5 Cost–Benefit Analysis

Nothing in all the world is more dangerous than sincere ignorance and conscientious stupidity.

Martin Luther King (1963)

CHAPTER SUMMARY. Properly done, cost–benefit analysis is a precise process for measuring the increase or decrease in household well-being attendant upon a change in economic circumstances. Cost–benefit analysis identifies and separates the components of utility change so that they are exhaustive and mutually exclusive. Here, we construct a theory to do that, interpret it, and explain how the derived forms apply to the expansion of casinos, an application that needs to allow for externalities. This chapter is notationally demanding, but the benefit is that once the methodology is completed, and the mathematics have done the work for us, we can be confident in the results. The main contribution of this chapter is the accurate listing of costs and benefits.

The literature on the costs and benefits of casino gambling is fraught with inadequacy and confusion. Even studies that purport to evaluate the economic impact of casinos commonly exhibit a great deal of misunderstanding about what should be included among benefits and costs, and provide little or no guidance about how the costs and benefits relate to one another or should be computed. In general, the costs and benefits discussed are casually listed, vary by study, and are presented with little or no justification of how they were selected. There is no appeal to theory to explain why other potential costs or benefits were excluded. We saw in Chapter 4 why the claim that jobs are an economic benefit of casinos confuses the means to social welfare with the ends.

One discussion of the costs and benefits of gambling identified three principal benefits of casinos: (1) gain in utility (for those gambling in moderation for entertainment); (2) ancillary economic benefits such as "job creation, investment stimulation, tourism development, economic development or redevelopment, urban or waterfront revitalization, or the improvement of the economic status of deserving or underprivileged groups;" and (3) additional revenues to the public sector.[172] The author listed two principal costs: (1) "moral disapproval," and (2) "fears of adverse social impacts," such as pathological gambling, crime, or political corruption.[173] The net increase in profits to business, unless it is meant to be part of ancillary economic benefits, is absent from the list of benefits.[174] Although this author listed gain in utility (clearly internal to the individual or household) as a benefit, he wrote that "many of the costs identified are internal to the individual or the household, as opposed to external – borne by society – and are therefore difficult to place into a cost–benefit framework." This view of costs (including the references to moral disapproval and fears of consequences instead of the actual consequences) suggests that the author believes costs are more subtle and possibly less tangible than benefits. However, because the process that was used to determine how items were included was not explained, there is little theoretical guidance about how the identified cost–benefit components relate to one another or how competing costs and benefits are reconciled.

This chapter shows how cost–benefit components based on utility are derived in a proper evaluation framework. The theory generates a taxonomy for costs and benefits that is exhaustive, internally consistent, utility-based, and theoretically sound. Although the primary purpose of Chapter 5 is to apply cost–benefit theory to evaluating casinos, the methodology applies generally to the evaluation of other industries.

THEORY

SUMMARY. Cost–benefit analysis measures citizen well-being in common units that can be added and compared. It is possible to separate the components of the change in individual well-being into mutually exclusive and exhaustive components. The benefits, if present, of a new business activity include the following:

- net increase in profits measured across all businesses
- net increase in taxes measured across all taxpayers
- consumer surplus (benefits to consumers from lower prices)
- distance consumer surplus (consumer benefits from nearer access to a casino)
- capital gains to consumers induced by the activity
- gains from relaxation or elimination of nonprice constraints on consumer choices

The costs of a new business activity, if present, are as follows:

- real resources consumed to deal with harmful externalities

(Note: Benefits with a negative sign are traditionally counted as costs. Thus, some items on the benefit list also could be costs.)

Our cost–benefit framework can be as comprehensive and general as desired, although our use of it in this chapter provides just enough detail to include all of the major elements commonly thought to be relevant to the economics of gambling. We will supply enough explanation to allow a more detailed application of the framework, if desired.

