

## COI and WTP—Is There a Middle Ground?

The cost-of-illness and willingness-to-pay approaches to valuing life and health are built on two very different theoretical foundations and depend on very different data sources for empirical estimation. Each approach has its own strengths and weaknesses. The COI approach provides a measure of social costs. However, estimation is not an exercise that follows a template; data limitations demand an analyst's judgment. Thus, following the approach is neither easy nor obvious. Further, COI is not built on modern principles of applied welfare economics. The WTP approach is a strict measure of individual well-being and is derived from neoclassical welfare theory. However, as consumer risk preferences usually do not leave a clear behavioral trail, analysts have to be creative to estimate WTP. WTP amounts do not provide a straightforward measure of social cost. There have been a number of attempts to develop hybrid measures using the strengths of each approach.

In this chapter, we examine three areas of the health-valuation literature that concern bridging the distance between the COI and WTP approaches. In the first section, we examine efforts to approximate the theoretically correct WTP approach with COI measures. Next, we discuss efforts to "individualize" the COI approach. In the third section, we discuss attempts to add a social component to the WTP approach.

### COI as an Approximation of WTP

The COI approach was conceived as a societal, not individual, measure of the costs of illness and premature death. Many economists have examined the usefulness of individual COI estimates in approximating individual WTP, based on the incorrect assumption that estimating COI is straightforward. Though numerous studies have found instances in which COI approximates WTP, the assumptions embedded in these studies are implausible.

In his petition for the WTP approach, Schelling (1966) was one of the first to argue that WTP differs from COI.

There is no reason to suppose that what a man would pay to eliminate some specific probability,  $P$ , of his own death is more than, less than, or equal to,  $P$  times his discounted expected earnings. In fact there is no reason to suppose that a man's future earnings, discounted in any pertinent fashion, bear any particular relation to what he would pay to reduce some likelihood of his own death. . . . But discounted lifetime earnings are relevant only in the way that they are relevant to ordinary decision about consumption, saving, quitting a job or buying a house. They are part of the income and wealth data that go into the decisions. Their connection is a functional one, not an accounting one.

(pp. 149-150)

In general, the theoretical literature supports Schelling's conclusion: illness and premature death cause changes in individual welfare that go beyond the direct or indirect costs of illness.

Individual welfare change associated with adverse health outcomes (i.e., WTP) is typically decomposed into four elements: 1) lost wages,<sup>24</sup> 2) medical expenses, 3) the dollar value of the disutility of illness, and 4) the impact of preventive expenditures. COI measures the first two elements but fails to capture the second two. The COI approach is not a good approximation of WTP precisely because it does not measure pain and suffering or the value of preventive behavior. In fact, a number of studies find that COI and WTP measures converge only in models that fail to include terms describing the utility of health (disutility of illness) or the influence of preventive expenditures (Linnerooth, 1979; Rosen, 1981; Berger et al., 1994; and Kenkel, 1994).

Linnerooth (1979) reviews and critiques four models that examine the relationship between COI and WTP. Two of the models included in her review establish

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<sup>24</sup> In cases of premature death, this term drops out of the calculations of WTP unless a bequeath motive is specified.

an exact correlation between COI and WTP (Conely, 1976; and Usher, 1971), while the other two conclude that no such correlation exists (Jones-Lee, 1974; and Cook and Graham, 1975). Linnerooth finds that the results of the different models critically depend on the specification of the objective function and particularly on the specification of "consumption." When the objective function is univariate, with utility depending only on lifetime consumption activities entailing a monetary exchange (and no bequest utility), then a direct, one-to-one relationship is established between income (human capital) and WTP. Linnerooth demonstrates that the studies conducted by Conley (1976) and Usher (1971) both depend on such a specification of the objective function in order to establish a correlation between the value of human life and human-capital measures. In both of these models, the value of life can be calculated from data on personal consumption (given assumptions with respect to the form of an individual's consumption utility). In fact, in Usher's model the value of life differs from lifetime earnings only to the extent of diminishing marginal utility of lifetime consumption.

Linnerooth demonstrates that when the objective function is expanded to include non-material consumption activities, the one-to-one relationship between human capital and consumption dissolves, and it is impossible to establish a strict correlation between COI and WTP. The other two models included in the Linnerooth review (Jones-Lee, 1974; and Cook and Graham, 1975) use the state-preference approach (where the states are "alive" and "dead") to derive the relationship between human capital and WTP. Both models break the wealth/consumption/utility link. Both models include bequest utility and both examine the utility of life with wealth as opposed to the utility of wealth (consumption). These studies assume that the utility of lifetime consumption is only a lower bound to the utility of living. As a result, lifetime earnings are a lower bound to WTP measures of reduced risk of death.

