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Abstract

Will unbearable regulatory costs ruin the US economy? This specter haunts official Washington, just as fears of communism once did. Once again, the prevailing rhetoric suggests, an implacable enemy of free enterprise puts our prosperity at risk. Like anti-communism in its heyday, anti-command-and-control-ism serves to narrow debate, promoting the unregulated laissez-faire economy as the sole acceptable goal and standard for public policy. Fears of the purported costs of regulation have been used to justify a sweeping reorganization of regulatory practice, in which the Office of Management and Budget (OMB) is empowered to, and often enough does, reject regulations from other agencies on the basis of intricate, conjectural, economic calculations.

This article argues for a different perspective: what is remarkable about regulatory costs is not their heavy economic burden, but rather their lightness. Section 1 identifies two general reasons to doubt that there is a significant trade-off between prosperity and regulation: first, regulatory costs are frequently too small to matter; and second, even when the costs are larger, reducing them would not always improve economic outcomes.

The next three sections examine evidence on the size and impact of regulatory costs. Section 2 presents cost estimates for a particularly ambitious and demanding environmental regulation, REACH -- the European Union's new chemicals policy. Section 3 discusses academic research on the "pollution haven" hypothesis, i.e. the assertion that firms move to developing countries in search of looser environmental regulations. Section 4 reviews the literature on ex ante overestimation of regulatory costs, including the recent claims by OMB that costs are more often underestimated (and/or benefits overestimated) in advance.

Turning to the economic context, Section 5 explains why macroeconomic constraints may eliminate any anticipated economic gains from deregulation. Section 6 introduces a further economic argument against welfare gains from deregulation, based on the surprising evidence that unemployment *decreases* mortality. Section 7 briefly concludes.

1. Two arguments against the trade-off

In theory, it would unquestionably be possible to spend so much on environmental protection that basic economic needs could not be met. At a sufficiently high level of

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regulatory expenditures, protecting nature and cleaning up the air and water *could* absorb enough of society's resources to compete with the provision of more fundamental goods, such as food and shelter. From this it is a short leap to the conclusion that the clash between economy and environment actually *is* an urgent problem, requiring detailed analysis of regulations to prevent worsening the terms of the trade-off. But the latter statement only follows logically if environmental policy is in fact consuming substantial resources, which are transferable to other, more basic needs. That is, the assumed urgency of the trade-off rests on the implicit assumptions that the costs of environmental protection are both large and fungible. Either of these assumptions could fail in practice:

- The costs of environmental protection could be nonexistent, or too small to matter; or
- Reduction of regulatory costs might not produce the desired economic benefits.

Environmental protection with little or no costs

Costless environmental improvement is frequently assumed to be impossible by definition. The hidden premise underlying this form of the trade-off argument is that the market economy is already performing as well as possible; that is, it has reached a Pareto optimum. From this perspective, any new expenditure on environmental protection necessarily represents a loss, because it diverts resources away from the things that consumers in their wisdom have chosen for themselves. (Strong forms of this argument come close to denying the existence of public goods, or at least the possibility of efficient delivery of them. Like most discussion of environmental regulation, this article takes it for granted that the government can and should deliver public goods.)

Reverence for market outcomes is at odds with the beliefs of many environmental practitioners, who assume that environmental improvements can bring economic benefits as well. The rhetoric of joint economic and environmental progress includes such overused imagery as "win-win solutions," the "double [or triple] bottom line," and opportunities to pick the "low hanging fruit." The ubiquity of these phrases underscores the extent to which environmental advocates find that the market is improvable – implying that it could not have already been at an optimum.

In a more academic vein, the Porter hypothesis maintains that carefully crafted, moderately demanding regulations can improve economic competitiveness and success in the marketplace (Porter and van der Linde 1995). Likewise, studies of energy conservation and greenhouse gas reduction frequently find opportunities for energy savings at zero or negative net cost, as in the "no regrets" options for climate change mitigation (IPCC 2001, 474-476). The critique of these opportunities is not that they are undesirable; who could argue with free environmental improvements? Rather, economists have argued that, in their own overused metaphors, there are no free lunches, nor \$20 bills on the sidewalk. If lunch is expensive and the sidewalk is bare, then the Porter hypothesis must be impossible, and there must be hidden costs associated with energy conservation.

Without attempting a thorough review of this debate, it seems plausible that there are significant cases where essentially costless energy savings and other environmental improvements are possible. In such cases, the fears of regulatory cost burdens and concerns about trade-offs are presumably easy to resolve; there should be a broad consensus supporting the adoption of costless improvements.

However, literally costless improvements are not the only ones to escape from the trade-off; economic constraints do not immediately become relevant to real decisions as soon as regulatory costs are greater than zero. Very small costs of regulation presumably have very small impacts on the economy. Regulations could easily have costs that are too small to matter -- and Sections 2-4 will suggest that this is the case in many important instances. The theoretical consensus that supports costless environmental improvement may vanish once costs become positive, however small; but practical concerns about economic impacts need not arise until costs become large in some meaningful sense.

