

# Five-Hundred Life-Saving Interventions and Their Misuse in the Debate Over Regulatory Reform

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## Introduction

John D. Graham is perhaps the most powerful policy analyst in America today. As the head of the Office of Information and Regulatory Affairs (OIRA) within the Office of Management and Budget, Graham oversees White House review of all of the major regulations proposed by dozens of federal agencies.<sup>1</sup> Although he has been in this job for less than one year, Graham already has begun to exert a large influence on the shape and scope of federal regulation. He has given notice to the agencies that he essentially intends to veto any rules he deems inconsistent with OIRA's economic precepts and methodologies,<sup>2</sup> and indeed he has already sent two rules back to the Environmental Protection Agency (EPA) on account of what he described as inadequate analysis.<sup>3</sup> These events could presage an era of White House involvement with agency rulemaking not seen since the days of Dan Quayle's much-criticized Council on Competitiveness.

Before coming to OIRA, John Graham was the director of the Harvard Center for Risk Analysis. In that capacity, Graham was a

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<sup>1</sup> Exec. Or. 12866, 3 C.F.R. 638 (1993) (reprinted in 5 U.S.C. § 601, app. at 557-61 (1994)).

<sup>2</sup> Memorandum from John D. Graham, OIRA Administrator, to President's Management Council (Sept. 20, 2001) (available at <[http://www.whitehouse.gov/omb/inforeg/oira\\_review-process.html](http://www.whitehouse.gov/omb/inforeg/oira_review-process.html)>).

<sup>3</sup> See Letter from John D. Graham, OIRA Administrator, to the Honorable Jeffrey R. Holmstead (Sept. 24, 2001) (available at <[http://www.whitehouse.gov/omb/inforeg/spark\\_engines\\_epa\\_sep2001.html](http://www.whitehouse.gov/omb/inforeg/spark_engines_epa_sep2001.html)>); Letter from John D. Graham, OIRA Administrator, to Tracy Mehan, Assistant Administrator for Water (Oct. 2, 2001) (available at <[http://www.whitehouse.gov/omb/inforeg/epa\\_water\\_quality\\_rtnltr.html](http://www.whitehouse.gov/omb/inforeg/epa_water_quality_rtnltr.html)>).

leading proponent of reforming risk regulation through increased reliance on cost-benefit and cost-effectiveness analysis. In his collaborative research with Tammy O. Tengs, Graham attempted to show that our current life-saving priorities squandered opportunities to save many more lives with the same resources we now spend. Perhaps most famously, Tengs and Graham claimed that over 60,000 more lives could be saved in this country every year if we shifted resources from cost-ineffective life-saving programs to cost-effective ones.<sup>4</sup>

Tengs and Graham's collaborative work has had a large influence on debates over health, safety, and environmental regulation. In particular, Tengs and Graham's claims regarding the cost-effectiveness of various life-saving interventions and the life-saving potential of a rearrangement of our life-saving priorities have been widely circulated and widely accepted by other scholars, elected representatives, and the interested public. These claims are, however, exceedingly problematic for four basic reasons. First, Tengs and Graham's results are skewed by their mistaken assumption that many environmental programs that were never implemented, nor even proposed, were in fact implemented. The practical effect of this mistaken assumption would have been to "take" money from unimplemented programs and "give" it to other programs, but since the money "taken" was not in fact being spent, it could not be "given" to other programs. Second, Tengs and Graham's set of life-saving interventions is exceedingly narrow; for example, the interventions representing toxin control are almost entirely comprised of two regulatory programs that have been defunct for many years. Third, Tengs and Graham's research ignores many benefits of regulation, particularly environmental regulation. Benefits that do not consist of quantified human lives saved are ignored in Tengs and Graham's calculus. Finally, Tengs and Graham's research rests on controversial moral judgments about whose life is worth saving.

Moreover, Dr. Graham has perpetuated and encouraged a misinterpretation of his and Tengs' data, one that wrongly holds that these data show that federal regulations result in the "statistical

<sup>4</sup> Tammy O. Tengs & John D. Graham, *The Opportunity Costs of Haphazard Social Investments in Life-Saving*, in *Risks, Costs, and Lives Saved: Getting Better Results from Regulation* 167, 172 (Robert W. Hahn ed., Oxford University Press & AEI Press 1996) [hereinafter *Opportunity Costs*].

murder” (to borrow Graham’s phrase) of 60,000 Americans every year. Dr. Graham’s misuse of his own data in the service of an anti-regulatory agenda warrants assiduous monitoring — by scholars, the public interest community, and the federal agencies themselves — of his activities as head of OIRA. There is reason to believe that a substantial segment of Congress shares this skeptical attitude toward Graham: his nomination to lead OIRA received more negative votes in the Senate (thirty-seven) than any of President Bush’s other nominees for positions concerning health, safety, and environmental regulation.

#### Five-Hundred Life-Saving Interventions and 60,000 Lives

Tammy Tengs and John Graham’s collaborative research on the cost-effectiveness of various life-saving interventions consists of two major studies. The first looked at the cost-effectiveness of over 500 life-saving interventions. The second considered the opportunity costs, in terms both of lives saved and money spent, of the pattern of life-saving investments found in the first study. John Graham has aptly summarized the combined message of this pair of studies: by spending life-saving resources the way we do now, we commit the “statistical murder” of approximately 60,000 Americans every year. These 60,000 people are the people who, according to Tengs and Graham, might have been saved if a more cost-effective pattern of life-saving interventions had been pursued. This section briefly describes each study and its conclusions.

#### *Five-Hundred Life-Saving Interventions and Their Cost-Effectiveness*

In research supervised by Dr. Graham, graduate student Tammy O. Tengs and several co-authors analyzed the costs and benefits of 587 life-saving measures.<sup>5</sup> These measures fall into three broad categories: fatal injury reduction, toxin control, and medicine.<sup>6</sup> The specific measures included under the heading of fatal injury reduction encompass such things as airplane safety, automobile safety, and fire prevention. The category of toxin control includes measures to control

<sup>5</sup> Tammy O. Tengs et al., *Five-Hundred Life-Saving Interventions and Their Cost-Effectiveness*, 15 *Risk Analysis* 369 (1995) [hereinafter *Five-Hundred Life-Saving Interventions*] (I refer hereafter only to Tengs and Graham as the authors of this study, as they are the study’s lead and senior authors).

