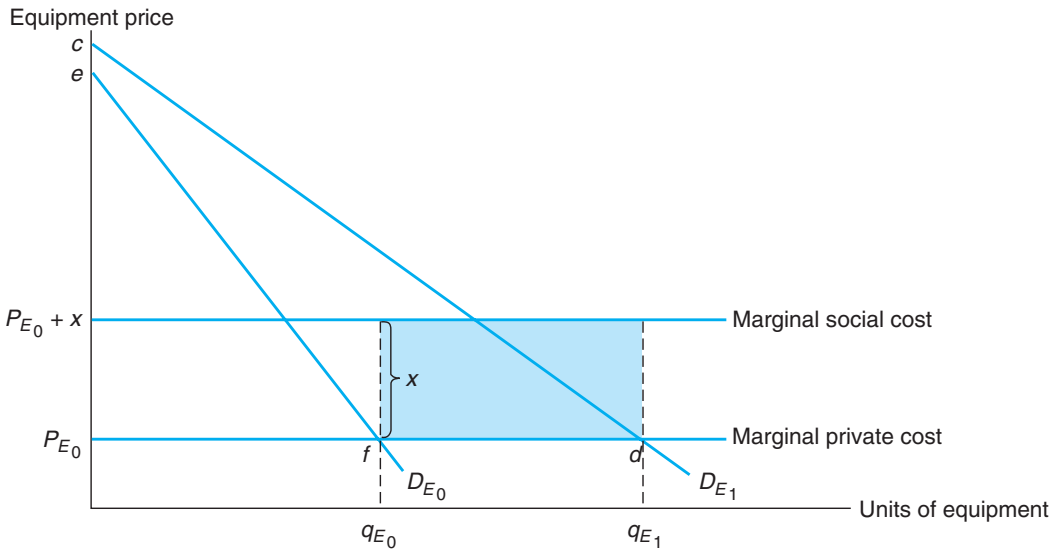

Figure 7.3 Distorted secondary market: market for fishing equipment (no price effect).

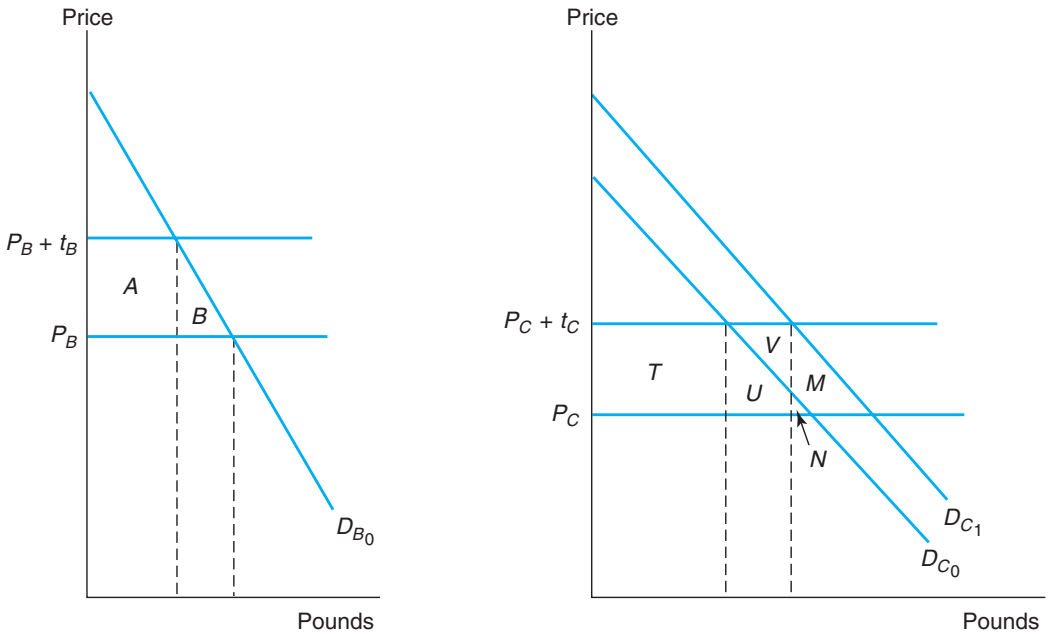

Figure 7.4(a) Market for beef.
Figure 7.4(b) Market for chicken.

with revenue equal to area T but reduces consumer surplus by areas $T + U$. Thus, the tax on chicken results in deadweight loss equal to the triangular area U.