Our starting point is the individual household's change in utility, $u_i^1 - u_i^0$, where subscript i identifies the household, u is the numerical level of utility, and superscripts 0 and 1 applied here and to other

Multiple Types of Gambling

For simplicity's sake, we presume that gambling is a standardized good and that casinos offer gambling on essentially the same terms as casinos in other locations. That is, the returns to playing roulette, slot machines, or a blackjack game are approximately the same regardless of where offered. The framework can be modified at the cost of more detail to allow for different qualities of gambling. In this case, the model would deal with multiple imperfectly substitutable goods.

variables throughout the analysis distinguish the "before" and "after" situations, respectively. To fix ideas, we will assume that casinos are geographically widespread in the final situation (Alternative 1) and less widely spread initially (Alternative 0). We assume that $u_i(x_i, x_i^g)$ is a utility function satisfying standard properties[175] defined on consumption bundle (x_i, x_i^g), where x_i is a listing of the economy's private goods, of which there are K types, and x_i^g is a listing of public goods, of which there are L types. A positive element of (x_i, x_i^g) denotes consumption of a good or service by the household, whereas a negative component indicates that the household is a provider of the good or service. In this, we follow standard general equilibrium accounting conventions for describing inputs and outputs. For example, the provision of 10 hours of labor by the individual would appear as -10 in the labor component of x_i, whereas consumption of 6 pounds of fish would appear as a positive number in the fish component.

The spread of a new business sometimes provides advantages to households in the form of amenity benefits. By these, we mean changes to the environment of the consumer that directly improve his or her well-being, but that do not operate through prices or the consumer's income. For example, in the case of casinos, the primary advantage to the household of more casinos is better proximity to the nearest one. Distance consumer surplus, introduced in Chapter 4, captures the

consumer's value for this amenity. Distance consumer surplus refers to the amount of money the consumer could give up when a casino is a shorter distance away and be no worse off than the alternative situation when the casino was farther away. From the household's perspective, proximity is a given feature of the economic environment, as are the available public goods x_i^g provided by noncasino sources and the prices that the household faces in the marketplace. All three need to be accounted for.

Next, relate utility to dollars as follows. Define the expenditure function $e_i(d_i, x_i^g, p_i, u_i)$ as the minimum expenditure needed to achieve utility u_i when prices are p_i, d_i is the distance to the nearest casino, and public goods are provided in the amount x_i^g. The expenditure function increases for larger u_i for fixed choice of d_i, x_i^g, and p_i. The sign of $e(d_i^1, x_i^{g1}, p_i^1, u_i^1) - e(d_i^1, x_i^{g1}, p_i^1, u_i^0)$ is identical to the sign of $u_i^1 - u_i^0$. Given distance, public goods, and prices, therefore, $e(d_i, x_i^g, p_i, u_i(x_i, x_i^g))$ is itself a utility function that reports utility in dollar units. That is, \$100 of utility is the utility that can be achieved by optimally spending \$100 at prices p_i with nearest casino d_i miles away when public goods x_i^g are provided.

We want to compare social welfare between situations 0 and 1. By definition, the changes in welfare that result for all households in the move from the original situation to the final one are the social costs and benefits of the change. The approach described thus far provides the framework for analyzing this change:

$$\Delta W = \sum_i w_i \left[e_i \left(d_i^1, x_i^{g1}, p_i^1, u_i^1 \right) - e_i \left(d_i^1, x_i^{g1}, p_i^1, u_i^0 \right) \right] \quad (5.1)$$

where w_i are the social weights accorded to the utility of each household, $\sum_i w_i = m,\ m_i > 0$, and m is the number of consumer households. In applying Equation 5.1, we must identify how we handle a number of issues.

- We assume that a dollar of value to one household is equal to a dollar of value to another. With respect to Equation 5.1, this implies that w_i is the same for all households. The transfer of wealth in gambling

is generally from relatively poor to relatively wealthy. Therefore, if we believed that a dollar generates more utility for rich than poor, our assumption would understate the social benefits. If we believed that a dollar generates more utility for the poor than the rich, our assumption understates the social costs of casinos. The assumption of equal value across households also implies that firm profits do not need to be assigned artificial premia or discounts based on which individuals or households happen to own them.[176]

