Benefits, Costs, Gains, and Losses: Choosing and Using the Appropriate Measures

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The often large disparity between people's valuation of gains and losses – the common demand for a greater, and often much greater, sum to give up an entitlement than they are willing to pay for an otherwise commensurate gain – raises two issues of particular interest in attempting to improve benefit-cost analyses and make it more consistent with people's preferences.

First, a given change in an entitlement will likely not have a single value to an individual. Instead there will be different values depending on the context of the change and the particular measure of gains and losses used to assess the value of the change.

Second, given the size of the difference in the valuations that will likely result from the use of different measures, the choice of which measure is appropriate for each assessment is of considerable practical importance for changes commonly the subject of benefit-cost, and similar, analyses. Losses and reductions of losses are, for example, likely to be seriously under-valued with the willingness-to-pay measure commonly used to assess them.

To the extent that people's valuations of gains and losses differ for particular changes, the correct, and not just the most convenient, choice of measure for each case can be expected to lead to more accurate estimates of welfare changes and, presumably, improved expenditure decisions, regulatory choices, damage assessments, and policy design

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The Measures and the Differences Between Them

As most benefit-cost texts and operational manuals dutifully point out, there is general agreement among economic analysts that the economic values of gains and losses are correctly assessed by two different measures: the value of gains are measured by the maximum sum people are willing to pay for them (the so-called WTP measure), and the value of losses are measured by the minimum compensation people demand to accept them (the so-called willingness-to-accept, or WTA, measure). However, it has been long and widely

assumed that, consistent with conventional views of standard theory, the two measures will yield estimates of equal value in the absence of income effects, and ones that are so similar that they can be treated as equivalent in the presence of income effects – "we shall normally expect the results to be so close together that it would not matter which we choose" (Henderson, 1941, p. 121); "…there is no basis consistent with economic assumptions and empirical income effects for WTP and WTA to exhibit sizable differences" (Diamond, Hausman, Leonard, and Denning, 1993, p. 66).

The assumption of equivalence between the measures is rarely questioned and remains the economic analysts' empirical assertion of choice. Consequently, economic practice takes little account of any differences between the measures, and analysts remain largely indifferent to their choice of measure. Although the WTA measure is widely acknowledged to be the appropriate metric for assessing the value of losses, and reductions in losses, it has become common practice to use the WTP measure for assessing these as well as gains, on the grounds, first, that it does not matter, and, second, that it is usually less trouble to assess – "… because it is often easier to measure and estimate", (U.S. EPA, 2000, p. 61).

However, in spite of the firmness with which the assumption of equivalence between the WTP and WTA measures are held and how deeply entrenched the practice of using only the WTP measure to assess losses as well as gains has become, empirical findings are very much at variance with this long held belief. Instead, the empirical evidence from numerous replicated studies suggests that the value of losses are commonly from two to four or more times greater than the value of otherwise commensurate gains (reviewed in, for example, Samuelson and Zeckhauser, 1988; Kahneman, Knetsch and Thaler, 1991; Rabin, 1998; and Horowitz and McConnell, 2002).

The findings of the pervasive difference between people's valuations of gains and losses are from a broad array of hypothetical survey studies, controlled experiments, and an increasing number of studies of people's real life decisions in uncontrolled natural experiments, and have been widely reported in the professional literature for about three decades. For example, in perhaps the earliest report of a large disparity between the measures, bird hunters said they would be willing to pay an average of $247 to preserve a marsh area that contributed to the propagation of ducks, but would demand an average of $1044 to agree to its destruction (Hammack and Brown, 1974). In one simple experimental test, individuals were found willing to pay $5.60, on average, for a 50 percent chance to win $20, but demanded an average of $10.87 to give up the identical chance to win the same prize (Kachelmeier and Shehata, 1992). A similar relative weighing of gains and losses have been reported in people's consumption and investment choices, as in the example of their reluctance to realize a loss to their investment portfolio and continuing to hold shares which have declined in

value from their purchase price – a practice that results in substantially lower overall returns (Odean , 1998); in the example of people responding differently to price increases than to price decreases giving rise to a price elasticity of –1.10 for increases in the price of eggs and –0.45 for decreases (Putler, 1992); and in the example of employees increasing payments to their retirement schemes from 3.5 percent of their wages to 11.6 percent when the choice of contribution was changed from the more aversive loss from current income, to the much less aversive foregoing of part of their future wage increases (Thaler and Berartzi, 2004). Many other studies have demonstrated that the valuation disparity is pervasive, usually large (though variable depending on the entitlements at issue and the further particulars of the context of the valuation), and not merely the result of income effects, wealth constraints, or transaction costs (for example, Kahneman, Knetsch, and Thaler, 1990; Camerer, 2000; Knetsch, Tang, and Thaler, 2001).