<sup>6</sup> *Id.* at 373-384 (listing interventions analyzed in this study).

arsenic, asbestos, benzene, radiation, and other hazardous substances. Finally, the category of medicine includes a wide variety of preventive and curative measures ranging from vaccinations to advice about quitting smoking.<sup>7</sup> Tengs and Graham's reported criterion for the inclusion of a life-saving intervention in this study was the availability of quantitative data on the intervention's costs and benefits.<sup>8</sup> Tengs and Graham also required that the studies be written in English and contain information on interventions pertinent to the United States.<sup>9</sup>

In this study, Tengs and Graham found that the costs per year of life saved varied widely across interventions and often reached very high levels. They also found that toxin control was the least cost-effective of the categories of life-saving interventions they considered.<sup>10</sup> Specifically, they found that the costs per life-year saved of toxin control ranged from less than or equal to zero (meaning that some interventions saved more money than they cost) to as high as \$99 billion for every year of life saved. They found that many toxin controls cost tens of millions of dollars for every year of life they saved.<sup>11</sup>

*The Opportunity Costs of Haphazard Social Investments in Life-Saving*

In a study building upon "Five-Hundred Life-Saving Interventions and Their Cost-Effectiveness," Tengs and Graham set out "to assess the opportunity costs of our present pattern of social investment in life-saving."<sup>12</sup> In other words, they purported to ask, what do we give up in addressing life-threatening risks the way we now do?

This second study, entitled "The Opportunity Costs of Haphazard Social Investments in Life-Saving," considered a subset of the 587 interventions included in "Five-Hundred Life-Saving Interventions." In this study, Tengs and Graham reportedly required that data on costs and effectiveness be national in scope; thus, the number of interventions included in the second study dropped from 587 to 185.<sup>13</sup> Ninety of

<sup>7</sup> *Id.*

<sup>8</sup> *Id.* at 370.

<sup>9</sup> *Id.*

<sup>10</sup> *Id.* at 371.

<sup>11</sup> *Id.* at 375-78, app. A.

<sup>12</sup> *Opportunity Costs*, *supra* n. 4, at 168.

<sup>13</sup> *Id.* at 169.

these interventions (almost half of all those included in the study) were toxin control measures that would, if proposed or implemented, fall within the jurisdiction of the EPA.<sup>14</sup>

Tengs and Graham's conclusions in this second study are now famous. They found that if resources now spent on life-saving investments were held constant but were redirected "so as to maximize lives saved," the country could save "an additional 60,200 lives" as compared to the number we now save with these investments.<sup>15</sup> Alternatively, holding constant the number of lives saved but redirecting resources to minimize expenditures on this life-saving activity, we could save \$31.1 billion per year while saving the same number of lives.<sup>16</sup>

The vast majority of lives saved through Tengs and Graham's proposed reallocation of life-saving resources occurred in the categories of fatal injury reduction and medicine; over half of the life-saving potential was found in the medical category alone.<sup>17</sup> Only about 5% of the life-saving benefits found by Tengs and Graham came from the category of toxin control.<sup>18</sup> Even more strikingly, less than 2% of the total life-saving benefits found by Tengs and Graham could be obtained by reallocating EPA's regulatory resources within EPA.<sup>19</sup>

### Taking Money From Unimplemented Programs

Tengs and Graham's studies both include many life-saving measures that have never been undertaken by anyone. As Tengs and Graham acknowledged in "Five-Hundred Life-Saving Interventions," that study includes life-saving measures that are fully implemented, "those that are only partially implemented, and those that are implemented not at all."<sup>20</sup>

<sup>14</sup> See Tammy O. Tengs, *Optimizing Societal Investments in the Prevention of Premature Death* 150, app. Q (unpublished Doctor of Science thesis, Harvard Univ. June 1994) (indicating that ninety interventions based on "EPA Regulation" were considered in the dissertation which formed the basis of Tengs and Graham's "Opportunity Costs" study) [hereinafter *Optimizing Societal Investments*].

<sup>15</sup> *Opportunity Costs*, *supra* n. 4, at 172.

<sup>16</sup> *Id.* at 173.

<sup>17</sup> *Optimizing Societal Investments*, *supra* n. 14, at 144-46, apps. K-M (showing life-years saved in separate categories of fatal injury reduction, medicine, and toxin control).

<sup>18</sup> *Id.* at 146, app. M.

<sup>19</sup> *Id.* at 150, app. Q.

In fact, a very large number of the toxin controls studied by Tengs and Graham in that article were never implemented by any agency, frequently for the very reason that their costs were thought to exceed their benefits. An equally large number of these controls were never even proposed by any agency. Indeed, although nine of the ten most expensive life-saving interventions in the entire study involved toxin control, not one of those nine interventions was ever implemented by a regulatory agency.<sup>21</sup> The most expensive intervention on Tengs and Graham's list — the control of chloroform from paper mills, purportedly costing \$99 billion per year of life saved — was never even proposed.<sup>22</sup> To determine which regulatory interventions on Tengs and Graham's list were implemented (or even proposed) by the relevant regulatory agency, one must consult the original studies providing the costs and effectiveness data on which Tengs and Graham relied.<sup>23</sup>

Similarly, of the 90 environmental measures included in "The Opportunity Costs of Haphazard Social Investments in Life-Saving" (representing almost half of all the measures considered), only eleven were ever implemented by the relevant agency, EPA. In other words, 79 of the environmental measures included in this study were never implemented. Most of these were rejected (or never even proposed) by EPA itself.<sup>24</sup> For example, almost half of the environmental measures included in the study are bans on certain asbestos products. As the study on which Tengs and Graham relied for their data on the costs and effectiveness of these measures clearly states, however, ten of these products were never in fact banned by EPA.<sup>25</sup> As for the remaining twenty-one asbestos product bans on Tengs and Graham's list, all were overturned in a single controversial judicial decision.<sup>26</sup>

<sup>20</sup> *Five-Hundred Life-Saving Interventions*, *supra* n. 5, at 372.

<sup>21</sup> See *Optimizing Societal Investments*, *supra* n. 14, at 25, tbl. 8 (showing "Ten Most Expensive Interventions").