Linnerooth's general conclusions about the relationship between COI and WTP are presented quite clearly at the end of her review,

The conclusion of this review is that there are no theoretical grounds for establishing an empirically useful relationship between the value, in the form of Hicksian compensating variations in

wealth, of current period changes in a person's risk of death and his lifetime earnings. The significance of this conclusion to the cost-benefit analyst is that there is no testable relationship between the willingness-to-pay and the human-capital approaches to placing a value on the loss of human life. (p. 71)

In a study following that of Linnerooth, Rosen (1981) develops a simple model with WTP for risk reduction defined as a function of consumption, income, leisure, and the probability of surviving the period. He finds that whether or not WTP exceeds income (i.e., human capital costs) depends on whether or not the utility of death exceeds the utility of zero consumption. Rosen finds this result "arcane and metaphysical" and concludes that theoretical analysis cannot establish an operational connection between human capital and risk valuation (p. 243).

Berger et al. (1994) develop the relations among a health-production function, COI, and WTP. This model includes health in three roles: as a variable in the utility function; as a determinant in the probability and quality of survival in the current period; and as part of the income constraint (the appendix provides a more detailed description of this model). Berger et al. are able to solve for an individual's *ex ante* WTP for an improvement in health status. They find that WTP collapses to COI only under four untenable assumptions: 1) defensive expenditures are nonexistent or unchanging, 2) utility is not enhanced by health, 3) there is no possibility that an illness is fatal, and 4) the value of consumption is equal to the utility of the value of consumption. Berger et al. conclude that "there are no plausible assumptions that can be made to simplify the WTP measure to COI" (p. 37).<sup>25</sup>

The conclusion of the theoretical literature examining the use of the COI approach to approximate WTP measures is that no amount of mathematical or theoretical manipulation changes the fact that there is simply no theoretical justification for equating indi-

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<sup>25</sup> Harrington and Portney (1987) succeed in reducing willingness to pay for a reduction in morbidity to the cost of illness measure under the assumptions that there are no preventive expenditures and that health does not enter the utility function directly.

vidual welfare with medical expenses and forgone earnings. As long as individuals place any value on nonmarket goods, services or intangibles, income and consumption measures will diverge from true welfare measures, and COI measures will diverge from WTP measures.

### **COI as a Lower Bound to WTP**

Though there are no plausible conditions under which COI approximates WTP, there are some conditions under which COI estimates serve as a lower bound to WTP estimates.

Berger et al. (1994) find that, given a positive WTP amount, COI understates the cost of illness for three primary reasons. First, the COI approach neglects savings in preventive expenditures. An individual's WTP for an improvement in a particular health risk is conditioned by the existence of defensive or preventive alternatives. For example, an individual might not be willing to pay a high price for cleaning regional ground water supplies if relatively inexpensive water filters are sufficient to minimize the risk of illness. Conversely, an improvement in ground water quality could lead to reductions in expenditures in water filters. The value of the reduction in water-filter costs would be reflected in the WTP for improvements in groundwater quality. However, the value of the reduction in preventive expenditures is not captured in COI amounts. COI amounts are therefore lower than WTP amounts when preventive expenditures exist.

The second reason COI is probably a lower bound to WTP is that COI measures do not incorporate the direct value of health. COI measures do not include any amounts reflecting the enjoyment of good health or the pain and suffering associated with ill health and premature death.

The third reason that COI is a lower bound to WTP is that while COI measures dollars (which are used to purchase consumption items), WTP measures the utility of consumption purchased with dollars. In general, the value of the utility of consumption is greater than the value of consumption (Kenkel, 1994), so the consumption utility lost due to the expenses associated with illness or death outweighs the expenses themselves. Because WTP amounts reflect the utility of

consumption, they will be greater than COI amounts which reflect only consumption expenditures.

Other theoretical studies support the conclusion that COI estimates are a lower bound to WTP estimates (Jones-Lee, 1974; and Cook and Graham, 1975), as does the overwhelming evidence in the empirical literature (Loehman et al., 1979; Blomquist, 1981; and Rowe and Chestnut, 1984). However, though both the theoretical and empirical literature indicate that COI is a lower bound to WTP, neither suggests that COI amounts are good predictors of WTP amounts. Kenkel et al. (1994) conclude their comparison of COI and WTP measures by observing that in general, WTP exceeds COI, "although there does not appear to be any strong tendency for the two to move together" (p. 100). Changes in COI amounts do not necessarily indicate similar changes in WTP. Studies that rely on COI amounts should not use changes in these amounts to predict similar changes in true individual welfare. A comparison of COI amounts should not be used to compare true individual welfare.