Now assume that the government is considering imposing a tax of t_B cents per pound on beef. As indicated in panel (a), if the new tax is adopted, the government will collect revenue represented by area A, but consumers of beef will lose surplus equal to the areas $A + B$. Consequently, imposition of the new tax will result in deadweight loss in the beef market equal to area B.

The increase in the market price of beef shifts the demand schedule for chicken, a substitute, from D_{C_0} to D_{C_1}. For reasons discussed previously, this shift does not represent a change in consumer surplus. Indeed, the deadweight loss in the market for chicken remains the same, although it does shift from area U to areas $M + N$. However, the shift causes an increase in the sale of chicken, as consumers substitute chicken for beef, resulting in an increase in tax revenues collected by the government. This increase, which is represented in panel (b) by area $U + V$, is a benefit from the tax imposed on beef that could conceivably more than offset the deadweight loss occurring in the beef market. The various effects of the tax on beef are summarized in the following social accounting ledger:

	Benefits	Costs
Consumers	–	$A + B$
Government revenue	$A + U + V$	–
Social benefit and costs	$U + V$	B

Notice that while *all* of the change in consumer surplus takes place in the primary market, increases in tax revenues occur in both markets.

The important lesson from this illustration is that, unlike situations in which there are no distortions in secondary markets, benefits and costs of a policy intervention cannot be fully measured by observing only the effects that occur in primary markets. Effects that occur in distorted secondary markets should, in principle, be valued separately. A method for doing this is described in Exhibit 7.1. Yet, in practice and as indicated in the exhibit, it is usually very difficult to do so. Estimation problems usually preclude accurate measurement of welfare changes that occur in secondary markets. Estimating the own-price effect (how quantity demanded changes as the price of the good changes) is often difficult; estimating cross-price effects (how the quantity demanded of good Y changes as the price of good Z changes) is even more difficult. Consequently, we are rarely very confident of predictions of demand shifts in secondary markets. Moreover, when secondary markets are distorted, it is also difficult to measure the size of the distortions. (Recall the x-cent loss of wildlife from the sale of another sinker. How is the value of x to be estimated?) Nonetheless, such measures are usually needed if program effects in distorted secondary markets are to be taken into account.

Fortunately, price changes in most secondary markets are likely to be small. Most pairs of goods are neither strong complements nor strong substitutes. Hence, large price changes in the primary markets are usually necessary to produce noticeable demand shifts in the secondary markets. Thus, even when secondary markets are distorted, ignoring these markets may result in relatively little bias to CBA.

Exhibit 7.1

It is sometimes both desirable and feasible to build models of closely linked markets to estimate changes in social surplus. They are commonly referred to as *computable general equilibrium* (CGE) models, but this is a misnomer – they take account of a small set of the many markets that make up an economy and thus might be more accurately called computable multimarket equilibrium models. Considering multiple markets rather than limiting analysis to the equilibrium demand schedule in the primary market is appropriate when markets are not neatly separable because of externalities in consumption or production.

One application of CGE models is to assess policy changes in markets for heterogeneous goods with production externalities. For example, what is commonly referred to as the oil market involves the extraction of crude oils of various qualities in various locations, their transportation to refineries employing different technologies to produce petroleum products, and the sale of these petroleum products in various regional markets. George Horwich, Hank Jenkins-Smith, and David Weimer use such a model to assess the efficiency of various public policy responses to oil supply disruptions.

Constructing, calibrating, and using industry-level CGE models are demanding tasks that require substantial resources and thus often are not worth developing for purposes of a single CBA. For example, a proper CBA of changes in the capacity of O'Hare International Airport would require a model that takes account of the network externality inherent in the airline system – delays originating at O'Hare propagate to flights into and out of other US airports. Creating a CGE model of the US airline industry would likely be too costly a task for analysts doing a one-time study of a proposed O'Hare expansion, but might be an appropriate investment for the Federal Aviation Administration to provide as a tool for assessing the net benefits of any proposed airport expansions.