The question naturally arises: what counts as large? Here it is important to resist the illusion of superficially big numbers. Quantities in the billions, which are commonplace in federal programs and nationwide impact assessments, are essentially impossible to understand in isolation. Some standard of comparison is needed to bring them down to a comprehensible scale. (A million seconds is about 12 days; a billion seconds is about 32 years.) Amounts in the billions of dollars are inevitably thought of as part of a ratio: if X billion dollars is the numerator, what is the appropriate denominator? When none is specified, the default denominator tends to be the listener's personal finances -- in which case one or a few billions look very large indeed.

In contrast, a penny per person per day sounds small. But for the US with its population of about 300 million, a penny per person per day and a total of \$1 billion per year are roughly the same. Per capita impacts, as in this example, are sometimes appropriate, particularly when the costs of regulations are spread across the population as a whole. Comparison to the revenues of the affected industry is also a useful standard for evaluating regulatory impacts. For issues affecting the entire US (or the EU), or even a large industry, a few billion dollars (or euros) per year is not a large number. This issue is important in the discussion in Section 2.

Environmental costs that cannot be traded for economic gains

Even when environmental policies impose noticeable economic costs, it does not necessarily follow that these costs could be traded for greater private incomes and consumption, or for the benefits that are thought to accompany higher incomes. There are two strands to this unfamiliar argument, presented in Sections 5 and 6 below, and briefly anticipated here.

First, deregulation might not produce increased economic growth. If a regulation or other environmental policy has measurable economic costs, it consumes resources such as labor and capital that could have been used elsewhere in the economy. The

policy, then, can only be "traded" for whatever those resources could have produced elsewhere -- in economic terms, the opportunity cost of those resources.

During a recession, labor and capital are typically less than fully employed. Supplying more of resources that are already in surplus may not produce anything more; the short run opportunity cost of additional resources could be zero. On the other hand, during expansions such as the late 1990s, the Federal Reserve carefully controls the level of employment and rate of growth; making more resources available for increased growth might just lead the Fed to step harder on the brakes in order to maintain the (unchanged) target pace of expansion. Again, the short-run opportunity cost of additional resources could be zero.

Second, economic growth may not produce the expected or desired benefits. An increasingly common style of analysis converts regulatory costs into health and mortality impacts, based on correlations between income and health. In the extreme, regulatory costs that are thought to lower market incomes have been labeled "statistical murder", because richer people live longer.

This line of argument is flawed in several respects. Perhaps the most dramatic response to the "statistical murder" story is the epidemiological evidence that mortality decreases in recessions. If deregulation leads to economic growth, which boosts employment, the expected result is paradoxically not a reduction in mortality.

In the long run, the availability of resources such as labor and capital must have something to do with growth rates, economic opportunities, and improvements in health and welfare. However, the relationship is a subtler and more tenuous one than is often recognized.

2. The low cost of regulating Europe's chemicals

Expensive regulations are less likely to be adopted in the US at present, due to exaggerated fears about regulatory costs, and to an administration that is extremely sympathetic to industry's concerns. Examples of truly expensive regulations may be easier to find elsewhere, such as in the European Union. Regulation has a better name in the EU than in the US; government-imposed constraints on private business that are taken for granted in Brussels would be immediately dismissed as beyond the pale in Washington.

REACH, Europe's new chemicals policy, is one of the most ambitious and demanding EU environmental regulations. (The name is an acronym for Registration, Evaluation, and Authorization of Chemicals.) When it is adopted, likely by early 2007, REACH will require chemical manufacturers and importers to register and test their chemicals for safety. During the 11-year phase-in period, some 30,000 chemicals will likely be registered and tested. Depending on the outcome of the tests, some chemicals (probably a very small minority) may be subject to partial or complete restrictions on

their use in Europe. An appeals procedure allows economic and other arguments to be raised against restrictions on the use of a chemical.

As in the US, industry groups have claimed that the costs of regulation will be prohibitive. A German industry federation commissioned a study, performed by the consulting firm Arthur D. Little (ADL), which presented lengthy calculations purporting to show that REACH would devastate German manufacturing, and seriously weaken the German economy as a whole (Arthur D. Little 2002). A French industry group sponsored another study, to date released only in the form of PowerPoint slides, claiming that France, too, would be flattened by REACH (Mercer Management Consulting 2003).

Numerous studies done without industry funding have reached very different conclusions, finding that the costs of REACH would be much lower, and entirely manageable. The European Commission estimated that the costs of registration and testing would total €2.3 billion over the 11 year period. I directed a study sponsored by the Nordic Council of Ministers, representing the governments of the Scandinavian countries, which estimated the registration and testing costs at €3.5 billion (Ackerman and Massey 2004). Our cost estimate represents less than one euro per person per year, over the 11-year phase-in of REACH.

Perhaps a better standard of comparison is that the €3.5 billion cost, if fully passed on to customers, would increase the average prices of the European chemical industry by a ratio of .0006, or 1/16 of 1%. This is, by any reasonable standard, a very small price change. The spot price of crude oil changes by more than that, on average, 51 weeks out of the year. The cost of REACH, standing alone, might sound big (billions of euros!), but the revenues of the European chemical industry over 11 years amount to a much bigger number of euros. Even a noticeably larger ratio could still seem small: if, as industry has sometimes claimed, most of the costs of REACH will be borne by one third of the chemical industry, the affected companies would be burdened with a price increase of about 1/5 of 1%.