<sup>22</sup> See Ralph A. Luken, *Toxic Pollutants*, in *Efficiency in Environmental Regulation: A Benefit-Cost Analysis of Alternative Approaches* 249 (Kluwer Academic Publishers 1990) (referring to chapter as study of "potential regulations").

<sup>23</sup> See *Five-Hundred Life-Saving Interventions*, *supra* n. 5, at 385-90.

<sup>24</sup> See George L. Van Houtven & Maureen L. Cropper, *When Is a Life Too Costly to Save?*, Policy Research Working Paper 1260, tbl. 1 (Environment, Infrastructure, and Agriculture Division, Policy Research Department, World Bank, March 1994).

<sup>25</sup> *Id.*

<sup>26</sup> See *Corrosion Proof Fittings v. EPA*, 947 F.2d 1201, 1230 (5th Cir. 1991) (overturning

In “The Opportunity Costs of Haphazard Social Investments in Life-Saving,” Tengs and Graham assert that they considered the extent to which the interventions they discuss have been implemented.

For each intervention, we supplemented cost-effectiveness data with two measures of the degree to which that intervention was implemented. For the subset of interventions where a “go/no-go” decision was made (for example, laws, regulations, or uniform building codes), we collected binary data on the implementation decision ( $B_{ijk}$ ). Because some degree of implementation can exist even in the presence of a “no-go” decision, or can be absent even with a “go” decision, however, we also collected data on “percent implementation” ( $P_{ijk}$ ). We defined that measure as “the percent of people in the target population who received the life-saving intervention as of 1992.”<sup>27</sup>

Tengs and Graham then explain that to gather information on “percent implementation,” they consulted two independent experts. In estimating how many women over the age of twenty receive annual cervical cancer screening, for example, they consulted two experts in cervical cancer.<sup>28</sup>

Unfortunately, however, Tengs and Graham do not, in their study, give any information as to which measures they considered implemented, which unimplemented, and which partially implemented, and this author’s requests for this information have gone unanswered by Tengs and Graham. However, in a statement filed in response to this author’s testimony on John Graham’s nomination to be head of OIRA, Tammy Tengs stated that the “Opportunity Costs” study assumed zero implementation for only twenty of the 185 interventions considered.<sup>29</sup> Yet, as noted, 79 of the environmental

EPA’s nationwide ban on asbestos products in part because the court disagreed with the agency’s cost-benefit analysis).

<sup>27</sup> *Opportunity Costs*, *supra* n. 4, at 169-70.

<sup>28</sup> *Id.* at 170.

<sup>29</sup> Sen. Comm. on Governmental Affairs, *Hearing on the Nomination of John D. Graham as Adm’r of the Office of Info. and Regulatory Affairs at the Office of Mgmt. and Budget*, 107th Cong., at 8 (forthcoming 2001) (testimony of Dr. Tammy Tengs) [hereinafter “Tengs’

interventions alone were never implemented. The reasons for Tengs and Graham's apparent assumption that at least 59 rules that were never issued were nevertheless implemented remain mysterious.<sup>30</sup> For example, based on information provided in related research, it is clear that Tengs and Graham assumed that EPA's nationwide ban on asbestos was fully implemented — which, as noted above, it was not.

Here is the sum total of what Tengs has had to say most recently on the point: "Toxin control interventions that were never promulgated (or even considered) by the EPA might nevertheless have some percent implementation, at least according to the experts we interviewed."<sup>31</sup> Thus it appears that Tengs and Graham assumed that even absent government regulation, firms were voluntarily undertaking the environmentally protective measures discussed in their study.

It is highly unlikely, however, that a firm would voluntarily undertake toxin controls that cost as much money as Tengs and Graham say they cost. Most economists would argue that a firm would undertake such controls only if it could save money by doing so, yet the cost figures cited by Tengs and Graham hardly show money-saving potential. Furthermore, one of the signature features of environmental problems is that the person or firm that invests in solving them cannot capture all, or even most, of the benefits of doing so, as environmental problems involve "public goods" enjoyed by all. The implication of this "public goods" analysis is that profit-maximizing firms will not undertake large-scale environmentally protective measures on their own initiative. All in all, without a good deal of empirical information about voluntary toxin control undertaken by firms (information not apparent in any of Tengs and Graham's research discussed here), it would be unreasonable to assume that such voluntary behavior occurs and that it costs what Graham says toxin control costs. Yet Tengs' statement suggests that this is precisely what they did, without explaining the reasoning behind such a problematic assumption and without revealing

Testimony"].

<sup>30</sup> See Tammy O. Tengs, *Dying Too Soon: How Cost-Effectiveness Analysis Can Save Lives*, National Center for Policy Analysis Report No. 204, at 6, tbl. II (May 1997) (available at <<http://www.ncpa.org/s204.html>>) (showing assumption of "100%" implementation of invalidated asbestos rule).

<sup>31</sup> Tengs' Testimony, *supra* n. 29, at 8.



the identity or area of expertise of any of the “experts” who purportedly endorsed this assumption.

In sum, for at least 59 of the 90 environmental measures considered by Tengs and Graham, the authors assumed that the measures were at least partially implemented even though no agency ever required this. This means that Tengs and Graham assumed that the costs associated with these measures could be transferred to other activities and programs, and thus produce either life-saving or money-saving opportunities. But the assumption of voluntary implementation by firms is implausible. If that conclusion is correct, then Tengs and Graham took money from places where it was not being spent in order to produce artificial life-saving or money-saving opportunities elsewhere.

The opacity of Tengs and Graham’s “opportunity costs” study on the question of percent implementation, and their subsequent declinations to explain their conclusions and reasoning on this point, make it impossible to draw more specific and critical conclusions about this aspect of their research. One can observe, as noted above, that they treated many unimplemented regulatory interventions as if they had been implemented. One could also wonder whether Tengs and Graham made the quite opposite error of treating some unimplemented measures as if they were infinitely expandable, or at least capable of being implemented in more circumstances than is practically achievable. But without more information in the study or from the authors themselves, it is impossible to confirm such speculations.