Despite the difficulty of creating useful CGE models, they are being increasingly used in policy analysis. For example, Thomas Nechyba has developed models of public education to take into account the effect of school outcomes on residential choice and the consequences of residential choice on student body composition and tax revenues, important factors in schooling outcomes.

Sources: George Horwich, Hank Jenkins-Smith, and David L. Weimer, "The International Energy Agency's Mandatory Oil-Sharing Agreement: Tests of Efficiency, Equity, and Practicality." In George Horwich and David L. Weimer, editors, *Responding to International Oil Crises* (Washington, DC: American Enterprise Institute for Public Policy Research, 1988), 104–33; Thomas J. Nechyba, "What Can Be (and What Has Been) Learned from General Equilibrium Simulation Models of School Finance?" *National Tax Journal*, 54(2), 2003, 387–414. See also Allen H. Klaiber and V. Kerry Smith, "Developing General Equilibrium Benefit Analyses for Social Programs: An Introduction and Example." *Journal of Benefit–Cost Analysis*, 3(2), 2012, 1–52.

7.3 Indirect Effects of Infrastructure Projects

Public infrastructure projects that improve transportation or communications, such as road building or harbor deepening, may substantially reduce the cost of production in some industries. These reductions in costs may have indirect effects in markets for consumption goods by reducing the prices at which the goods are sold. These indirect effects are similar but not quite the same as the secondary market effects that are the main topic of this chapter. In the case of secondary markets, a government policy influences prices in a primary market, which in turn influences demand in secondary markets in which goods that are complements of or substitutes for the primary market good are sold. In the case of an indirect effect, a government infrastructure project reduces the production costs of firms by reducing their expenditures on various inputs, and this direct effect of the project causes indirect effects by reducing prices in markets in which the goods produced by the firms are sold.

Although the two situations differ, both raise a similar question: can the change in social surplus that results from the government's policy be adequately measured by focusing on the market in which the intervention takes place? In both cases

the answer is similar: it can if the markets that are indirectly affected are not seriously distorted.[7]

We have already demonstrated this point when secondary market effects occur. To illustrate this in the case of indirect effects that result from public expenditures on infrastructure improvement, consider the harbor-deepening project that was discussed in Chapter 5. The direct effect of the project on shippers that use the harbor is a gain in surplus that is represented by area P_0abP_1 in Figure 5.3. However, the shippers do not necessarily keep this entire gain. Competitive pressures will likely result in firms paying lower prices for productive inputs that are shipped through the harbor. This, in turn, will cause cost curves in the markets in which these firms sell their goods to shift downward and to the right. If prices in these markets fall as a result, then consumer surplus will increase.

In competitive markets for these goods, this indirect gain in consumer surplus is already captured by the direct surplus gain represented by area P_0abP_1 in Figure 5.3.[8] The reason is that some of the surplus gains initially enjoyed by shippers are ultimately passed on to the buyers of consumption goods through the reductions in the prices of these goods. If markets where the indirect effects occur are distorted, however, then some of the changes in surplus in these markets may not be captured by surplus changes in the market where the direct effects take place. For example, the price reductions may engender increases in sales in markets with either positive or negative externalities. If so, third parties will enjoy an increase in surplus when positive externalities are present and will suffer a decrease in surplus when negative externalities exist. These changes are not reflected by the direct changes in surplus.

7.4 Secondary Market Effects from the Perspective of Local Communities

Advocates of localized recreational facilities – for example, advocates of new sports stadiums, museums, and parks – frequently contend that major benefits will occur in secondary markets. For example, they predict that the demand for the services of local restaurants, hotels, and other businesses will increase. In addition, they often claim that such projects result in *multiplier effects*; that is, as purchases from nearby businesses increase, these businesses will, in turn, also spend their newly gained revenues nearby, and this, in turn, will generate still more revenues that will be spent locally, and so forth.

As long as secondary markets in a community are not distorted, one should be very cautious in counting revenues from local projects that are generated by secondary market effects and multiplier effects as project benefits. There are several reasons for exercising this caution.