The German industry study, performed by ADL, is the only major study to explain why the costs might be much larger. Yet the authors used only slightly higher figures than everyone else for the direct costs of registration and testing. Their enormous estimates of the costs of REACH came from creative calculation of indirect costs such as decreases in productivity, delays in innovation, etc. In their economic model, industry displays little imagination or adaptability, and never responds to regulation by innovating or switching to safer substitutes. Rather, industry's sole answer to regulation is to notice that profits have decreased, and therefore to decide to cut back on production. A bizarre misreading of basic microeconomic theory led ADL to estimate that production losses would average 9 times any cost increase imposed on German industries. Meanwhile, they mistakenly assumed that costs of REACH would be incurred over only 7 years, rather than 11, thus inflating the annual costs during the phase-in period by more than 50%. These and other mistakes drove cost impacts sharply upward.

They identified many separate pathways by which REACH might conceivably affect industry. Specifically, ADL assumed that each regulatory impact pathway would cause a specified percentage reduction in industry output; all the separate reductions were assumed to be independent, and multiplied to obtain the cumulative reduction. Thus if one regulatory impact is believed to cause a 10% cutback in output, and another to cause a 20% cut, the combination causes output to fall to $90\% \times 80\% = 72\%$ of the original level. This strange, nonstandard methodology seems designed for exaggeration, as any mild overstatement in individual factors will be amplified through multiplication by all the other factors. If ADL has inappropriately doubled the size of one of the individual cost factors, the entire estimate of the cost and impacts of REACH will be doubled via the multiplicative method. The appendix to my Nordic Council study provides a detailed critique of both the individual impact pathways and the overall methodology of the Arthur D. Little study.

The predominant role of indirect cost impacts suggests another comparison: how large is the ratio of indirect costs of regulation to the direct compliance costs? The highest ratio that I am aware of in a government, NGO, or academic study of REACH is about 6 to 1. The implicit ratio in the Arthur D. Little study is 650 to 1. Without knowing precisely what this ratio should be, it is tempting to say that we know what it is not: in an advanced industrial economy such as Germany, there is no visible basis for the claim that regulations impose indirect costs of 650 times their direct compliance costs.

US industry and government have been emphatic in their opposition to REACH, issuing alarmist predictions of its possible impact on the US. (These, too, are greatly exaggerated; at worst, US companies exporting to Europe might face the same percentage cost increase as European companies. A small percentage is a small percentage, whether it is expressed in euros or in dollars.) It seems safe to say that no recent US regulations have approached the ambition or scope of REACH. If one of Europe's most demanding regulations will increase prices by 1/16 of 1%, imagine how much less the costs will be for the timid proposals that still pass muster in Washington.

3. Pollution havens: theory vs. reality²

If regulatory costs imposed significant burdens on the economy, it should be easy to find their footprints. Because the costs are not uniformly distributed, there should be dramatic extremes where regulations have trod most heavily on the human landscape. Companies that have closed because of environmental costs, moving to Mexico or other countries where the regulatory climate was more lenient; workers thrown out of jobs by rigid environmental strictures; formerly prosperous communities shut down by the economic burdens of command-and-control regulation -- they should be all around us. If the fabled regulations of mass destruction exist, there is no way to hide them in a bunker; they should be visible for all to see. But the actual, identifiable examples of jobs lost to regulations rarely extend beyond a handful of stories about small numbers of workers in

² This section draws heavily on the work of Eban Goodstein (Goodstein 1999) and Kevin Gallagher (Gallagher 2004).

the most directly environmentally damaging, rural industries such as logging and coal mining.

The economic impacts of environmental regulations have been intensively studied for years. As Eban Goodstein has demonstrated (Goodstein 1999), there is no evidence that significant numbers of jobs or businesses have ever been lost for environmental reasons. Companies don't move, between states or between countries, to avoid expensive environmental standards, because environmental standards aren't that expensive. Environmental compliance costs are above 2% of industry revenues only in a handful of the most polluting industries; Goodstein cites a maximum of 7% for pulp mills. Among the reasons for major layoffs, as reported by the Bureau of Labor Statistics, environmental and safety-related shutdowns are among the least common, accounting for about 0.1% of job losses (Goodstein 1999; Ackerman and Massey 2002). Contrary to predictions, the Clean Air Act Amendments of 1990 did not destroy jobs; the same is true for the stringent local air quality regulations imposed by the South Coast Air Quality Management District in Southern California. A study of the South Coast regulations concluded, "In contrast to the widespread belief that environmental regulation costs jobs, the most severe episode of air-quality regulation of industry in the [United States] probably created a few jobs." (quoted in Goodstein 1999, 54)

Economists have carried out extensive studies of the "pollution haven hypothesis," i.e. the notion that polluting industries will flee to countries with lax environmental standards. The results have been almost entirely negative. A 1995 review of the literature on the subject concluded

Overall, there is relatively little evidence to support the hypothesis that environmental regulations have had a large adverse effect on competitiveness, however that elusive term is defined... studies attempting to measure the effect of environmental regulation on net exports, overall trade flows, and plant-location decisions have produced estimates that are either small, statistically insignificant, or not robust to tests of model specification. (Jaffe et al. 1995, 157-158)

