ONWARD Wisconsin

Unleashing Capitalism with Common Sense Public Policy

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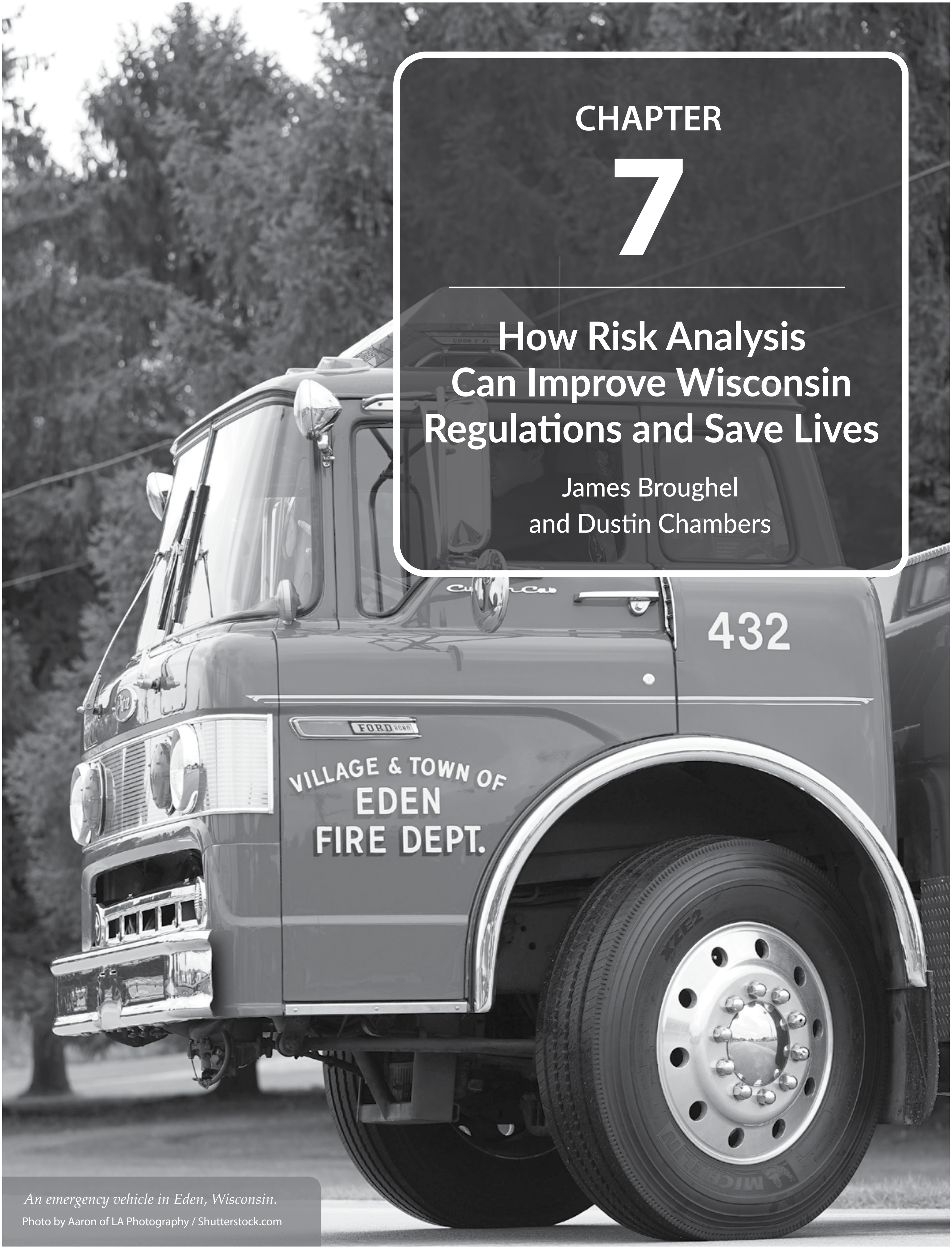
How Risk Analysis Can Improve Wisconsin Regulations and Save Lives

James Broughel
and Dustin Chambers



An emergency vehicle in Eden, Wisconsin.

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7 How Risk Analysis Can Improve Wisconsin Regulations and Save Lives

Each morning when we wake up, we face a plethora of risks in the day ahead. These may include the risk of getting into a car accident on the way to work, the risk of catching COVID-19 from our coworkers, and the risk of contracting heart disease from eating poorly or not exercising. Although risks are usually thought to be associated with harms (which is primarily how they will be discussed in the context of this chapter), some risks can be beneficial. When we buy a lottery ticket there is a risk we might win. There is a risk of meeting our future spouse when we walk into a nightclub, a risk of landing our dream job after we submit an employment application.