First, absent market distortions, these revenues are relevant only when standing is restricted to some group smaller than society as a whole, such as to residents of a specific geographic area. As discussed in this chapter, when society is broadly defined, such claims cannot be justified unless the secondary market is distorted. For example, in evaluating the fish-stocking project from the narrow perspective of the local county, one might count as a benefit increases in revenues received by local businesses resulting from non-residents buying fishing equipment in the county or frequenting local hotels

and restaurants. From the broader social or national perspective, however, these expenditures simply represent a transfer from non-residents to residents because they occur only as a result of consumers shifting their spending from one geographic area to another. Similarly, tax payments by non-residents may count as a local benefit, but would likely be offset by lower tax payments elsewhere with national standing.

Second, when standing is restricted to residents of a local community, any social surplus gains that accrue to non-residents as a result of a local project can no longer be counted as project benefits. For example, surplus gains enjoyed by sports team fans or owners who reside outside the community no longer count. Thus, the case for a local project could actually be stronger if standing is not restricted to the local community than if it is.

Third, as indicated earlier in this chapter, even if the demand for local products and services increases as a result of a local project, suppliers do not receive increases in surplus unless prices increase. Even when prices do increase, the resulting increase in producer surplus is at least partially offset because consumers who are residents of the local community must now pay more for goods and services and, as a result, lose consumer surplus. However, some residents may value the growth that occurs in the local economy in and of itself. Moreover, expansions in local businesses may provide some opportunities for taking advantage of economies of scale and, therefore, could produce benefits in the form of lower production costs.

Fourth, localized multiplier effects generally tend to be relatively small because local businesses are often owned by non-residents. Moreover, many of the purchases by local businesses are made outside the local area. Thus, expenditures made within a local area readily dissipate elsewhere, and this becomes increasingly true as standing is restricted to smaller geographic areas.

It is only when secondary markets are distorted that effects in these markets can potentially generate important benefits for the community. However, negative impacts can also occur, such as increases in pollution and congestion that result when non-residents use local roads to reach a recreational facility. Local projects are most likely to generate significant positive benefits in secondary markets when local rates of unemployment are high or other local resources are idle and substantial barriers to resource mobility exist. Under such circumstances, increases in demand in secondary markets and the multiplier effects that accompany these demand increases could significantly reduce levels of unemployment and increase the utilization of other idle resources such as empty buildings. The utilization of idle resources such as empty buildings has very low opportunity costs, and as discussed in Chapter 6, large increases in surplus accrue to many unemployed workers when they are hired. However, as also pointed out in Chapter 6, it is only when the rate of unemployment is fairly high that a substantial fraction of those hired are likely to be drawn from the ranks of the unemployed.

7.5 Conclusion

Most of the key concepts from Chapters 5, 6, and 7 are summarized in Table 7.1. As the table indicates, changes in social surplus serve as the basis for measuring the costs and

benefits of policies. The concept of opportunity cost helps us value the inputs that policies divert from other uses; the concept of WTP helps us value policy outputs. The key to valuing outputs is to identify the primary markets in which they occur. When the outputs are not traded in organized markets, ingenuity is often needed to infer supply and demand schedules (remember the market for "fishing days"). For this purpose, various shadow pricing techniques, such as those discussed in Chapters 14–17 of this book, are often needed. Costs and benefits that occur in undistorted secondary markets are typically very difficult to value, but generally need not and, indeed, should not be added to costs and benefits that are measured in primary markets. Doing so will usually result in double counting.

The rules that appear in Table 7.1 cannot be used without first determining the type of market in which the various potential impacts of a project or program occur – input, output, or secondary market – and then determining whether the market is efficient or inefficient. In practice, this is sometimes difficult. To illustrate the sorts of judgments that must be made in practice, we conclude by listing selected impacts of a

Table 7.1 *Rules for Measuring Social Benefits and Costs of Government Interventions*

Type of intervention	Efficient markets	Inefficient markets
Change in input markets (Concept: value costs as the opportunity cost of the purchased resources.)	If supply schedule is flat, value cost as direct budgetary expenditure. (Example: purchase of materials from a competitive national market.) If supply schedule is not flat, value cost as direct budgetary expenditure less (plus) any increase (decrease) in social surplus in market. (Example: purchases of materials from a competitive local market.)	Value costs as direct budgetary expenditure less (plus) any increase (decrease) in social surplus in market. (Examples: hiring unemployed labor; purchases of materials from a monopoly.)
Changes in output markets (Concept: value benefits as WTP for the change and costs as WTP to avoid the change.)	Value change as net change in social (i.e., consumer and producer) surplus plus (less) any increase (decrease) in government revenues. (Example: government provision of goods and services to consumers or producers.)	Value change as net change in social (i.e., consumer, producer, and third party) surplus plus (less) any increase (decrease) in government revenues. (Example: tax or subsidy in market with externality.)