Hanemann (1991) has correctly pointed out that standard theory can, under particular conditions, allow for a large difference in gain and loss values for an identical entitlement. These include a positive income effect and a lack of substitutes for the good at issue. However, large differences have been observed under conditions that violate those required for this standard theory explanation. The endowment effect is, as Hanemann notes, "a different phenomenon" (1991, p. 645n), but it seems to be a far more general explanation for the observed pervasive differences than the narrow possibilities offered by standard theory.

Some other reports have suggested that the difference between valuations of gains and losses diminishes, or even disappears, with repeated trials. However, the evidence demonstrating this elimination has come from experiments using a second price Vickrey auction (an auction in which the highest bidder buys at the second highest bid, and the lowest seller sells at the second lowest offer). Although substituting a ninth price for a second price in a Vickrey auction should have absolutely no effect on people's valuations as they have the same incentive to name their reservation prices either way, the findings of controlled tests showed that it gave rise to large and rapidly widening differences (Knetsch, Tang, and Thaler, 2001). This replicated finding leaves the conclusions from earlier reports of convergence very much in doubt. Other reports that people in the business of trading are less likely to exhibit endowment effects, at least with respect to buying and selling goods (for example, List, 2003), is not an unexpected result as trading is the point of their enterprise –"There are some cases in which no endowment effect would be expected, such as when goods are purchased for resale rather than for utilization" (Kahneman, Knetsch, and Thaler, 1990, p. 1328) – it says little, however, about the many other instances of an endowment effect on other types of valuations. Plott and Zeiler (2005) also reported a decrease and elimination of the valuation disparity under particular experimental conditions,

but here too the reason seem to have more to do with particulars of the design and less to do with the absence of an endowment effect.

Although differences in people's evaluation of gains and losses may not be universal, current evidence strongly suggests that it is pervasive among individuals weighing the advantages and disadvantages of proposed changes. Field studies of people's real investment and consumption decisions and choices indicate that this is especially likely to be the case for most consumer dealings and for changes that are likely to be the subject of damage assessments and benefit-cost or other forms of policy analyses.

The valuation disparity evidence, and a long line of human decision studies, suggest that people: (1) value changes from a reference state, rather than as comparisons between two end points as assumed in standard economic theory; (2) value losses from the reference far more than gains beyond it; and (3) experience diminishing marginal effects of both gains and losses (Kahneman and Tversky, 1979). These characteristics of people's valuations are illustrated in a value function much like that of Figure 1, in which changes in the quantity of a good or entitlement between the reference state, **R**, and **L**, are in the domain of losses, and those between **R** and **G** are in the domain of gains. Consistent with observed choices and decisions, changes between **R** and **L** have a much larger impact on the welfare of the individual, or value, than changes between **R** and **G**.

The Choice of Measure

The different valuations of gains and losses give rise to four different measures, as indicated in Figure 1.[1] There are two measures of the value of a positive change: (1) the WTP to obtain it, and (2) to WTA to forego it. Similarly, there are two measures of the value of a negative change: (1) the WTA to accept it, and (2) the WTP to avoid it. This gives rise to the need to choose between the two measure of the value of a positive change and the choice between the two measures of the value of a negative choice. Criteria for the appropriate choice of measures for valuing particular kinds of outcomes have, however, been in short supply – likely due in no small part to the lack of much attention to the disparity issue by economists and the near total absence of interest on the part of public and private agencies and organizations.

While further refinements might be expected to provide more definitive criteria, present evidence suggests that the most appropriate choice of measure, that best reflects real welfare changes, largely turns on what people regard as the reference state that forms the basis of particular valuations, and their characterization of

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[1] There may well be other differences depending on other valuation contexts, but only those related to the differing valuations of gains and losses are considered here.

the change at issue. In large part this appears to be akin to the distinction between compensating variation (CV) and equivalent variation (EV) measures of the welfare gains and losses associated with a change (usually portrayed as a change in the price of a commodity, but can be a change in a risk to health, a change in environmental amenity, or whatever).

The CV measures are based on the initial state, for example before the gain or the loss of an entitlement, as the reference for valuing the change in welfare caused by the change – "The change in income necessary to restore the consumer to his original indifference curve is called the compensating variation" (Varian, 1990, p. 248). The EV measures value a welfare change on the basis of the reference state being the position after the change – "…it is the income change that is equivalent to the price [or entitlement] change in terms of the change in utility" (Varian, 1990, p. 249).