The reason policy makers care about risks is that a responsibility of public policy is to prevent harms of various kinds. However, no harm will occur with certainty. There may be only a small chance of an asteroid hitting the earth, but the results would be catastrophic. By contrast, there is a high probability that a citizen will experience a mosquito bite this year; however, the harm from this event is minuscule. How should policy makers react to such a divergence in risks?

What these events have in common is they combine an outcome with an associated probability. For example, there might be a 1 percent chance of developing cancer from walking onto a radioactive waste site with no protective equipment. Or there could be a one-in-a-million chance of being hit by lighting during a thunderstorm. In each case, the overall level of risk depends both on the likelihood some event will occur (the probability) and on the consequences of the event itself. These consequences can be very significant, as with death, or they can be trivial, as with the mosquito bite.

Policy makers should be deliberate when assessing risks for the simple reason that there are opportunity costs to using public funds. Spending money to mitigate the risk of children drowning in swimming pools means fewer resources are available to devote to fire prevention. The result is that the overall level of risk may be higher than it could be, given the current allotment of public resources. In other words, optimizing the government's risk mitigation strategy (and allocating the current level of funding accordingly) could lead to a reduction in the risk faced by the community with no additional funds spent. However, without careful analysis, it is usually not obvious how resources should be spent, which is why risk analysis is critical to the efficient implementation of risk policy.

In determining how much risk to take on, a person must consider a number of factors, including but not limited to the specific *target* risk being addressed. For example, let's say someone is concerned about the risk of dying in a car accident. One could reduce risk substantially by sitting at home all day rather than driving to work. A salesperson who spends most of the day on the telephone might be able to perform this job from almost anywhere, so the option to telework might be available, making this risk-reduction strategy more palatable. On the other hand, a plumber doesn't have this luxury. In choosing the stay home, the plumber forgoes a considerable amount of income. As we will see, forgoing income results in elevated *substitute* risks of various kinds.

Risks that increase when another risk falls are called "countervailing risks," and in some cases these can even be large enough to offset the risk that is directly being reduced by policy (the "target risk"). By choosing to stay home rather than drive to work, the plumber described above has reduced the chance of dying in a car accident. But by forgoing income, the plumber might have to cut back on a monthly gym membership or make cheaper and less healthful eating choices. These behavioral changes could increase risks associated with poor health.

Even the example of the teleworking salesperson presents tradeoffs, since social isolation might increase the risk of depression. Some people might opt to drive to work in spite of having the option to telework, simply because they prefer to chat with coworkers in the coffee room or to see their colleagues face to face in meetings. For both the salesperson and the plumber, staying at home is not costless, including in terms of accepting countervailing risks.

Public policy makers have it even harder because they must make decisions about risk for an entire community. The state of Wisconsin has annual expenditures of roughly $60 billion (Urban Institute 2022). Some of these funds are spent to reduce residents' risks. Spending on police departments reduces the risk that certain crimes will occur, such as robberies or vandalism. Spending on hospitals reduces the risk of a child dying after accidentally drinking poisonous chemicals. Spending on free or subsidized school lunches reduces the risk of malnutrition. And so on. Since public funds are not unlimited, public policy makers must make tough decisions and set priorities about which risks to mitigate.

Directing spending toward the largest risks is not necessarily an optimal strategy either. There is a 100 percent chance that every person on this planet will die at some point. Consequently, this risk presents us with a very high-impact outcome (death) and a high likelihood of it occurring (100 percent). But that does not mean that all of our resources should be spent on the development of antiaging drugs or artificial hearts and brains. After all, such drugs and technologies might not be very effective, so we might not get a high return on investment. Relatedly, if we only have a limited amount to spend on risk reduction, we might save more lives by directing scarce resources toward other purposes. For example, spending a few million dollars on additional traffic lights might save more lives than devoting the same resources toward antiaging research that has little chance of working.

Another important concept policy makers should consider is what economists call "diminishing marginal returns." Even if traffic lights are very effective at preventing deaths, it wouldn't make sense to have them at every street corner. At some point we don't want more traffic lights. The cost of lights becomes prohibitively expensive because the lights slow down the flow of traffic and increase travel times, which causes other problems. At some point, even high-payoff risk reduction efforts start producing lower returns, so it makes sense to spend on other priorities—perhaps higher-visibility crosswalks.