A more recent literature review reached similar conclusions (Jayadevappa and Chhatre 2000). Eric Neumayer demonstrated that neither the US nor Germany has had unusually large net outflows of investment in dirty industries; a section of his chapter on the subject is subtitled, "Why is there so little evidence for pollution havens?" (Neumayer 2001) Brian Copeland and Scott Taylor, in a very thorough theoretical and empirical analysis of trade and the environment, conclude that "the evidence does not support the notion that trade patterns are driven by pollution haven motives." (Copeland and Taylor 2003, 277) Kevin Gallagher shows that the dirtiest industries in the US have not been migrating to Mexico, either before or after NAFTA; while these industries have been declining in the US, their share of manufacturing has been declining even faster in Mexico. Moreover, a handful of major industries -- steel, aluminum, and cement -- appear to be cleaner (i.e., emit smaller amounts of criteria air pollutants per dollar of sales) in Mexico than in the US. A likely explanation for this unexpected pattern is that

the Mexican plants are newer than their US counterparts, and incorporate newer, cleaner technology (Gallagher 2004).

The economics literature is nearly, but not quite, unanimous on this question. Two recent articles have found modest empirical support for the pollution haven hypothesis. Matthew Kahn and Yutaka Yoshino use intricate and indirect methods of measuring the pollution intensity of trade inside and outside of regional trading blocs. They find that for trade outside of blocs, middle-income countries tend to expand dirty exports as they grow, while high-income countries expand cleaner exports. The effect is weaker inside regional trading blocs (Kahn and Yoshino 2004).

Matthew Cole presents superficially contradictory findings on trade between the US and Mexico (Cole 2004). (A careful reading shows that his results are not literally in conflict with each other.) On the one hand, the trade flows in both directions are becoming cleaner, but Mexico's exports to the US are becoming cleaner (declining in air pollution intensity) faster than US exports to Mexico. Since 1988, he finds, "The pollution embodied in US imports from Mexico [has been] less than that embodied in exports to Mexico and, furthermore, this gap has been widening rather than narrowing." (Cole 2004, 441) On balance, it is Mexico rather than the US that is escaping from trade-related air pollution on the other side of the Río Grande, seemingly contradicting the pollution haven hypothesis. On the other hand, Cole also finds that US imports, from Mexico and from the world, are growing faster (as a share of US consumption) in industries that have higher pollution abatement costs, just as the pollution haven hypothesis would suggest.

Neither of these articles finds a strong effect, and neither presents a clear, easily interpreted picture of the movement of industry in response to US pollution control costs. Meanwhile, the bulk of the economics literature, as described earlier, continues to suggest that a good pollution haven is hard to find.

4. Advance overestimates of regulatory costs

By now there is a substantial literature demonstrating that the best-known claims of extraordinary costs imposed by environmental policy do not stand up to careful examination. Tales of billions of dollars spent per life saved by esoteric regulations are based on errors and misrepresentation; they represent, as Lisa Heinzerling put it, "regulatory costs of mythic proportions" (Heinzerling 1998), (Heinzerling and Ackerman 2002). No attempt will be made to summarize the full extent of that literature here.

However, one aspect of the issue is worth expanding upon, namely the biases in prospective estimates of regulatory costs. Prospective estimates are, of course, all that is available when a new policy is under discussion. And the evidence is clear: the costs of environmental protection are much more often overestimated, rather than underestimated, in advance.

A classic example is the 1974 OSHA standard for workplace exposure to vinyl chloride. Consultants to OSHA estimated the costs of reducing vinyl chloride exposure at around \$1 billion; industry estimates were even higher. Actual costs turned out to be around a quarter of OSHA's estimate, since industry quickly developed new, cost-effective technologies to comply with the regulation (U.S. Congress Office of Technology Assessment 1995).

Similar patterns have been found for many environmental standards. One study found that compliance costs for environmental regulations were overestimated in advance in 11 out of 12 cases (Hodges 1997). Another study found that advance cost estimates for environmental compliance turned out to be more than 25 percent too high in 14 out of 28 cases, while they were more than 25 percent too low in only 3 of the 28 cases (Harrington et al. 2000). A study for Environment Canada and the Ontario Ministry of Energy, Science and Technology, focusing specifically on the costs of controlling chlorinated substances, confirmed that overestimation of regulatory costs is more common than underestimation (Cheminfo Services 2000).

An in-depth examination of prospective cost estimates for regulations by Thomas McGarity and Ruth Ruttenberg reviews most of these as well as quite a few other examples, and identifies a series of reasons why cost estimates are biased upward in advance: (McGarity and Ruttenberg 2002)

- Regulators rely on regulated industries for empirical data, and the industries have a clear interest in secrecy and/or inflated cost estimates, either of which will discourage strict regulation.
- The likelihood of court challenges to strict regulations pushes agencies toward making conservative assumptions, again tilting in favor of the regulated industries.
- For lack of information, agency analyses often compare the costs of a proposed regulation to a zero regulation baseline, rather than the appropriate measurement of the incremental costs relative to existing regulations.
- Companies' reported costs of regulatory compliance sometimes include costs of upgrading other equipment at the same time that environmental controls are installed.
- Regulatory analyses frequently take a static approach, ignoring the learning curve effects, economies of scale, and regulation-induced productivity increases that may result from new environmental standards.