Tengs and Graham’s research almost certainly overstated life-saving and money-saving opportunities in another way as well. Tengs and Graham’s first study did not in fact look at 587 different interventions. In numerous cases, Tengs and Graham examined the very same life-saving measure, but from the perspective of different analysts. These analysts obviously had very different views about the costs and effectiveness of the very same life-saving measures. For example, Tengs and Graham report two estimates of the cost per life-year saved of a ban on urea-formaldehyde foam insulation in homes: one estimate puts the cost at \$11,000 per life-year saved, and another at \$220,000 per life-year saved.<sup>32</sup> Tengs and Graham also offer two estimates of the

<sup>32</sup> *Five-Hundred Life-Saving Interventions*, *supra* n. 5, at 377, app. A.

cost-effectiveness of controlling arsenic emissions at glass plants: one estimate (for “glass manufacturing plants”) is \$2.3 million per life-year saved and the other (for “glass plants”) is \$51 million per life-year saved.<sup>33</sup> “Glass plants” and “glass manufacturing plants” are one and the same in EPA’s regulations.<sup>34</sup>

Likewise, in “The Opportunity Costs of Haphazard Social Investments in Life-Saving,” many life-saving measures appear more than once, even though only one such measure would ever be undertaken or even proposed. Arsenic emission controls at glass plants appear twice on the list; arsenic emission controls at primary copper smelters appears three times; benzene emission controls at chemical manufacturing process vents appears twice; benzene controls at bulk gasoline plants and at bulk gasoline terminals both appear twice; radionuclide controls at elemental phosphorous plants appears a stunning five times; and radionuclide controls at coal-fired industrial and utility boilers appears thrice and twice, respectively.

Tengs and Graham provide no guidance as to how one might choose between these strikingly different perspectives on the cost-effectiveness of the very same life-saving measures. They also do not face up to the strange consequence of their duplication of life-saving measures. One might conclude that we could save a large amount of money in arsenic control simply by adopting the views of the \$2 million analyst rather than the \$51 million analyst. Once again, given the limited information provided by Tengs and Graham, it is impossible to determine what role these duplications played in Tengs and Graham’s results. The most that can be said is that if Tengs and Graham assumed that resources could be saved simply by choosing one expert’s views over another’s, this would again lead to an overstatement of life-saving and money-saving opportunities.

#### Limited Set of Interventions

As explained later in this article, many people, including Graham himself, have used the “Opportunity Costs” study to launch a large-scale attack on environmentally protective programs. Not only does this

<sup>33</sup> *Id.*

<sup>34</sup> See Lisa Heinzerling, *Regulatory Costs of Mythic Proportions*, 107 *Yale L.J.* 1981, 2013 (1998).

attack ignore the fact that the vast majority of the environmental measures included in this study were never implemented, it also ignores the extremely limited scope of Tengs and Graham's analysis insofar as it applies to environmental measures. Although 90 of the 185 measures in the "Opportunity Costs" study were environmental measures — thus, superficially suggesting a rather comprehensive look at environmental regulation — fifty (over one-half) of these measures were (or would have been, if they had ever been adopted) implemented under just one provision of one environmental statute, section 112 of the Clean Air Act, dealing with hazardous air pollutants. Moreover, Tengs and Graham's analysis applies to measures undertaken (or, rather, *not* undertaken) under an earlier version of section 112 which no longer exists when the statute was completely overhauled in the 1990 Clean Air Act.<sup>35</sup> In addition, thirty-one of the environmental measures were part of EPA's nationwide ban on asbestos, undertaken under section 6(a) of the Toxic Substances Control Act.<sup>36</sup> That ban was overturned in court ten years ago,<sup>37</sup> and since then, the EPA has not banned a single substance under section 6.

To sum up, out of 90 environmental measures considered by Tengs and Graham, 81 were undertaken (or not undertaken) under statutory provisions that are either formally or effectively defunct and have been so for at least a decade. Therefore, to the extent one attempts to develop a critique of environmental protection based on this study, one's critique will be at least a decade out of date.

Tengs and Graham's research is unduly narrow in another way as well. As noted above, they consider three categories of private and public life-saving measures — medical interventions, fatal injury reduction, and toxin control — in order to see how many more lives we could save if we spent the same amount of money on these programs we now spend, but spent it differently or, alternatively, how much money we could save by saving the same number of lives, but through a different arrangement of programs. Their analytical universe not only includes only a small slice of the array of life-saving measures we

<sup>35</sup> See 42 U.S.C. § 7412 (2001).

<sup>36</sup> 15 U.S.C. § 2605(a) (2001).

<sup>37</sup> *Corrosion Proof Fittings*, 947 F.2d at 1230.

actually take, but also fails to include activities we undertake that do not save lives, but cost a lot of money that might otherwise be spent on saving lives.

When addressing the first problem, Tengs and Graham's research overlooks some of the most expensive kinds of life-saving measures we undertake today. The whole category of military expenditures, for example, appears nowhere in their work. Yet if one is serious about reallocating life-saving expenditures to the place where they do the most good, then we should think hard about whether the billions spent on, for example, the B-2 bomber is an effective means of protecting American lives. Of course, in the current climate, questioning military expenditures might not be a politically expedient thing to do, but political expediency that prevents cost-effective life-saving strategies is an attitude John Graham has purported to fight against, not to embrace. One might also point out that military expenditures, for example, protect national interests — such as protecting a “way of life” — beyond the saving of human life. The same is certainly true of environmental protection, yet this did not stop Tengs and Graham from evaluating the cost-effectiveness of environmental protection solely in terms of life-years saved.

A second problem along these lines is that Tengs and Graham seek to reallocate expenditures only among programs that save lives. They do not ask, for example, whether the billions of dollars in subsidies to the mining, logging, ranching, and farming industries might be better spent on, for instance, smoking cessation and childhood immunizations. They do not even ask whether money spent subsidizing tobacco itself might better be spent on smoking cessation programs.

Finally, given that Tengs and Graham do not limit their analysis to regulatory programs, one must wonder why they do not consider whether the combined billions spent in this country on soft drinks, fad diets, leaf blowers, riding lawn mowers, and cable television might be better spent on Nicoret gum and the nicotine patch. Suppose an individual, in deciding whether to go to the doctor when ill, thought very hard about the other health-improving activities for which this money might be used (such as, perhaps, a new pair of walking shoes or an exercise video) — without considering whether to eliminate other,

non-health-related expenditures first. Might not that person seem a little crazy? Yet this is the way Tengs and Graham's research proceeded.