Both the WTP to obtain a positive change and WTA to accept a loss take the state without the change as the reference point, and are, therefore, CV measures. The maximum WTP is the sum that an individual would pay for the positive change of acquiring an entitlement and be left only as well off as without the exchange – the amount that would leave the person on the same indifference curve as without the change. The minimum WTA is the sum that would fully compensate the individual for the negative change of the loss of an entitlement – the amount that would leave the person on the same indifference curve as that of the loss not occurring.

In contrast, the WTA to forego a positive move to the reference state and the WTP to avoid a move to the reference state are based on a reference that incorporates the change and are, therefore, EV measures. The WTA measure is the sum deemed equivalent to a reduction in the loss of an entitlement – it is based on a choice between two points on an indifference curve indicating an improved level of welfare over the present position. The reference for the valuation is that associated with a sense of entitlement to the improved position, and the value of the move to the improved state is the compensation necessary (that is, the WTA) to make up for its not being forthcoming. The value of reducing a loss is the WTA of foregoing the reduction. The value of preserving a historic or cultural site might, for example, be the WTA to forego preservation, as it seems plausible that most people would regard having the amenity as being the reference state. Similarly the value of most health interventions might be the WTA to forego a return to normal (reference) health.

The WTP measure of a negative change in the domain of gains is given by the amount a person is willing to pay to avoid a loss. It is a choice between two points on an indifference curve associated with a reference state providing a lower level of welfare than the present position. The appropriateness of this measure appears to depend on the extent to which there is some sense of obligation or acceptance of the lower level of

entitlement as somehow normal and expected and therefore conferring legitimacy for this being the reference state Deteriorating motor skills or decreasing stamina with advancing age might, for example, be taken as the norm and thereby be considered the reference for valuing improvements to these expected conditions.

The relationship between the reference state and the alternative measures of the value of positive and negative changes can be summarized in the following array:

Welfare Measure	Implied Reference State	Valuation Measures	
		Positive Change	Negative Change
Compensating Variation	**Present**	**WTP to Improve**	**WTA to Accept Loss**
Equivalent Variation	**After Change**	**WTA to Forego Ref.**	**WTP to Avoid Ref.**

It is often suggested that the alternative measures here being distinguished on the basis of the reference state, are determined by extant legal entitlements – "WTP and WTA can also be identified with what they imply about property rights" (U.S.-EPA, 2000, p. 60). Using this criterion, the value of controlling waste discharges would be measured by people's WTP to reduce pollution, if pollution is legally permitted, and by their WTA to allow or to put up with if it is legally prohibited.

However, the reference people use to value a change seems unlikely to result from the assignment of legal rights. Assignments of legal entitlements such as whether or not a person has a cause of action against a neighbour or other party for some offending action, turn on not only efficiency, equity, fairness, and other justice goals, but also asymmetries in avoidance costs and costs of enforcement, compliance, and transfer of original entitlements. The choice of a valuation measure is about choosing a metric that best reflects actual changes in economic welfare resulting from particular changes. While the correlation between reference states and extant legal entitlements may be high in most jurisdictions – no doubt in part due to the strong tendency of legal regimes to evolve in ways that offer greater protection to more important values – there are many cases in which the two diverge. And it is the reference state that appears to have the greater claim on more accurately reflecting actual welfare changes, not the legal rule.

Rather than being determined by legal entitlements, discriminating between the CV and EV measures of gains and losses, and consequently the appropriate choice of measure, may more usefully be determined by what Zerbe (2001) refers to as "psychological ownership" (p. 20), or what people feel is deserving or "right". While not an entirely operational definition, the reference state may be one reflected in what most people in the community regard as the expected or normal state (Kahneman and Miller, 1986), a distinction similar to the test of what is acceptable and unacceptable neighbourly behaviour (Ellickson, 1973), and the harm/benefit

text for legal liability whereas actions preventing harms are treated differently from ones that are undertaken to provide benefits (Fischel, 1995). As Kahneman and Miller (1986) suggest, normal conditions do not prompt the questions or comments that deviations from the norm do. For example, delays caused by congestion raise comments and questions of why they come about or how they might be avoided, but trips that take a reasonable time normally do not give rise to such questions of why and how this happened.

It also does not seem likely that something being predictable will mean that it is incorporated in what is regarded as the reference state, and therefore into criteria for determining an appropriate valuation measure. Road accidents, for example, are a predictable result of road travel. Yet accident-free travel may well be considered the reference state for most people, suggesting that the compensation required to accept more accidents (the WTA measure) might better be used in weighing the merits of programs or projects designed to reduce these losses.

Determining the appropriate reference state appears to be largely an empirical matter of which state is likely to best describe people's feeling about particular changes. Although the reference state will often be the status quo, in important cases it may not be as it is the expected state or norm that is likely to be the determining factor. For example, soiled foreshores may be the reality after a marine oil spill, but most people in the area would no doubt regard unspoiled shores as the norm – another day without a spill would not be out of the ordinary and people would be in no need of an explanation of how it came about. This would then be the reference for their subjective reactions and valuations of both the loss caused by a spill and the benefit of cleanup activities – the WTA to accept the spill, and the WTA to forego measures respectively.