(continued)

Table 7.1 (cont.)

Type of intervention	Efficient markets	Inefficient markets
Changes in quantities exchanged in secondary markets as a result of government intervention in input or output markets (Concept: commodities exchanged in secondary markets are typically complements of or substitutes for commodities exchanged in primary markets; most impacts in secondary markets can be valued in primary markets.)	If prices do not change in secondary market, ignore secondary market impacts. If prices do change, but benefits in primary market are measured using a demand schedule with other market prices held constant, then social surplus changes in the secondary market will always represent reductions in social surplus that should be subtracted from changes in the primary market. However, if benefits in the primary market are measured using a demand schedule that does not hold other prices constant, ignore secondary market impacts. (Example: price changes in primary market cause demand schedule shifts in competitive secondary market.)	Costs or benefits resulting directly from increases in the size of the distortion should, in principle, be measured. Other impacts in secondary market should be ignored if prices do not change. (Example: price change in primary market causes the demand schedule to shift in a secondary market with an externality.)

These rules pertain only to measuring impacts of government interventions on society as a whole. Issues concerning standing are ignored in the rules.

hypothetical street-widening project that would substantially increase traffic along the route and ask the reader to consider what type of market each occurs in and, hence, whether each should be included in a cost–benefit analysis of the project. Our own judgment concerning each, which is based on the assumption that surplus gains by those who drive on the street are measured by using an equilibrium demand schedule for trips, appears in Exhibit 7.2.

Exhibit 7.2

1. The increased traffic would cause vibrations that crack the walls of adjacent houses.The cracked walls in houses that would result from the increased traffic are a negative externality. Although the externality would occur in the secondary market for housing, it should be taken into account in the study.
2. Profits of gasoline at filling stations that are located along the route would increase.The increased purchases of gasoline would occur in a secondary market. If this market is not seriously distorted (e.g., by externalities or monopoly power), then the increase in gasoline purchases should be ignored because any effects on surplus will be captured by measuring surplus in the output market. (Notice, however, that doing this neglects the fact that it is the owners of the filling stations, rather than automobile drivers, who receive the increase in surplus from increased purchases of gasoline; it also ignores the possibility that filling station owners who are located on other streets may face reductions in surplus.)
3. The property values of these stations would also increase.The property market is also a secondary market. Hence, these effects should be ignored.
4. Traffic on adjacent streets would decline. Therefore, the remaining motorists would experience quicker and cheaper journeys.The decrease in traffic on adjacent streets can be viewed as a reduction in a negative externality – congestion – that distorts a secondary market (the adjacent streets are presumably substitutes for the street that would be widened). This is a real benefit that should be taken into account.
5. Air pollution along the route would increase. Air pollution is a negative externality that distorts the output market. Hence, it should be taken into account.
6. The increased auto traffic would require the city to hire three more police officers to enforce traffic regulations.The hiring of three additional police officers would take place in an input market for labor and can be viewed as a direct cost of the project.
7. The greater number of motorists would lead to an increased number of traffic violations, and the resulting fines would mean that the city receives increased revenue.The increase in traffic fines would simply be a transfer between motorists and the city and, except for their distributional implications, can be ignored.
8. Fewer people would ride buses; as a consequence the bus company would lay off 10 bus drivers.The 10 laid off bus drivers would lose their

jobs because the demand schedule in the secondary market for public transportation would shift to the left. Unless this market or the factor markets that serve this market are distorted, the shift in demand can be ignored. Examples of such distortions are the loss of monopoly profits by the bus company or the inability of the bus drivers to find new jobs because of high rates of unemployment. Otherwise, the bus drivers would simply find new jobs at a similar level of compensation, implying that widening the road would have no effect on the social value of the output they produce.