On the other hand, McGarity and Ruttenberg note that there are also downward biases in cost estimates, including a tendency to ignore indirect social costs of regulation, reliance on vendors of control technologies that are eager to win new markets, and a failure to take sufficient account of "Murphy's law" in projecting responses to regulatory requirements. On balance, the factors producing upward bias appear more numerous and more powerful.

The OMB response: 2004

However, the opposite perspective continues to be argued in the annual reports from OMB's Office of Information and Regulatory Affairs (U.S. Office of Management and Budget 2004; U.S. Office of Management and Budget 2005). The 2004 report devoted three pages (U.S. Office of Management and Budget 2004, 51-53) to the discussion of ex ante versus ex post regulatory cost estimates, leading with the assertion that many commentators believe costs are underestimated in advance. OMB cites three studies in support of the view that regulatory costs are typically underestimated. Yet all three simply claim that costs are large, not that advance estimates are consistently low. The details of these claims are not impressive:

- Mark Crain and Thomas Hopkins, in a consultant report for the Small Business Administration, agonize at length over the plausible idea that there are economies of scale in regulatory compliance, so that smaller firms have a higher compliance cost per employee (Crain and Hopkins 2000). For its estimates of environmental regulatory costs, the study uses the high end of the range published by OMB. So in citing this study, OMB is effectively citing itself, not a new source of information.
- Harvey James estimates the costs of compliance with 25 OSHA regulations as of 1993 (James 1998). But he also observes that the cost per firm was 5.5 times higher in a 1974 study of OSHA compliance costs done by the National Association of Manufacturers. James then simply asserts that the costs per firm could not be lower today than in 1974. On that basis, he multiplies his 1993 numbers by 5.5 -- thereby eliminating all empirical content in his study of 1993 costs, and simply recycling a 1974 estimate by an anti-regulatory industry group.³
- Finally, a detailed economic modeling exercise by Dale Jorgensen and Wilcoxon estimates the impact of the environmental regulations on US economic growth (Jorgensen and Wilcoxon 1990). They state at the outset that they have not attempted to assess any of the benefits, to consumers or to producers, of a cleaner environment. As a result, "the conclusions of this study cannot be taken to imply that pollution control is too burdensome or, for that matter, insufficiently restrictive." (Jorgensen and Wilcoxon 1990, 314-315)

Modeling costs but not benefits, they find that the growth rate was reduced by 0.19% due to regulations during 1974-1983. They analyze a scenario involving the complete absence of regulations, including removal of all limitations on the use of high sulfur coal, and all motor vehicle pollution controls. Even if one were willing to contemplate such a wholehearted embrace of smog, acid rain, and toxicity, there are two reasons why the effect on the growth rate would be smaller today: the study was based on a period when the first round of spending for compliance with the Clean Air Act and the Clean Water Act was underway; and it

³ The polemical nature of this study is suggested by its prominent table of the costs of compliance with OSHA regulations proposed in the late 1970s. Almost all of the costs in the table are for compliance with a generic carcinogen standard -- presumably the standard that was rejected in the *Benzene* decision. Only in a note many pages later, at the end of the article, does James acknowledge that the generic carcinogen standard was never actually implemented.

was also a period when the dirty industries which account for most pollution control spending represented a larger fraction of the US economy than at present.

The OMB response: 2005

In its 2005 report, OMB takes a different tack. In a chapter entitled "Validation of benefit cost estimates made prior to regulation," the report reviews "47 federal rules where pre-regulation estimates of benefits and costs were made by federal agencies and some post-regulation information is published by academics or government agencies." (U.S. Office of Management and Budget 2005, 42) The bottom line judgment is that overestimates of benefit-cost ratios were more common than underestimates: 11 were declared accurate (meaning that advance estimates were within 25% of the retrospective judgments), 22 advance estimates were too high, and 14 were too low.

OMB's report is not strictly comparable to other literature on advance cost estimates. It differs from other analyses in restricting its attention to estimates made by federal agencies; many of the most controversial and politically significant estimates are made by or sponsored by industry groups. Thus it could still be the case that regulatory cost estimates that arise in political debates are typically overestimated, whether or not federal agencies have a tendency toward underestimates.

Moreover, OMB examines both costs and benefits, and finds advance estimates to be too high much more often for benefits than for costs. Evaluating OMB's judgments on benefits estimates would be a substantial task, which for the most part is not undertaken here. Regulations do not operate in a vacuum; even in hindsight, it is not immediately obvious how large the benefits from a regulation have turned out to be. If a regulation reduces the risk of death in an industry or community, it is necessary to distinguish the effects of the regulation itself from any other factors that may have altered death rates in the same period. In other words, a retrospective study would be needed to identify those benefits -- and methodological errors could bias the retrospective, as well as the prospective, estimate.