- One desirable implication of our assumption is that firm profits are equally important to social welfare regardless of which firm generates them. For example, casino profits are valued the same as the profits of a noncasino firm.
- To allow for regional tax differences, households and firms may face different prices. In an extreme case, each firm and household could have a different, personalized set of prices. Household i faces prices p_i, firm j faces prices p_j, and endowments ω (i.e., goods of the K types available in the economy that are not produced in the current period but are inherited from nature or the past) are traded at prices p_ω.
- We allow for the possibility that consumers may be constrained in their market decisions by factors other than price and income. We often refer to these as **transactions constraints**. The most important example would be constraints on labor supply that result in unemployment. People have a reservation wage above which they are willing to work, but cannot always find a job at that wage, and lowering their asking wage will not increase the chances of their getting a job.
- Firms and economy endowments ω are owned by households. Household i owns share θ_{ij} of firm j, $\sum_i \theta_{ij} = 1$, and endowment ω_i, where $\sum_i \omega_i = \omega$, the economy endowment vector.
- The government uses tax revenues to buy goods and services and to provide public goods.[177] The government does not publicly provide private goods, although this complication could be added to the model. The relevant feature for the analysis is that real resources are used to produce the goods provided by the government. Hence, taxes

paid by casinos and other firms are a social benefit because they make available more resources to provide utility-raising goods to the public. Holding the quantities of public goods constant, taxes *paid* by the public reduce their welfare by shrinking their ability to consume goods and services.

- In addition to direct benefits and costs, casinos may generate positive or negative externalities. In general, positive externalities are helpful effects from an activity on an agent different from the one undertaking the activity that do not operate through markets and that are not reaped by the agent creating them. Negative externalities are the same as positive externalilities, except that their effects on other agents are harmful. For example, if a casino's presence reduces crime in an area, leading to less need for police presence, this frees resources to the rest of the community and represents a positive externality. The firm creating the positive externality does not personally benefit from the effect. If the reverse is true, and the casino increases the need for police, real resources are removed (paid for by the public in taxes), which is a negative externality.
- Although it is not strictly necessary for deriving a working cost–benefit measure, sketching some of the background details of the production side of the economy may be helpful to some readers. Production is conducted by firms and government. The production choice of agent j is described by its list of inputs and outputs $(y_j, y_j^g, -y_j^G) \in Y_j$, where Y_j is the $(K + 2L)$-dimensional set of feasible production choices. The production set is assumed to satisfy standard assumptions, such as being nonempty, closed, and convex. y_j is the K-dimensional vector listing private goods. Following the usual convention, an element in y_j with a positive sign denotes an output and an element with a negative sign denotes an input. y_j^g in L-dimensional space is the vector of public goods produced by agent j. y_j^G, also L-dimensional, lists the public goods available for use as inputs in the production of agent j. The capital letter G denotes the publicness of the list of public goods; all firms can use the same public-good inputs. The negative sign before y_j^G indicates that y_j^G are inputs to the firm.

Social accounting in real terms requires that

$$x + r = y + \omega + z \tag{5.2}$$

$$x_i^g = \sum_j y_j^g = -y_j^G \tag{5.3}$$

where $x \equiv \sum_i x_i$ is aggregate consumption of private goods, and $y \equiv \sum_j y_j$ is aggregate current production of private goods. Consumption of public goods by households x_i^g and use of public goods as inputs by firms y_j^G each equal the available economy supply $\sum_j y_j^g$ because of their public-good feature. z is the economy trade vector. Although it, too, is not central to our discussion, we include z to be consistent with the general framework we develop. Components of z are economy excess demands for traded goods. A zero denotes a nontraded good, a positive entry denotes imports. The vector r of nonnegative numbers in K-dimensional space denotes resources taken out of the productive system. These are resources used to deal with harmful externalities and to produce public goods. A car used by police, and not available to provide utility to households, would come from the car services component of r, for example. Because utility depends on (x_i, x_i^g) and not r, the drain of goods and services implies real utility cost to households.

Consider the following carefully chosen identity, a telescoping sum where each term cancels part of the preceding term:

$$\sum_i \left[e_i \left(d_i^1, x_i^{g1}, p_i^1, u_i^1 \right) - e_i \left(d_i^1, x_i^{g1}, p_i^1, u_i^0 \right) \right] =$$

$$\sum_i \left[e_i \left(d_i^1, x_i^{g1}, p_i^1, u_i^1 \right) - p_i^1 \cdot x_i^1 \right] \tag{5.4}$$

(Transactions Constraints in Situation 1)

$$+ \sum_i \left[p_i^1 \cdot x_i^1 - p_i^0 \cdot x_i^0 \right] \tag{5.5}$$

(Income Effects)

$$+\sum_i \left[p_i^0 \cdot x_i^0 - e_i\left(d_i^0,\, x_i^{g0},\, p_i^0,\, u_i^0\right)\right] \tag{5.6}$$