### Disregard of Many Benefits of Health, Safety, and Environmental Protection

Another important limitation of Tengs and Graham's studies is that they assume that the only benefit of environmental protection is to prevent fatal illnesses in humans. These studies ignore many significant benefits of environmental programs. Most obviously, their fixation on fatal illnesses ignores nonfatal harms to human health. Most lethal substances also cause nonfatal health effects. Toxic chemicals can, for example, cause respiratory, neurological, reproductive, hematological, and other health-impairing disorders. Not all of these disorders are fatal, yet they are nevertheless unpleasant and costly byproducts of toxic pollution. In addition, environmental toxins can harm ecosystems, harms which simply do not show up in Tengs and Graham's limited analysis.

Tengs and Graham's analysis not only excludes the many benefits of health, safety, and environmental regulation that do not involve life-saving; it also excludes life-saving benefits themselves if these cannot be quantified. This often means that, in the context of toxin control, any life-saving benefits, other than the prevention of cancer, are ignored because cancer prevention is often the only life-saving benefit that can be quantified. One reason why it is easier to quantify the risk of cancer is because there is a clear end point: the subject under study — either a human or a laboratory animal — either does or does not develop a tumor. With respect to other kinds of human health effects, however, such as impairments of cognitive development and reproductive capacity, the relevant end point is not so obvious.

Moreover, even with respect to estimates of cancer deaths, risk assessments often use assumptions that may result in the understatement of risk. For example, one standard assumption in risk assessment is that the population targeted by regulation has the same susceptibility to the relevant harm as the population studied in the risk assessment.<sup>38</sup> However, most of the epidemiological studies

<sup>38</sup> See Proposed Guidelines for Carcinogen Risk Assessment, 61 Fed. Reg. 17960, 17966 (EPA 1996) (proposed Apr. 23, 1996).

underlying regulatory estimates of risk have involved only white male workers.<sup>39</sup> Women, children, the elderly, racial and ethnic minorities, and poor people may be more vulnerable to the risks in question than the relatively healthy white male workers assumed in most analyses.<sup>40</sup>

To be sure, Tengs and Graham acknowledge that their analysis does not capture all of the benefits of life-saving programs. But it is worth keeping in mind that their focus on quantified life-years saved ignores some of the most important benefits of the programs in question.

### Whose Life Is Worth Saving?

A final problem with Tengs and Graham's studies on regulatory cost-effectiveness involves the studies' assumptions about whose life is worth saving. Tengs and Graham's studies do not assume that all human lives endangered by human action are equally valuable. On the contrary, in estimating the cost-effectiveness of the life-saving measures they analyzed, Tengs and Graham used two analytic techniques that embody controversial assumptions about whose life is worth saving.

First, they based their cost-effectiveness analysis on the regulations' effectiveness in saving *years* of life, or *life-years*.<sup>41</sup> Put simply, this means that in the view of Tengs, Graham, and their co-authors, a measure that saves the lives of the elderly is not as good as one that saves the lives of the middle-aged, and likewise, a measure saving the lives of the middle-aged is not as good as one saving the lives of the young. It also means that benefits, like the prevention of nonfatal illnesses and the protection of ecosystems, are not taken into account in Tengs and Graham's analysis. Tengs and Graham acknowledge that many of the interventions in their research have benefits beyond increasing the human life span,<sup>42</sup> but the research makes no attempt to account for such benefits.

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<sup>39</sup> See e.g. *id.*; see also Robert R. Kuehn, *The Environmental Justice Implications of Quantitative Risk Assessment*, 1996 U. Ill. L. Rev. 103, 123.

<sup>40</sup> See *id.* (citing sources).

<sup>41</sup> *Five-Hundred Life-Saving Interventions*, *supra* n. 5, at 370; see also *Opportunity Costs*, *supra* n. 4, at 169.

<sup>42</sup> *Five-Hundred Life-Saving Interventions*, *supra* n. 5, at 372.

Second, in calculating the benefits of life-saving measures, Tengs and Graham employed an analytic technique known as “discounting.” Specifically, they reduced all future life-saving benefits by 5% per year.<sup>43</sup> Equations available in appendices to their original research seem to indicate that Tengs and Graham performed this calculation in the following way: suppose, for example, that a particular measure would save the life of a thirty-five year old, thus saving forty-two life-years if one assumes that this person’s life expectancy is seventy-seven years. Tengs and Graham discounted all of the years of life saved by such an intervention by 5% per year, *from the year in which the year of life would otherwise have been lived*. This means that Tengs and Graham would have discounted the last year saved by the hypothetical intervention over a period of forty-two years. As a result, the last year of life saved would be reduced in their analysis to 1/8<sup>th</sup> of a year. This large reduction in future benefits is the inexorable result of discounting, a process akin to compound interest in reverse.

Both of these analytic devices have a large negative effect on assessments of environmental programs in particular, and both are very controversial. Absent these assumptions, the cost-benefit ratios of the life-saving measures evaluated by Tengs and Graham, especially those involving toxin control, would have been very different. As noted, typically the only quantifiable benefit of toxic substances control is the prevention of cancer. Since cancer is a disease primarily of old age, and since it has a long latency period, the practices of looking at life-years saved, and of discounting future benefits, produce results that systematically disfavor toxin control.

Discounting, in particular, can have a profound effect on the perceived present-day benefits of actions whose purpose is to prevent future harm. If discounted over a long enough period, even the benefits of preventing catastrophes become trivial. For example, Tengs and Graham’s 5% discount rate means that the death of one billion people 500 years from now is less important than the death of one person today. The logic of discounting also means that saving the lives of your children in the future is worth less than saving your own life today. Discounting also systematically downgrades the importance of actions

<sup>43</sup> *Opportunity Costs*, *supra* n. 4, at 169.

taken to prevent long-latency diseases and long-term ecological harm. Yet these long-term aspirations are among the major aims of the kinds of programs that have fared so poorly in analyses of costs per life saved, especially environmental programs.

It is not difficult to grasp the issues inherent in the question of whether to evaluate life-saving programs according to the life-years or the lives they save. The question turns, essentially, on whether one views younger and older people as equally worthy of protecting from the hazards of environmental agents. Our society's norms of equality weigh strongly against offering less protection to people based simply on age or life expectancy.