Despite these differences in approach, OMB's discussion of the 47 rules appears to be a response to the findings of advance overestimates of costs. Even on its own terms, accepting OMB's judgments on the individual rules, the report is fundamentally unpersuasive, for two reasons. First, the report does not establish a reasonable basis for inferring that federal agencies tend to overestimate; its data do not contain a statistically significant bias toward overestimates. Second, the report's main finding is entirely due to its treatment of OSHA estimates, which raise a number of unique issues unrelated to general biases in estimates.

The choice of rules was based solely on data availability, heavily skewed by a few sources that reviewed multiple rules. OMB refers to the rules as a "convenience sample" which is not necessarily representative of federal rules in general (U.S. Office of Management and Budget 2005, 48). But let us suppose for the moment that they were a

true random sample of federal rules and agency estimates, and see what the sample would imply about the overall tendency to overestimate.

With 11 advance estimates accurate, 22 over, and 14 under, OMB's sample is not terribly far from finding the average estimate to be accurate. Change just 4 of the overestimates to under, and all trace of bias would disappear. How likely is it that the appearance of bias has occurred purely by chance? For the purpose of statistical analysis, OMB's judgments can be converted to numbers: 0 for accurate, -1 for underestimates, and +1 for overestimates. Then the sample mean is 0.17, and the standard error is 0.13. The null hypothesis that the true mean is zero, i.e. no bias, cannot be rejected, with $p = .19$. In other words, if there was no bias in reality and we drew a random sample of 47 cases, there is a 19% probability that it would look at least as biased as the OMB sample. Of course, standard statistical practice, which OMB would certainly insist on in agency scientific analyses, requires $p = .05$ or less to reject the null hypothesis of no effect.

In contrast, the Harrington et al. study mentioned earlier (Harrington et al. 2000), which found 3 underestimates of costs, 14 overestimates, and 11 accurate, passes the significance test with flying colors: using the same numerical scoring, the sample mean is .38, with a standard error of .13. The null hypothesis that the true mean is zero is clearly rejected, with $p = .005$; there is less than a 1% probability of getting the Harrington et al. result by chance if there is no real bias in advance cost estimates. (Note that Harrington et al. find a tendency to overestimate regulatory costs, while OMB alleges a tendency to overestimate benefit-cost ratios. Thus "overestimate" has opposite implications in the two contexts.)

Not only does the slight appearance of bias in the OMB study turn out to be statistically insignificant; it is also entirely due to OMB's treatment of the 13 OSHA rules. As shown in Table 1, all of the tilt toward overestimates comes from the OSHA rules, where OMB believes that overestimates of benefit-cost ratios are essentially the norm. (OSHA's 1974 vinyl chloride rule, discussed above, a famous case in which advance estimates of costs were far too high, did not make it into OMB's "convenience sample.") Among the non-OSHA rules in OMB's sample, underestimates slightly outnumber overestimates, although with $p > .5$ (see table) it is completely clear that this pattern is not statistically significant.

	Total	OSHA	All other
Accurate	11	2	9
Overestimate	22	11	11
Underestimate	14	0	14
<i>p value for no bias</i>	<i>.19</i>	<i>.00</i>	<i>.56</i>

As can be seen from a glance at the data, there is essentially no chance that the true mean, or bias, is the same for the OSHA and non-OSHA rules (statistically, the hypothesis that the two groups have equal means is rejected with $p < .00001$).

So in the end, the scant evidence of overestimates provided by OMB comes down to their treatment of the 13 OSHA rules. In 6 of the 13 cases, OMB relied on a single source, an article by Si Kyung Seong and John Mendeloff (Seong and Mendeloff 2004). That article discusses OSHA's tendency toward prospective overestimates of benefits, suggesting several explanations. Prospective estimates from regulatory agencies typically assume complete implementation of proposed rules, whereas retrospective evaluations reflect actual, potentially incomplete implementation. The availability of data on workplace fatalities improved significantly in 1992, allowing more accurate estimates of reduced mortality due to regulations; 9 of the 13 OSHA rules in the OMB study were adopted before 1992. Seong and Mendeloff also suggest that OSHA is more likely to be inaccurate in analyzing less expensive rules, which naturally receive less analytical effort; and they conclude that OSHA systematically overestimates the benefits of training programs.

Thus the allegation that OSHA overestimates benefits could simply reflect the agency's beleaguered status. Ever since the Reagan administration, OSHA has been particularly hard-hit by industry and conservative attacks, budget cuts, and defeats in the courts. As a result, OSHA may be more constrained and powerless than other regulatory agencies. It is all too believable that OSHA is constantly planning on complete implementation of its rules but unable to achieve it, or that it has been forced to stick to small proposals, frequently involving nothing more than training programs. According to Seong and Mendeloff, the result would be a pattern of overestimation of benefits of OSHA regulations. This is an important story, but it bears no resemblance to OMB's suggestion of a pattern of systematic overestimation of benefit-cost ratios by government agencies.

5. Opportunity costs and growth-growth trade-offs

The previous sections have suggested several reasons to doubt that environmental regulations impose huge economic costs. This section turns to the economic context of the debate, arguing that even if regulatory costs look significant, deregulation might produce surprisingly little additional growth and personal consumption.