(Transactions Constraints in Situation 0)

$$+\sum_i \left[e_i\left(d_i^0,\, x_i^{g0},\, p_i^0,\, u_i^0\right) - e_i\left(d_i^0,\, x_i^{g1},\, p_i^0,\, u_i^0\right)\right] \tag{5.7}$$

(Public Good Effect)

$$+\sum_i \left[e_i\left(d_i^0,\, x_i^{g1},\, p_i^0,\, u_i^0\right) - e_i\left(d_i^1,\, x_i^{g1},\, p_i^0,\, u_i^0\right)\right] \tag{5.8}$$

(Distance Consumer Surplus)

$$+\sum_i \left[e_i\left(d_i^1,\, x_i^{g1},\, p_i^0,\, u_i^0\right) - e_i\left(d_i^1,\, x_i^{g1},\, p_i^1,\, u_i^0\right)\right]. \tag{5.9}$$

(Consumer Surplus)

We now explain what the components in Equations 5.4 through 5.9 tell us. Start with Equation 5.4. Recall that $e_i(d_i^1,\, x_i^{g1},\, p_i^1,\, u_i^1)$ by definition is the *least* costly way of achieving the utility u_i^1 that was actually achieved in Situation 1. Consumption bundle $(x_i^1,\, x_i^{g1})$ satisfies $u^1 = u(x_i^1,\, x_i^{g1})$ and thus is one way to achieve utility u^1. If bundle x_i^1 – the choice actually made by the consumer in Situation 1 – is not the cheapest way to achieve utility u_i^1, then Equation 5.4 is positive and the consumer's choice must have been constrained. Otherwise, why would the consumer choose a more costly bundle to achieve the same utility? Thus, the cost difference in Equation 5.4 is the amount of money the individual would be willing to pay to remove the constraint.

We will interpret Equation 5.5 at the end of the discussion because it needs one more manipulation before we are ready to give it meaning.

Equation 5.6 measures the welfare impact of transactions constraints on the consumer in Situation 0. Its interpretation is the same as Equation 5.4 was for Situation 1.

The telescoping sum requires the presence of Equation 5.7, which measures the value to households of the change in public goods provided between the initial and final situations.[178] The government pays for the public goods it provides with tax dollars. The formula in

Equation 5.7 allows for the worth of those public goods to be above or below the cost of the inputs needed to make them. Government using $100 to pay for public goods that the public values at $65, for example, would constitute inefficient or wasteful government. It is not our purpose to discuss whether getting more taxes to the government increases the amount wasted, for example, so we will speak as if additional taxes produce public goods of value equal to the cost of the resources used to produce them. We could also allow for the possibility that the government rebates some tax dollars in a lump-sum fashion back to the private citizens who use them to purchase private goods and services. Either way, the additional taxes received by government and paid by business represents a benefit to consumers.

Distance consumer surplus, Equation 5.8, measures the value to the consumer of having the nearest casino distance d_i^1 away compared to distance d_i^0. For example, in the initial situation, the consumer needed $e_i(d_i^0, x_i^{g1}, p_i^0, u_i^0)$ to reach initial utility. When the nearest casino is closer, distance $d_i^1 < d_i^0$, the income needed to maintain original utility, $e_i(d_i^1, x_i^{g1}, p_i^0, u_i^0)$, is smaller (presuming the individual likes to gamble). The difference in Equation 5.8, therefore, is the amount the consumer would be willing to pay to have the nearest casino closer.

Equation 5.9 is the conventional measure of consumer surplus. It measures the amount of money that the consumer would be willing to give up to have better prices. The only difference between the two terms in Equation 5.9 is the price vector. If prices p_i^1 are better for the household than prices p_i^0 (i.e., lower for goods purchased and/or higher for goods sold, such as labor), then Equation 5.9 is positive.