9. Widening the road would necessitate cutting down a number of trees. These trees would then be sold to a nearby sawmill.The benefits and costs of cutting down the trees and selling them to a sawmill can be assessed independently of the street-widening project. If the benefits from cutting down the trees exceed the costs, then the trees should be cut regardless of whether the street-widening project is undertaken. However, if the costs exceed the benefits, then the costs and benefits of cutting the trees should be included in the CBA of the street-widening project.

Exercises for Chapter 7

1. Recall exercise 1 from Chapter 5 in which an increase in the toll on a highway from \$.40 to \$.50 would reduce use of the highway by 5,000 cars per week.
   a. Because of the reduced use of the highway, demand in the secondary market for subway rides increases. Assuming that the price of subway rides is set equal to the marginal cost of operating the subway and marginal costs are constant (i.e., the supply schedule is horizontal), and no externalities result from the reduced use of the highway and the increased use of the subway, are there additional costs or benefits due to the increased demand for subway rides? Why or why not?
   b. Because of the reduced use of the highway, demand in the secondary market for gasoline falls by 20,000 gallons per year. There is a stiff tax on gasoline, one that existed prior to the new toll. Assuming that the marginal cost of producing gasoline is \$1 per gallon, that these marginal costs are constant (i.e., the supply schedule is horizontal), that no externalities result from the consumption of gasoline, and that the gasoline tax adds 30 percent to the supply price, are there any additional costs or benefits due to this shift? If so, how large are they?
2. Recall exercise 2 from Chapter 5 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 $7 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 the annual consumption of coal rises by 40 million short tons, but the price of coal remains unchanged.

3. Recall exercise 2 from Chapter 5 in which a country imposes an import fee on the crude oil it imports. Imagine that all the crude oil imports to the country are made by ships owned by its nationals. The Association of Petroleum Shippers argues that the reduction in imports resulting from the import fee will drive down the price of shipping services and thereby inflict a loss on them. The Committee for Energy Independence, which favors the import fee, argues that the reduction in shipping prices will benefit consumers of shipping services. Which argument is correct? In preparing an answer, make the following assumptions: the import fee will reduce the quantity of imported crude oil from 3 billion to 2.5 billion barrels per year; the reduction in barrels shipped will drive per-barrel shipping costs down from $4 per barrel to $3 per barrel; and the elasticity of demand in the shipping market at the new equilibrium ($3, 2.5 billion barrels) is −0.3. Also assume that the shipping market is undistorted and that the prices of other goods, including shipping services, were held constant in estimating the demand schedule for crude oil.

4. (Instructor-provided spreadsheet recommended.) Consider an individual's utility function over two goods, q_m and q_s, where m indicates the primary market in which a policy will have its effect and s is a related secondary market:

$$U = q_m + \alpha q_s - (\beta_m q_m^2 + \gamma q_m q_s + \beta_s q_s^2)$$

where α, β_m, β_s, and γ are parameters such that $\beta_m > 0$, and $\beta_s > 0$, $\beta_m < (1 - \gamma q_s)/2q_m$, $\beta_s < (1 - \gamma q_m)/2q_s$, and $\gamma < p_m\beta_s/p_s + p_s\beta_m/p_m$. For purposes of this exercise, assume that $\alpha = 1$, $\beta_m = 0.01$, $\beta_s = 0.01$, and $\gamma = -0.015$. Also assume that the person has a budget of \$30,000 and the price of q_m, p_m, is \$100 and the price of q_s, p_s, is \$100. Imagine that the policy under consideration would reduce p_m to \$90.

The provided spreadsheet has two models. Model 1 assumes that the price in the secondary market does not change in response to a price change in the primary market. That is, p_s equals \$100 both before and after the reduction in p_m. Step 1 solves for the quantities that maximize utility under the initial p_m. Step 2 solves for the quantities that maximize utility under the new p_m. Step 3 requires you to make guesses of the new budget level that would return the person to her original level of utility prior to the price reduction – keep guessing until you find the correct budget. (You may wish to use the Tools|Goal Seek function on the spreadsheet instead of engaging in iterative guessing.) Step 4 calculates the compensating variation as the difference between the original budget and the new budget. Step 5 calculates the change in the consumer surplus in the primary market.