The costs of regulation do not consist of goods that would be of direct use to consumers; if regulation were rolled back, it would not be helpful to simply redistribute scrubbers, filters, catalytic converters and the like to other uses. Rather, the trade-off hypothesis must be that regulation requires the use of productive resources, principally labor and capital; in the absence of regulation, these resources could be used to produce consumer goods (or other desirable products). A related assumption, normally taken for

granted, is that expanding the available supplies of labor and capital would in fact increase the production of consumer goods.⁴

Yet the truth of that related assumption is less obvious than it might seem. Suppose that deregulation occurs during a recession. In that case, unemployed labor and capital are already available on the market; indeed, that is almost the definition of a recession. It is far from certain that increasing the surplus of idle labor and capital will produce any economic benefit in the short run.

Alternatively, suppose the deregulation occurs during an economic expansion. It is becoming increasingly standard practice for the Federal Reserve to maintain tight control of the pace of expansion, effectively preventing an acceleration of growth above a target level. In the late 1990s, for instance, economic growth was limited by Federal Reserve intervention -- not by regulations, or by the availability of labor or capital. Again, an increase in available productive resources might not have led to any additional output, income, or consumption in the short run. If deregulation had put more labor and capital on the market, the Fed might have simply clamped down harder to achieve its targets (Goodstein 1999).

In the long run, the availability of labor and capital must have something to do with the pace of economic growth. The manner in which that long run effect occurs, however, depends on macroeconomic mechanisms about which there is no consensus. Would additional labor and capital somehow accelerate the recovery from recession, or make the next recession less deep? In an expansion, would the Fed quickly notice that increased output is now possible without risking inflation, or would it take years -- perhaps even another business cycle -- for the Fed's targets to adjust to the additional resources? Both theoretical and empirical macroeconomic analysis would be required to have confidence about the answer to these questions.

A common critique of risk-reducing regulation today is that it should examine "risk-risk" trade-offs, considering not only the risk directly addressed by regulation, but also the offsetting risks that might be indirectly created by the regulation. It is equally the case that calculations involving the costs of regulation should examine the "growth-growth" trade-offs, considering not only the resources used in regulatory compliance, but the actual benefits available from using those resources elsewhere. In the short run, there may be no foregone growth at all. If the claim is that deregulation would create additional growth only in the long run, via slow, complex pathways, then the usual arguments about the need to discount future benefits would apply to this economic gain. Not only the extent of growth, but the timing, needs to be calculated in order to determine the real opportunity cost of the resources used to comply with regulations.

⁴ The same discussion applies not just to consumer goods, but to any desirable goods that could be produced with the resources used for regulatory compliance. Likewise, it applies to the resources saved by avoiding new regulation, as well as the resources released by deregulation. For narrative simplicity, this section tells the story purely in terms of deregulation and consumer goods.

6. Is employment hazardous to your health?

A clever rhetorical strategy has appeared in recent economic arguments for deregulation. Rather than emphasizing the monetary costs of regulation per se, critics of regulation have converted these costs into numbers of deaths that supposedly result from the expenditures. Expensive regulations can thus be charged with "statistical murder." As Lisa Heinzerling and I have argued (Ackerman and Heinzerling 2004, chapter 3), the statistical murder theory is doubly fallacious. The correlation between income and mortality is weak in developed countries, except at very low income levels; different variants of the statistical murder story have used widely differing prices per life saved, resting on different indirect inferences from very limited data. Moreover, regulation does not remove money from the economy, so much as cause it to be spent in different sectors. Incomes decrease for those who produce and sell polluting products, but increase for those who develop, install, and operate pollution controls, monitor compliance, and research and debate regulatory options. Whether or not one considers this reallocation to be desirable, it is primarily a change in the composition, not the aggregate level, of national income.

But an even more decisive rebuttal is available. Remarkably enough, the statistical evidence shows that mortality decreases during recessions, and increases as employment rises. So even if the costs of regulation were large enough to matter (despite the evidence to the contrary in sections 2-4), and even if deregulation boosted economic growth and employment in the short run (despite the arguments to the contrary in section 5), the result might well be an increased death rate.

The evidence on mortality and business cycles is presented in a symposium in the December 2005 issue of the *International Journal of Epidemiology*. The lead article, by José A Tapia Granados, presents and analyzes data for the US throughout the 20th century (Tapia Granados 2005a). Age-adjusted mortality rates are significantly, negatively correlated with unemployment rates -- meaning that death rates go up when unemployment goes down -- for the population as a whole, and separately for men and women, and for whites and nonwhites. The relationship is strongest for the working age population.

Looking at individual causes of death, in the late 20th century (after 1970) deaths from traffic accidents, major cardiovascular diseases, and cirrhosis of the liver were all significantly, negatively related to the rate of unemployment. In earlier periods, there was also a strong relationship between employment and flu and pneumonia deaths, and a weaker but significant relationship with cancer deaths, in the same "perverse" direction. Of the major causes of death examined in the article, only suicide shows the naïvely "expected" pattern of worsening when unemployment rises.