We now turn to Equation 5.5, which we postponed. To revise it, use the aggregated household budget identity

$$\sum_i p_i \cdot x_i = \Pi + p \cdot \omega + T - E \tag{5.10}$$

where Π is the after-tax profit of firms in the economy, $p \cdot \omega$ is the income from endowments, T is taxes collected, and E is expenditure on resources r used to deal with externalities and provide public goods.[179]

The key consideration is that E represents expenditure on real resources taken from the economy. Differencing Equation 5.10 between the initial and final situations[180] yields

$$\sum_i \left[p_i^1 \cdot x_i^1 - p_i^0 \cdot x_i^0 \right] = \Delta\Pi + \Delta p \cdot \omega + \Delta T - \Delta E. \qquad (5.11)$$

Thus, Equation 5.5 measures benefits appearing as net increase in profits to firms, increased value of household endowments, the net change in taxes collected, and the increased use of economy resources by government due to the shift from the initial to the final situation.[181]

Substituting Equation 5.11 into Equation 5.5, writing the distance effects in differential form, and rearranging gives the following overall taxonomy of cost–benefit elements that we seek:

$$\begin{aligned}
\Delta W &\equiv \sum_i \left[e_i \left(d_i^1, x_i^{g1}, p_i^1, u_i^1 \right) - e \left(d_i^1, x_i^{g1}, p_i^1, u_i^0 \right) \right] \\
&= \sum_j \Delta\Pi_j + \Delta T + (5.9) \\
&\quad + \left(\sum_i \int_{\mathrm{d}_i^0}^{\mathrm{d}_i^1} \frac{\partial e_i}{\partial \mathrm{d}_i} d\mathrm{d}_i \right) + \Delta p_\omega \cdot \omega + (5.7) \\
&\quad + (5.4) + (5.6) - \Delta E \\
&= \text{Change in Profits} + \text{Change in Taxes} \qquad (5.12) \\
&\quad + \text{Consumer Surplus} + \text{Distance Consumer Surplus} \\
&\quad + \text{Capital Gains} + \text{Public Good Effect} \\
&\quad + \text{Transactions Constraints}^1 + \text{Transactions Constraints}^0 \\
&\quad - \text{Externality Costs.}
\end{aligned}$$

The nine components in Equation 5.12 are an exhaustive and exact tabulation of the elements that measure the economic effects of a new industry – in this case, casinos. Moreover, Equation 5.12 with Equations 5.4–5.9 shows precisely *how* each term should be computed. Whether a component is a cost or a benefit depends on the sign. Normally, profits are

Unemployment

The introduction of a new industry or business might be able to temporarily reduce unemployment below what it would have been otherwise. Discovering what the time path of unemployment would have been with and without the industry present is extremely difficult to do.

A significant amount of promotional material purports that casinos decrease unemployment, but fails to prove what employment *would have been* in the absence of casinos. Most casinos were introduced after 1991, when the country was recovering from the recession of 1990–91. The period from 1991 to 2001 also coincided with the longest economic expansion in American history. As the country emerged from the recession, unemployment declined in areas with and without casinos. If casinos *temporarily* reduced unemployment faster than it would have fallen otherwise, this transitory effect could correctly be counted as a benefit of casinos. However, we know of no study that has made this case. On the contrary, the failure to account for the decline in unemployment that would have occurred anyway leads to a classic *post hoc, ergo propter hoc* fallacy of logic. An example appears in Chapter 4, which discussed The Evans Group (1996). Although The Evans Group argued that casinos reduced unemployment, its study did not report that areas without casinos with comparable starting unemployment rates experienced comparable and, in many cases, larger reductions in the unemployment rate.

expected to be a benefit because introducing a new activity is expected to create profits for the entering firm. The term in Equation 5.12 requires something different, however. The introduction of the new industry must cause the profits summed over all firms to rise. Only if net profits increase is the contribution of profits positive. Higher net profits, of course, is beneficial because it implies that there is more income available for the purchase of goods and services to those who own the profits. Increased taxes are also typically expected to be on the benefit side of the ledger because taxes collected from casinos enter government coffers and are used to provide utility-enhancing goods to citizens. Better access to casinos is a benefit to those who gamble, but consumer surplus is typically

TABLE 5.1. Summary of Casino Costs and Benefits

Benefits	Costs	Cost or Benefit as Applicable
Higher Profits	Externality	Transactions Constraints
Higher Tax Collections	Costs	Capital Gains
Distance Consumer Surplus		Consumer Surplus

not a consideration because prices of gambling or other products are not usually lower because of gambling. The primary costs are the externality costs associated with gambling.