Model 2 assumes that $p_s = a + bq_s$. Assume that $b = 0.25$ and a is set so that at the quantity demanded in step 2 of model 1, $p_s = 100$. As no analytical solution for the quantities before the price change exists, step 1 requires you to make guesses of the marginal utility of money until you find the one that satisfies the budget constraint for the initial p_m. Step 2 repeats this process for the new value of p_m. Step 3 requires you to guess both a new budget to return the person to the initial level of utility and a marginal utility of money that satisfies the new budget constraint. A block explains how to use the Tools|Goal Seek function to find the marginal utility consistent with your guess of the new budget needed to return utility to its original level. Step 4 calculates the compensating variation. Step 5 calculates the change in the consumer surplus in the primary market and bounds on the change in consumer surplus in the secondary market.

Use these models to investigate how well the change in social surplus in the primary market approximates compensating variation. Note that as utility depends on consumption of only these two goods, there are substantial income effects. That is, a price reduction in either of the goods substantially increases the individual's real income. Getting started: the values in the spreadsheet are set up for a reduction in p_m from \$100 to \$95. Begin by changing the new primary market price to \$90 and resolving the models.

Notes

1. For a helpful analysis that uses a somewhat different approach than the one presented in this section but reaches very similar conclusions, see Herbert Mohring, "Maximizing, Measuring, and Not Double Counting Transportation-Improvement Benefits: A Primer on Closed- and Open-Economy Cost–Benefit Analysis." *Transportation Research*, 27(6), 1993, 413–24.

2. As advocates of a policy often claim benefits in secondary markets, it is ironic that demand shifts in undistorted secondary markets that cause price changes always involve losses in social surplus. This can be seen by using panel (b) in Figure 7.2 to illustrate the case of an outward shift in demand in a secondary market, as well as the case of an inward shift in demand. Simply take D_{G_1} as the original demand schedule and D_{G_0} as the post-project demand schedule. Using the post-project demand schedule for measuring social surplus changes, we see that the price increase from P_{G_1} to P_{G_0} results in a producer surplus increase equal to the area of trapezoid $P_{G_1}fgP_{G_0}$ and a consumer surplus loss equal to the area of $P_{G_1}hgP_{G_0}$ so that social surplus falls by the area of triangle fgh.

3. See Richard E. Just, Darrell L. Hueth, and Andrew Schmitz, *Applied Welfare Economics and Public Policy* (Englewood Cliffs, NJ: Prentice Hall, 1982), chapter 9.

4. For greater detail concerning this point, see Just, Hueth, and Schmitz, *Applied Welfare Economics and Public Policy*, 200–13.

5. Indeed, under certain assumptions, areas *abc* and *efg* will almost exactly equal one another. The most important of these assumptions is that the price changes in the two markets represented in Figure 7.2 are small and that no income effects result from these price changes. If there are no income effects, there will be symmetry in substitution between the two goods. In other words, their cross-substitution effects will be equal. That is, $\partial q_F/\partial P_G = \partial qG/\partial P_F$. Therefore, $\Delta P_F \Delta q_F \approx \Delta P_G \Delta q_G$. Hence, area *abc* approximately equals area *efg*. Typically, income effects do occur as a result of price changes, but as discussed in Appendix 3A, these effects tend to be small for most goods. Consequently, one would anticipate that area *abc* would generally closely approximate area *efg*.

6. Separate measures would have to be obtained, however, to examine how benefits and costs were distributed among various groups. For example, area *abc* is a gain to consumers, while area *efg* is a loss to producers. To the extent these two areas are equal, they represent a transfer of surplus from producers to consumers. In addition, surplus corresponding to area $P_{G_0}efP_{G_1}$ is also transferred from producers to consumers.

7. For a detailed analysis of the secondary market effects of transportation and land use projects, see David M. Newberry, "Spatial General Equilibrium and Cost–Benefit Analysis," in K. Puttaswamaiah, editor, *Cost–Benefit Analysis: Environmental and Ecological Perspectives* (New Brunswick, NJ: Transaction Publishers, 2002), 1–18.

8. For a formal demonstration of this assertion, see Jan Rouwendal, "Indirect Welfare Effects of Price Changes and Cost–Benefit Analysis," unpublished paper (Amsterdam: Tinbergen Institute Discussion Paper No. 02–011/3, 2002).