Discounting is more complicated. In discounting, one reduces the benefit one expects to receive in the future by a fixed rate that is designed to capture, in essence, the cost of waiting for the benefit. In the financial context, discounting future sums of money reflects the fact that money received in the future is worth less than money received today because if one receives money today, one can invest it and produce even more money for the future. One might also be impatient to receive the money now. In the life-saving context, discounting is a far more problematic and controversial concept than it is in the financial context.

In their collaborative research, Tengs and Graham do not elaborate on their decision to discount lives. In a statement responding to this author's statement opposing Graham's nomination to head OIRA, however, Tammy Tengs explained that discounting is necessary in order to avoid the so-called "Keeler-Cretin" paradox.<sup>44</sup> The idea is that if we do not discount future benefits, we will never spend anything to save lives now because we could always put our money in the bank now and use it to save more lives in the future. This is a specious argument. First, the argument wrongly assumes that the costs attributable to life-saving will not rise over time. Second, in a related vein, it assumes that the life-saving in question can be brought about either today or years from now; but with respect to environmental protection, at least, the things we do today cannot be done years from now to prevent deaths – they must be done now.<sup>45</sup> Finally, of course,

<sup>44</sup> See Tengs' Testimony, *supra* n. 29.



citation to the Keeler-Cretin paradox assumes all regulatory decisionmakers have the same obtuse devotion to quantitative analysis as some cost-benefit analysts do — that they will simply tote up the numbers and, if they come out the way Tengs suggests, keep their life-saving money in the bank *forever*. Ask yourself if you know anyone who behaves this way.

In addition, even Tengs' unconvincing cite to the Keeler-Cretin paradox does not explain why Tengs and Graham discount these particular studies. The life-saving interventions whose benefits they discounted would have prevented deaths predominantly due to cancer, and would have done so by reducing exposures to carcinogens in the air, water, and land. These reductions in exposures would predominantly have coincided with the costs expended to reduce them. Where costs and benefits occur contemporaneously, the case for discounting disappears.

The controversy over the discounting of life-saving benefits is complex, but there are three additional, basic reasons why discounting is problematic in this setting.<sup>46</sup> First, lives do not compound the way money does. You cannot put a life — or a life-year, for that matter — in the bank and earn money on it. Although one could argue that lives do indeed “compound” through human births, no serious scholar in the literature on discounting advances this as an argument in favor of discounting future life-saving.

Second, it is inaccurate to suggest that a human life, or life-year, lost in the future is somehow not a “whole” life or life-year. If a person dies thirty years from now due to cancer caused by exposure to arsenic, a whole life is lost. Yet at a discount rate of 5%, analysts like Tengs and Graham would deem a regulation saving that person's life to have saved less than 1/4<sup>th</sup> of a life. But human lives do not come in fractions.

Finally, although many people who advocate discounting purport to do so on the basis of people's preferences, it would be surprising to learn

<sup>45</sup> See Lisa Heinzerling, *Environmental Law and the Present Future*, 87 *Geo. L.J.* 2025, 2073-74 (1999).

<sup>46</sup> See *e.g. id.*; Heinzerling, *Regulatory Costs of Mythic Proportions*, *supra* n. 34, at 2043-2056; Lisa Heinzerling, *Discounting Our Future*, 34 *Land & Water L. Rev.* 39 (1999); Lisa Heinzerling, *Discounting Life*, 108 *Yale L.J.* 1911 (1999); Lisa Heinzerling, *The Temporal Dimension in Environmental Law*, 31 *ELR* 11055 (2001). All of these pieces offer a more extended discussion of the case against discounting.

that most members of the public agree with the idea, implicit in discounting at a 5% rate, that lives saved in the future are essentially trivial compared with lives saved today. Indeed, one could make a very plausible argument that the existence and widespread popularity of dozens of federal statutes ensuring a high level of environmental protection belie the claim, implicit in discounting, that the future matters relatively little to the ordinary person. Closer to home, most parents are probably at least as concerned about their children's future, and as anxious to make it good, as they are concerned about their own present well-being. Discounting ignores — indeed, it discourages — this fundamental human impulse.

### How Graham's Research Has Been Misused

We did not conduct an analysis of the output of the regulatory system, nor do we imply otherwise. No where in either paper do we advocate for, or even discuss, shifting EPA responsibilities, radon, or loans and tax incentives. These papers are simply not focussed on the EPA. To say otherwise is a grave and deliberate misrepresentation of our work.<sup>47</sup>

Many observers have misinterpreted Tengs and Graham's research. Most prominently, they have cited the "Opportunity Costs" study as if it shows that *government regulation* results in the "statistical murder" (to use Graham's phrase) of 60,000 Americans every year. This misinterpretation appears frequently in the academic, political, and popular literature on risk regulation. The Senate's Governmental Affairs Committee, for example, has been told more than once that Tengs and Graham's research shows that a rearrangement of *regulatory* priorities would save 60,000 lives per year.<sup>48</sup>

The misrepresentations of Tengs and Graham's data began, in fact, simultaneously with their initial publication. In the introduction to the book in which the "Opportunity Costs" study appears, Robert Hahn claims that the study by Tengs and Graham "compiles new data on

<sup>47</sup> Tengs' Testimony, *supra* n. 29, at 2, 9.

<sup>48</sup> See e.g. Sen. Comm. on Governmental Affairs, *The Regulatory Improvement Act of 1998: Hearings on Sen. 981*, 105th Congress 4 (Feb. 24, 1998) (joint testimony of Robert W. Hahn & Robert E. Litan, The American Enterprise Institute & The Brookings Institution).

hundreds of regulatory interventions and estimates their costs and life-saving benefits.”<sup>49</sup> This study, Hahn continues, “assesses the opportunity costs of the current activity and determines an ‘optimal portfolio’ of regulatory activity that could save more lives at less cost.”<sup>50</sup> The ink was not even dry on Tengs and Graham’s study, in other words, before it was being misused as an indictment of government regulation — and misused in precisely the way Tengs criticizes in the epigraph to this section.

It is not only other researchers, however, who have misrepresented Tengs and Graham’s research; Dr. Graham himself has misrepresented his own research. These misrepresentations fall into two general categories. First, Graham has marketed his research as if it revealed government regulation to be the primary culprit in the misallocation of life-saving resources. Second, he has misstated the regulatory cost-effectiveness found by his studies.