The effect of introducing casinos on improving or worsening the extent of constraints on household market transactions varies. The main way that this might apply is through gambling's effect on unemployed workers. In the long term, most economists believe that quantity demanded equals quantity supplied. In the labor market, therefore, full employment will be reached with or without a given industry present in the economy. In that case, the contribution operating through the transaction term in the long term is zero.

A new regional business could change prices enough to matter to local residents. We noted in Chapter 4 that if casinos increased employment, the demand for local housing could increase, thus raising housing prices and providing capital gains for residents. The *reduction* in demand for residential property and capital *losses* in the areas from which the new residents came would have to be accounted for as well. Over time, if new housing was built to respond to the increased demand, the prices of the existing stock of housing also would be affected. Because gambling does not create new people (it can only move them from one place to another), a reasonable first approximation is that the net effect of a casino on capital gains and consumer surplus considerations is small. If firm and household prices are invariant to the amount of gambling ($p_i^0 = p_i^1$, $p_j^0 = p_j^1$, $p_\omega^0 = p_\omega^1$), the two terms in Equation 5.12 related to capital gains on endowments and consumer surplus drop out.

COMMON MISTAKES IN APPLYING COST–BENEFIT ANALYSIS

SUMMARY. Cost–benefit analysis tends to be misused in predictable ways. Chapter 4 discussed the tendency to state an industry's impact on regional jobs as an economic benefit without computing its significance in terms of value to area residents. Other common mistakes are to confuse business profitability with social profitability; to focus on the profits of the industry being added to the economy and to neglect to account for lost profits of other businesses; to count taxes paid by the industry as being added to the economy without accounting for reduced tax collections elsewhere; to make unsubstantiated claims about unemployment; and to neglect to consider externality costs.

Equation 5.12 allows us to address some common errors and mistakes of cost–benefit analysis in the case of gambling. The first obvious error is the tendency to identify business profitability, $\sum_j \Pi_j$, and its improvement, $\sum_j \Delta\Pi_j$, with "social profitability"; that is, passing a cost–benefit test. Business profitability is clearly important to social profitability and contributes to a true cost–benefit evaluation, but the two are not synonymous. Failure to account for all of the components of social profitability is perhaps the most common failing. Casino profits are visible and prominent; costs and other benefits may be less so.

Another error is to evaluate the economic impact of gambling with respect to the profits and taxes of a subset of firms – typically, the profits and taxes of firms in one state or region and sometimes the profits and taxes of local gambling firms only. Net profits and taxes are calculated by determining the casino profits and taxes, minus the reduction in profits and taxes of other businesses caused by casinos. Although casino profits and taxes are highly visible, they are invalid measures of *social* benefits because they do not adjust for the entire economy for the lost profits and taxes of competing businesses. This point is not special to casinos. Any business – be it Wal-Mart or a drugstore chain – that attracts consumer sales, employs labor and other inputs, and displaces competing businesses should be evaluated on the same basis. Equation 5.12 sums profits over all firms, not just casinos or firms in one location.

Ignoring firms that lose profits and pay lower taxes due to the expansion of gambling is equivalent to selecting weights for them in Equation 5.1 that are zero. Because households own these other firms, this violates the assumption that households are treated equally.

With respect to social costs, it is not uncommon for studies to omit them entirely or to focus only on costs within the state, even though casinos that border another state have ramifications for citizens of the neighboring jurisdiction. Equation 5.12, discussed previously with respect to firms, also sums over *all* households and regions. Evaluations that consider only the costs or benefits of a subset of households or regions are inaccurate and incomplete. For example, the cost–benefit measure in Equation 5.12 does not treat the impact of a job in one location as more valued than the same job in another. Employment is not a benefit to the economy unless it increases one or more of the components in Equation 5.12.

Regional competition across jurisdictions often suffers from the problems just discussed. When the benefits – often profits and taxes – go to the jurisdiction with the casino but the social costs go to another, the winning jurisdiction has no incentive to care about the costs. Implicitly, it is weighting the costs as zero because they accrue elsewhere, when a true cost–benefit analysis would count them. A similar circumstance applies to production externalities. The town that has a factory that creates tremendous pollution and damage to the residents in some other location, or a factory that produces a defective good that damages users of the good, may still extol the desirability of the factory. In explaining why political decisions may not match up with social desirability, we should consider the failure to count the damage imposed on others, as well as lack of knowledge about costs.