### ***COI Is a Lower Bound of WTP Only When Restricted to Individual Costs***

All the evidence supporting the hypothesis that COI is a lower bound to WTP is based on a restricted COI measure. COI measures are a lower bound to WTP measures only if COI amounts are restricted to individual costs. COI studies that adhere to the theoretical underpinnings of the approach and measure social costs could feasibly result in COI amounts that surpass an aggregation of individual WTP amounts. If individual valuations do not incorporate social costs and benefits, then COI amounts could be larger than WTP amounts.

There are many cases involving health in which individual and social costs diverge. Most notably, public and private insurance arrangements introduce a wedge between the price the individual pays and the true cost of medical goods and services. Paid sick leave could also lead to differences in individual and social valuations of the cost of illness. Pure altruism could also enter into social costs estimates differently than in private estimates. If COI estimates include a wider array of social costs than individual WTP esti-

mates, then there is no basis for concluding that COI is a lower bound to WTP.

Thus, when analysts compare social costs with health benefits, there are no assurances that COI is a lower bound to WTP.

At present, direct comparisons of these individual willingness-to-pay estimates and the aggregate cost of illness estimates cannot be made (Kenkel, 1994, p. 43).

### The “Individualization” of COI

Many of the early applications of the COI approach focused on insuring that COI estimates were undiluted measures of social costs, and these applications were diligent in weeding out purely individual costs. In the early literature, researchers typically calculated COI net of consumption, arguing that consumption represented individual welfare and that the real loss to society from an individual’s morbidity and mortality were the net earnings lost to society. Reflecting this reasoning, the National Safety Council’s accident costs were computed net of consumption until 1984 (Miller, 1986).

As a rule, consumption is no longer netted out of COI estimates, though most COI studies have continued to pursue a social perspective. Typically, COI estimates have included earnings gross of taxes to reflect the loss to society of forgone earnings, and non-labor income is usually not included in COI estimates, the rationale being that non-labor income would not be lost to society even with the death of the individual. Though most COI studies retain a societal perspective, recent theoretical preference for individual willingness-to-pay valuations has led to attempts to calculate “individualized” COI measures.

One of the most widely cited studies that added an individual element to the COI approach was conducted by Landefeld and Seskin (1982). They individualized their human capital calculations by computing earnings net of taxes, including non-labor income, using an individual, rather than a social, discount rate and including a risk aversion factor. Landefeld and Seskin’s COI estimates more closely approximate WTP measures than traditional COI estimates,

although such measures still do not incorporate preventive expenditures or the utility value of health.

### The “Socialization” of WTP

The WTP approach is a purely individual measure of the costs of illness and premature death. However, most evaluations of costs and benefits for public policy involve social costs, and there have been a number of attempts to systematically introduce social considerations into WTP estimates.

Bailey (1980) adjusted individual WTP by including costs borne outside the family of a fatality victim, such as future direct taxes on labor and future indirect business taxes on labor that would be lost to society due to an individual’s premature death. Arthur (1981) expanded the WTP approach to include economic transfers across society and make WTP estimates actuarial, as in the COI approach. Arthur includes a net social burden term in his WTP formulation so that individual enjoyment of extra life years is offset by consumption costs to society.<sup>26</sup>

There would seem to be a danger of double accounting in any attempt to include an externally defined social cost term in a WTP framework. Many costs that do not bear directly on the individual enter the WTP decision process. In making personal decisions, individuals certainly consider the well-being of their family and friends, and in many cases, the well-being of complete strangers or future generations. The distinction between social and individual is often blurred in individual cost-benefit calculations, meaning that some of the consumption terms introduced in efforts to “socialize” WTP have already been included in the calculation.

WTP represents pure welfare measures because the individual incorporates all relevant costs and benefits to choose the highest valued alternatives. To retain

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<sup>26</sup> Arthur's "social consumption equivalent" function is the basis for statistical value-of-life estimates calculated by Miller (1986) and Miller, Calhoun, and Arthur (1989) and is therefore incorporated in cost-benefit analyses conducted by a number of government agencies (e.g., Federal Highway Administration, Consumer Product Safety Commission).

its theoretical validity, social considerations should be introduced directly into the individual's utility-maximization decision and not simply added on as a correctional term.

### **Is There a Middle Ground? Some Conclusions**

In general, any attempt to find a middle ground between WTP and COI seems to reduce, not improve, the theoretical justification of either approach. Efforts to mimic WTP estimates with COI seem especially ill conceived. Individualized COI estimates are, at best, poor substitutes for WTP estimates, and, in the processes of becoming poor substitutes, they lose many of their good qualities. Individualized COI estimates lose their transparency, their value in economic accounting, and their theoretical foundation as welfare measures. The COI approach has no theoretical basis as an individual welfare measure. Conversely, socialized WTP measures that supplement individual valuations with social consumption costs could result in measures that actually overstate true social costs.