Another study, by Christopher Ruhm, similarly found that for 1972-1991, increased unemployment was associated with decreases in total mortality in eight of 10 major causes of death (Ruhm 2000). The two exceptions were Ruhm's findings of no

significant relationship between unemployment and cancer deaths, and, as in the study discussed above, more suicides at times of higher unemployment.

When more people are working, there is more traffic and therefore more traffic fatalities. There is also more stress at work and hence more cardiovascular disease. During economic upturns, alcohol and tobacco consumption increase, as does obesity; meanwhile, time spent on exercise, sleep, and social interactions all decrease. In the past, workplace contagion may have caused deaths by spreading infectious diseases such as flu and pneumonia. Even though some underlying causes of mortality, such as stress, involve chronic, long-term conditions, the timing of deaths may reflect short-term triggers related to employment. Heart attacks among the working age population are known to peak on Mondays (Willich et al. 1994).

Although counterintuitive, the finding of an association between increased employment and increased mortality is not new. Peer-reviewed publications making this point date back to 1922, and have continued throughout the intervening years. Most have been in public health journals, although at least one has appeared in a leading economics journal (Ruhm 2000). US, Canadian, and British data all support the idea that recessions are somehow better for health. One epidemiologist, M. Harvey Brenner, has long challenged this finding (Brenner 2005), but Tapia and Ruhm both provide effective critiques of Brenner's statistical methodology (Ruhm 2000; Tapia Granados 2005b). Tapia maintains that Brenner has used excessively complicated models with too little data to validate them, undermining the credibility of his time series results. Ruhm suggests that Brenner's earlier study of a 40 year span from the 1930s to the 1970s primarily reflects the decline in mortality that occurred as the US emerged from the 1930s depression. This era witnessed important medical and nutritional advances, as well as rising incomes and declining unemployment.

Two other major objections should be noted. First, at an individual level, death rates are higher for the unemployed than for the employed. This is not incompatible with the aggregate pattern. Perhaps mortality is always higher for the unemployed than for the employed, but is higher for each group during economic expansions than during recessions. Then it is easy to construct numerical examples in which overall mortality increases during expansions (Tapia Granados 2005b).

Second, over the long run it is clear that rising incomes have been associated with falling death rates. However, the correlation is not perfect; the periods of fastest declines in death rates are not the times of fastest increase in incomes. The long-run decreases in mortality may be caused by changes that are only loosely correlated with income, such as improvements in sanitation, public health, and achievement of minimum nutritional standards. Over the long run, the decrease in mortality rates is one of the most important effects of economic development; but this need not imply any relationship to short-term economic fluctuations in an already developed country. Small gains in average income, hypothesized to occur as a result of deregulation, could be associated with no improvement, or even worsening, in public health and nutritional standards for the poor.

Needless to say, there is not much left of the anti-regulatory "statistical murder" story once this perspective on unemployment and mortality is acknowledged.

7. Conclusion

This article has presented several pieces of the picture of regulatory costs; by way of conclusion, it may be helpful to briefly summarize the argument as a whole.

Reports of the economic burden imposed by regulatory costs have been greatly exaggerated. The widely imagined trade-off between economic prosperity and environmental protection rests on multiply mistaken premises. Many environmental policies impose little or no net costs on the economy; even when regulatory costs appear significant, there may be no short run opportunity to exchange those costs for additional economic growth; and even when growth occurs, it may not lead to desired outcomes such as reduced mortality.

Even a policy as ambitious as REACH will lead to very small cost increases, raising the price of chemicals sold in Europe by an estimated 1/16 of 1%. Claims of ominously greater impacts appear primarily in industry-funded studies, the most detailed of which relies on an idiosyncratic and indefensible methodology. Likewise, there is little evidence of jobs actually lost to regulations, outside of a few of the most environmentally damaging, extractive industries. The "pollution haven hypothesis," suggesting that companies move to regions or countries with more lenient environmental regulations, has been rejected by virtually all analysts who have studied the question.

Several researchers have found that prospective estimates of the costs of regulation are more likely to be too high than too low. One of the principal voices rejecting this finding is that of OMB, which has maintained in its annual reports that regulatory costs may be underestimated or benefit-cost ratios overestimated in advance. The grounds for this contrary conclusion include citation of a limited number of unconvincing studies, and manipulation of a regulatory data set which does not show a statistically significant tendency toward overestimates of benefit-cost ratios.

Even when regulations have significant costs, it is not necessarily the case that these costs are fungible. In a recession, idle economic resources are already available and are not creating short-run growth; in an expansion, the Federal Reserve may enforce predetermined limits on the pace of growth in order to prevent inflation. It is now common to discuss the need for a "risk-risk analysis," comparing old risks alleviated by policies to the new risks created by the same process. It is equally necessary to consider a "growth-growth analysis," comparing economic costs imposed by policies to the actual opportunity cost of the same resources used elsewhere.

Finally, even if growth were to occur as a result of deregulation, it is not certain that it would lead to the anticipated beneficial consequences, such as reduced mortality. A remarkable line of empirical research demonstrates that in the US and several other

countries in the 20th century, age-adjusted mortality rates increased during economic expansions and declined during recessions. The rhetorical equation of regulations with reduced growth and increased mortality, dubbed "statistical murder" by regulatory critics, turns out to be dead wrong.

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