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CE Course on Adversity

Understanding Adversity from an Economic Perspective

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In health, safety and environmental policy, effects are typically deemed "adverse" based on the judgment of environmental scientists. The pattern has been with us for so long, and it has enjoyed such uniform acceptance among environmental scientists themselves, that the Office of Management and Budget recently proposed to formalize it across all federal health, safety and environmental risk assessment [1]. There are at least three longstanding problems with this historic approach. Each has been acknowledged occasionally but systematically ignored, and each constitutes by itself a fatal flaw.

First, it is acknowledged that the community of environmental scientists lacks a commonly accepted definition of adversity. For example, in the context of air pollution, "Any attempt to establish criteria to define an 'adverse' effect … is likely to be questioned" [2]. Effects span a broad range from no effect at all to consequences that are unambiguously harmful. Environmental scientists might agree on classification at the extremes but inevitably disagree concerning where to draw the line between adverse and nonadverse effects. Because many effects of great interest lie within the range of professional disagreement, the community is incapable of reaching genuine consensus. This problem is made exponentially more difficult if "genuine" adverse effects are hard to observe and precursors to such effects are used instead as proxies for adversity [3, 4].

Second, without a common definition, the determination of adversity depends on which individual environmental scientist, school or sect of such scientists, or institution is empowered to make the determination. Adversity determinations are therefore inherently and irreducibly subjective, value-laden, impossible to reproduce, and beholden to a decidedly nonscientific political process. Environmental scientists will strive to couch their subjective judgments in scientific terms, but at root these judgments will be grounded in political, policy, and ethical considerations that are not of a scientific nature. Value-based contests over adversity determinations spill over into nominally scientific endeavors, most notably peer review. This transforms peer review from a screening-level test of minimum scientific quality appropriate to the purpose at hand, into a political and policy debate over everything from risk management philosophy to the choice of peer reviewers to the procedures they will follow to negotiate a quasi-policy outcome.

Third, when environmental scientists make adversity determinations based on their own values and preferences, they supplant the values and preferences of those who would actually experience these effects. They rarely, if ever, calibrate

their personal judgments with public values. When calibration does occurs, it is typically performed selectively with respect to the elite opinion of other environmental scientists and persons who share the same or similar public values. This raises serious doubts about the moral legitimacy of environmental scientists' adversity determinations.

The economic framework addresses all three of these problems.

First, an adverse effect is defined economically as any phenomenon that reduces an individual's utility, thus resulting in a loss of consumer's surplus. The severity of an adverse effect is captured quantitatively by the magnitude of this loss; the larger the loss, the more severe the adverse effect. The value of lost consumer's surplus is approximately equal to compensating or equivalent variation [5]. For small utility losses (such as would accompany low probability risk events), compensating variation and equivalent variations are indistinguishable.[1] In short, economics defines an adverse effect as any phenomenon that an individual is willing to pay (or must be paid) to avoid. The degree of adversity ("severity") is captured by the magnitude of WTP (or WTA).

Second, in the economic framework neither the definition of adversity nor its magnitude is dependent on which individual scientist, school or sect of such scientists, or institution is empowered to make the determination. The scientist's role is limited to measurement. An effect is either adverse or beneficial depending on the sign of WTP (or WTA). An effect can be adverse for some individuals ($WTP_i>0$) and beneficial for others ($WTP_j<0$). Finally, for the same individual, an effect can be beneficial at some doses ($WTP_i<0 \mid _{dose<x}$) and adverse at others ($WTP_i<0 \mid _{dose>y}$).

Third, the economic definition is ethically superior because it does not impose the values of the scientist on the individual or population that experiences the effect. Rather, it presumes that the values of those whom public policy would serve are inherently legitimate and superior to the values of elites who otherwise could arrogate to themselves the authority to supplant these values with their own.

This presentation will describe the economic model of adversity using graphical and mathematical economic models. In addition, it will compare and contrast the underlying assumptions and principles of the economic framework with the those found in the default model of adversity as practiced by environmental scientists.

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[1] Compensating and equivalent variation are the bases for willingness-to-pay (WTP) and willingness-to-accept (WTA), respectively, and WTP normally is used because it is more readily estimable.

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