Discounting the Value of Future Gains and Future Losses

Just as people are willing to pay less for a gain than they demand to accept a loss, they can also be expected to be willing to pay less now for a future gain than the sum they would accept to agree to a future loss. The present value of a future gain is, of course, the amount that an individual is willing to pay now. Similarly, the present value of a future loss is the sum demanded now.

The smaller present value of a future gain – given by the smaller WTP – implies that individuals use a higher rate to discount future gains; and the larger present value of a future loss – indicated by the larger WTA – similarly implies that they use a lower rate to discount future losses. While reports of empirical evidence of this distinction are not yet plentiful, that which is available appears to be consistent with this expectation (for example, Loewenstein, 1988; Donkers, Gregory, and Knetsch, in process).

If benefit-cost valuations are to reflect people's preferred tradeoffs of present and future outcomes, the evidence strongly suggests that different rates for discounting future gains and future losses are called for, rather than the single invariant rate prescribed by texts and manuals, and used in practice. This also requires the choice of appropriate measures to value future outcomes and discount rates, which are analogous to the problem of choosing appropriate measures for valuing near term positive and negative changes.

The use of different rates, that more accurately reflect people's preferences would, for example, likely give more weight to future environmental and other losses – as they are discounted at lower rates – and consequently justify greater present sacrifices to deal with them than would be the case following the usual practice of invariant rates. It would also likely call for more actions that reduce risks of future losses relative to ones that provide future gains, as the latter would be discounted at higher rates.

Concluding Comments

The evidence that people commonly value losses, and reductions of losses, more, and often far more, than gains, suggests that otherwise commensurate changes will have different values depending on the measure used to assess them. Conventional benefit-cost, and other, analyses as currently advocated and practiced, have largely ignored this evidence and its implications for the choice of measure to assess the value of gains and losses.

An indication of the significance of the lack of attention to the valuation disparity is suggested by considering a hypothetical choice between two equally costly projects serving the same numbers of people: A would shorten the distance between two points reducing travel time by ten minutes on this route; B would replace a bridge and eliminate the need for a detour that increased travel time by 10 minutes when a bridge failed. Traditional analyses of the benefits and costs of transit projects would lead to the conclusion that there is nothing on these facts to choose between them. As they cost the same and as the conventional measure of how much people are presumed to be willing to pay for a 10 minute reduction in travel time would yield identical estimates of the benefits of the two projects, analysts would be indifferent between them. People, other than analysts – transportation users and taxpayers among them – would, of course, be very unlikely to be indifferent between two such projects. As a survey of senior public servants in Singapore revealed, only a small proportion of people would consider the two of equal worth, while the vast majority would favour project B that reduces a loss, over project A that provides a less valued gain (Chin and Knetsch, in process).

The reason for this preference is largely that projects that prevent or reduce losses are valued more highly than ones that provide gains, and they do so because, contrary to conventional economic analyses and traditional assessments of costs and benefits, people weigh losses far more than gains.

The distinction between what people perceive as a gain and what they think of as preventing or mitigating a deterioration in the provision of services has considerable practical importance. If, for example, people consider reasonably free-flowing traffic as the norm or reference for judging their satisfaction with the provision of transportation services, as may well be the case, then delays caused by congestion are likely to be framed by them as losses. Consequently, projects that mitigate such conditions would be viewed as reducing losses and their value is almost certain to be understated by taking how much people are willing to pay for them as an estimate of their benefits, as is commonly done. Similar distinctions arise in health, environmental, and many other areas. The common practice of, for example, estimating the "value of damages to health (both morbidity and mortality) due to air pollution" on measures of people's "willingness to pay to avoid such effects" (Alberini and Krupnick, 2000, p. 37), would seem to be justified only on a showing that people regard suffering ill health due to pollution as being the normal or reference state.

While more realistic valuations using more appropriate measures of gains and losses can be implemented on current evidence, further improvement in the guidance provided by cost-benefit and other such assessment studies would likely follow from better information in two areas. The first is the extent to which there are differences between WTP and WTA valuations of changes – which on current evidence appear to be large for the types of projects and changes likely to be the subject of valuation efforts. The second is the extent that people regard various types of changes as gains or as reductions of losses – the conditions or causal factors that determine the reference state they use in judging their value.

On present evidence, it appears highly likely that the benefits of taking greater account of the findings of valuation disparities would greatly outweigh the costs of doing so.

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Figure 1. Value of Gains and Losses From Reference State