*Attributing Resource Misallocations to Regulation*

In congressional testimony, Dr. Graham has used the research set forth in “Five-Hundred Life-Saving Interventions” and “Opportunity Costs” as a basis for calling the present allocation of life-saving resources “statistical murder.”<sup>51</sup> Dr. Graham has told the Senate Committee on Governmental Affairs that his research demonstrates that federal regulation is in serious need of reform. In testifying in favor of Newt Gingrich’s “Contract With America’s” bills several years ago, Dr. Graham stated:

For the past fifteen years, I have studied the decision making of federal agencies responsible for protecting public health, safety, and the environment. These agencies include, for example, the Consumer Product Safety Commission, the Environmental Protection Agency, the Food and Drug Administration, the National Highway Traffic Safety Administration, the Occupational Safety and Health Administration, and the Nuclear Regulatory

<sup>49</sup> Robert Hahn, Introduction in *Risks, Costs & Lives Saved*, supra n. 4.

<sup>50</sup> *Id.* at 1, 3 (emphasis added).

<sup>51</sup> H.R. Comm. on Science, *Risk Assessment and Cost Benefit Analysis*, 104th Cong. 1124 (1995) (written testimony of John D. Graham).

Commission. Although each of these agencies serve[s] a vital public function, I have found that the decisions of these agencies are not always based on a good understanding of science, engineering, and economics. As a result, our regulatory system is far less effective and efficient than it could and should be. One of my previous doctoral students at [the Harvard Center for Risk Analysis], Professor Tammy Tengs of the University of California at Irvine, found in her doctoral dissertation that lifesaving investments in the United States are often inefficient. Based on a sample of 200 policies, she estimated that a reallocation of lifesaving resources to cost-effective programs could save 60,000 more lives per year than we are currently saving, at no increased cost to taxpayers or the private sector. In short, a smarter regulatory system can provide the public with more protection against hazards at less cost than we are achieving today.<sup>52</sup>

Similarly, two years ago, Dr. Graham joined a group of economists in signing onto a brief filed in the U.S. Supreme Court in a case challenging the constitutionality of the federal Clean Air Act. In that brief, Dr. Graham and his co-signatories urged the Court to interpret the Clean Air Act to require cost-benefit analysis of national air quality standards. They premised their argument on the perceived failings of current health, safety, and environmental regulation. As they put it:

both the direct benefits and costs of environmental, health, and safety regulations are substantial — estimated to be several hundred billion dollars annually. If these resources were better allocated with the objective of reducing human health risk, scholars have predicted that tens of thousands more lives could be saved each year.<sup>53</sup>

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<sup>52</sup> Sen. Comm. on Governmental Affairs, *The Regulatory Improvement Act of 1999: Hearings on Sen. 766*, 106th Congress (April 21, 1999) (testimony of John D. Graham, Ph.D., Director, Center for Risk Analysis, Harvard School of Public Health) (alteration in original); see also Subcomm. on Risk Assessment and Cost/Benefit Analysis for New Regulations & Subcomm. on Health and Environment of the Comm. on Commerce, Joint Hearings, 104th Cong. 307 (1995) (written testimony of John D. Graham)(alteration in original).

<sup>53</sup> Brief of Amici Curiae AEI-Brookings Jt. Ctr. for Reg. Stud. et al., at 1-2, *Am. Trucking Assns. v. Whitman*, 531 U.S. 457 (2001) (citing *Opportunity Costs*, *supra* n. 4).

In his academic work, moreover, Graham has used the research conducted with Dr. Tengs to launch a large-scale attack on regulatory programs that protect health, safety, and the environment. Calling the “public’s general reaction to health, safety, and environmental dangers” a “syndrome of paranoia and neglect,” Graham has chosen to focus his disapproval on regulatory agencies rather than, say, the medical professionals whose apparent failure to offer smoking cessation advice to their patients results in a good deal of lost opportunity for life-saving.<sup>54</sup> For example, he has contended that the data he has compiled with Dr. Tengs “call for reconsideration of the toxin-control budgets of agencies such as EPA and OSHA [Occupational Safety and Health Administration].”<sup>55</sup>

Thus, in testimony, Supreme Court briefing, and academic writing, Graham himself has misused his “Opportunity Costs” study. He has suggested that this study supports the conclusion that the current regulatory system squanders the opportunity to save tens of thousands of additional lives every year. This conclusion does not follow from Graham’s research. As noted, most of the life-saving potential found in Graham’s research comes from reallocating expenditures in the field of medicine, not from reallocating resources used by the EPA or OSHA. It is a myth that federal regulation “statistically murders” 60,000 Americans every year. Yet, not only has John Graham apparently done nothing to correct the widespread impression that his own research supports this claim, he has also actively promoted this misinterpretation of his own data.

#### *Inaccurate Statements About Regulatory Cost-Effectiveness*

Tengs and Graham’s studies include both regulatory and non-regulatory life-saving measures. Many of these measures would be undertaken, if at all, in the non-regulatory environment of individuals acting in their private capacities, such as doctors advising patients about quitting smoking<sup>56</sup> or thirty-five-year-old men undertaking an

<sup>54</sup> John D. Graham, *Making Sense of Risk: An Agenda for Congress*, in *Risks, Costs, and Lives Saved*, *supra* n. 4, at 183-207.

<sup>55</sup> John D. Graham, *Comparing Opportunities to Reduce Health Risks: Toxin Control, Medicine and Injury Prevention*, *National Center for Policy Analysis Report No. 192* (June 1995) (available at <<http://www.ncpa.org/studies/s192/s192.html>>) (alteration in original).

<sup>56</sup> *Five-Hundred Life-Saving Interventions*, *supra* n. 5, at 384, app. A.

exercise regimen.<sup>57</sup> Many other measures would entail government regulation or intervention. Indeed, in “Five-Hundred Life-Saving Interventions,” the category of toxin control consists almost entirely of measures that might be (but in many cases have not been) undertaken by the government.<sup>58</sup>

There is, of course, nothing inherently wrong with including both regulatory and non-regulatory life-saving programs in such a study. In that case, however, one must be careful to avoid attributing the costs and misallocations of private decisions to governmental actors. Graham has misused his own research in this fashion as well.

For example, as noted above, the most expensive intervention in the “Five-Hundred Life-Saving Interventions” study — the control of chloroform from paper mills, weighing in at \$99 billion per year of life saved — was never even proposed.<sup>59</sup> Yet Graham has cited this measure as an “EPA standard for chloroform emissions” and has stated that it “imposes over \$99 billion in costs for each year of life added.”<sup>60</sup> But the “standard” was never proposed, and hence the costs never “imposed.”

In addition, in treating unimplemented environmental measures as if they were implemented, Tengs and Graham’s “Opportunity Costs” study greatly reduces the apparent cost-effectiveness of environmental regulation. Again, it is impossible to determine the magnitude of this inflation based on the public record, but given the available evidence as described above in this article, it appears to be very large.

One last point bears mentioning here. Although Tengs and Graham devote considerable energy to arguing that we should reallocate our life-saving resources, they actually provide no concrete examples in their “Opportunity Costs” study of what we should be doing instead of what we are now doing. Only by studying Tengs’s unpublished Ph.D. dissertation, written under Graham’s supervision, can one learn which life-saving interventions these researchers favor. The following observations will be limited to toxin control.

<sup>57</sup> *Id.* at 380, app. A.

<sup>58</sup> *Id.* at 377, app. A.

<sup>59</sup> Luken, *Toxic Pollutants*, *supra* n. 22, at 249.

<sup>60</sup> John D. Graham, *How to Save 60,000 Lives* (Electric Edison Institute 1995) (available at <<http://www.eci.org/>>) [hereinafter *How to Save 60,000 Lives*].

As it turns out, most of the toxin controls that Tengs and Graham found to be cost-effective have already been implemented. A handful of apparently cost-effective interventions regarding asbestos and benzene were not implemented, but these rules together would have saved a total of only twenty-four lives — nowhere close to the 60,000 lives cited in the Tengs and Graham study. The only large life-saving opportunity in the area of toxin control that is identified by Tengs and Graham is radon remediation in homes, as encouraged by the government's funding of low cost loans, tax write-offs, or other financial incentives.<sup>61</sup> In effect, then, the consequence of following Tengs and Graham's research would be a wholesale shift of EPA's responsibilities from the regulation of pollution of the air, water, and land through mandatory controls on polluters to the encouragement of residential radon remediation, which typically involves simply caulking basements through loans and tax incentives. Nowhere do Tengs and Graham face up to the shrinking, indeed trivialization, of environmental law that their proposals would entail.

### Conclusion

Perhaps the most famous empirical claim in Tammy Tengs and John Graham's research — indeed, one of the most famous claims in all of the literature on risk regulation — is that we could save 60,000 more lives per year if we reallocated our life-saving resources. Tengs and Graham's empirical research has frequently been misinterpreted as supporting a claim that we are “statistically murdering” approximately 60,000 Americans every year through foolish government regulations. At least some of the life-saving potential Tengs and Graham have found, however, is based on the elimination of government regulations that were never implemented. Most of this life-saving potential, moreover, has nothing to do with government regulations, but instead comes from rearranging priorities in non-regulatory situations such as the advice doctors give to patients to quit smoking.

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<sup>61</sup> See Kenneth L. Mossman & Marissa A. Sollitto, *Regulatory Control of Indoor Rn*, 60 *Health Phys.* 169 (1991).

Tammy Tengs and John Graham have, from all appearances, done nothing to correct the widespread misinterpretation of their own research. Indeed, Graham himself has frequently encouraged this misinterpretation — by telling the Supreme Court that 60,000 lives could be saved if resources now spent on regulation were spent more wisely;<sup>62</sup> by publishing articles that refer to unimplemented, indeed, unproposed environmental measures as if they were implemented,<sup>63</sup> and by testifying that bills that would have substantially changed environmentally protective programs in this country were a good idea because, without such reform, we could be rightly accused of “statistical murder.”<sup>64</sup> These are not someone else’s misrepresentations of Graham’s data; they are Graham’s misrepresentations.

Even if Tengs and Graham’s work accurately represented the products of the current regulatory system, which it does not, their work nevertheless would begin from premises systematically skewed against environmentally protective programs. The exclusive fixation on human lives saved and the discounting of future lives saved both bias the conclusions against environmental protection — which does many more things than save human lives and which focuses in significant part on the future — from the outset. Moreover, Tengs and Graham’s use of prospective estimates of life-saving costs will tend to overstate costs of environmental rules, which have as one of their goals the development of cheaper, more effective technologies to reduce pollution. In these ways, Tengs and Graham’s conclusion that toxin controls fare poorly in terms of cost-effectiveness when compared to other kinds of life-saving interventions comes as no surprise; it is a conclusion that is embedded in the very premises of Tengs and Graham’s studies.

Using Tengs and Graham’s research on life-saving priorities and assuming that maximizing the number of lives with current investments is the goal, it would appear that priorities for reform of life-saving investments would be established as follows: first, reform health-care expenditures; second, redirect expenditures on fatal injury reduction; and, only as a distant third, reform our approach to controlling toxins.

<sup>62</sup> Brief of Amici Curiae AEI-Brookings Jt. Ctr. for Reg. Stud. et al., *supra* n. 53, at 1-2.

<sup>63</sup> *How to Save 60,000 Lives*, *supra* n. 60.

<sup>64</sup> H.R. Comm. on Science, *Hearings on Risk Assessment and Cost Benefit Analysis*, 104th Cong. 1124 (1995) (written testimony of John D. Graham).



Moreover, EPA's operations would be of relatively little concern in this schema, given the quite small contribution even a major overhaul of this agency's priorities could make to overall life-saving results, according to the research discussed in this article.

Curiously, however, this is not how Dr. Graham has allocated his own resources. Indeed, as explained, he has used his research on the cost-effectiveness of life-saving measures in arguing for a major restructuring of our regulatory system. In addition, he has reserved a special disfavor for environmentally protective programs. Scholars, citizens, and government representatives who have an interest in ensuring a high degree of environmental protection in this country should closely monitor Graham's work as Administrator of the Office of Information and Regulatory Affairs in order to see that the built-in anti-environmental biases of his previous work do not find their way into federal regulatory policy.