This is where risk analysis comes in. Risk analysis is a tool that analysts can use to assess the magnitude of risks for the purposes of making the kinds of comparisons just described. The purpose of this chapter is to explain to policy makers what risk analysis is and how it can be used to inform policy in Wisconsin, and also to walk through how that analysis is produced, including how to avoid some common pitfalls. We will focus primarily on mortality risks—that is, the risk of death—since these risks tend to be the largest and most significant risks that individuals and policy makers are concerned with. However, it is worth noting that the principles described in this chapter can be applied to other risks as well.

We begin our chapter with a review of the literature on "mortality risk analysis," explaining how the analysis of mortality risks has gained acceptance over time. This acceptance, however, has come primarily from the academic community, because most governments around the world still do a poor job analyzing risks. We therefore proceed with some step-by-step instructions that policy makers can follow in order to assess risks.

An important tool for deciding how to deal with risks is "cost-effectiveness analysis," which is used to evaluate how much it costs to achieve a particular change in outcomes. For example, an analyst might estimate the cost-per-life-saved of various policy alternatives and then see which one saves the most lives for the least cost. In order to perform cost-effectiveness analysis prudently, one needs to estimate the opportunity costs of funds that are to be devoted to implementing a regulation or other policy. These opportunity costs include how funds might be used to reduce risks in the absence of the policy. Calculating opportunity cost sounds hard to do, but there are sound conceptual ways to do it. With such information in hand, regulators and other policy makers can make more effective decisions that save both money and lives.

Our chapter concludes by examining several recent Wisconsin regulations for which regulators have produced an economic impact analysis. We demonstrate how key values from this kind of analysis can be used to determine whether a regulation actually increases or reduces mortality risks. Fortunately, a cost estimate is often all that is needed to make a preliminary assessment of a regulation's impact on mortality risk. Since Wisconsin regulators don't appear to be considering these outcomes at present, there is an opportunity for tools like risk analysis to be incorporated into the Wisconsin policy making process. Moreover, the analysis recommended in this chapter is fairly easy to conduct, so the state could perform this kind of analysis on a modest budget, so long as analysts are adequately trained.

All told, there are many opportunities available to Wisconsin policy makers (as well as to policy makers in other states) to make their regulatory system more evidence-based and rational from a risk perspective. This chapter offers an accessible explanation of how to do it.

Risk-Risk Tradeoffs

The academic literature on the mortality costs of policy expenditures chiefly traces back to the scholarship of Aaron Wildavsky, a political scientist at the University of California, Berkeley, who famously coined the phrase "richer is safer" (1981). Wildavsky's argument was that wealth is the primary means by which society combats risk. With fewer resources, fewer risks can be addressed and with more resources, more risks can be addressed. Hence, richer is safer. This theoretical argument has been borne out in the data as well. At the individual level, richer individuals tend to live longer (Chetty et al. 2016). The finding extends to the national level: richer countries overcome many of the risks that plague developing countries, such as malaria (Pritchett and Summers 1996).[1]

Since having more resources means one is able to combat more risks, it is easy to see how this logic also applies in reverse when resources are taken from people. That is to say, when individuals' incomes are lowered, they have fewer resources to devote to risk reduction, and hence they are likely to see some risks increase in their lives. A classic example involves job loss. If a person is living on the margins and barely making rent, losing a job might compel a move to a worse neighborhood with more crime and lower-performing schools, which in turn might result in short-run dangers while also having long-lasting impacts on the person's children. It is easy to see why low-income families are more susceptible to the kinds of risk increases that accompany a decline in income (Thomas 2019).

The association between income and health contributes to what economists call "risk-risk tradeoffs," or the idea that when one risk is reduced, another risk might be increased at the same time (Graham and Wiener 1995). For example, taking a Tylenol might reduce the risk of a headache while simultaneously increasing the risk of a stomachache. In the context of income and health, spending money to reduce risks through public programs can increase risk as citizens are taxed to pay for the risk mitigation measures.

Risk-risk tradeoffs are commonplace. One recent study that analyzed Germany's policy of phasing out its nuclear power plants found that reducing the risk of a Fukushima-style meltdown by closing nuclear power plants resulted in increased coal-fired power plant emissions, thereby raising risks associated with air pollution (Jarvis, Deschenes, and Jha 2019). Here we see an example of a countervailing risk (air pollution) increasing in lockstep with the reduction of a target risk (nuclear power plant meltdown). It is also possible for "coincident risk" reductions to occur, whereby a risk falls in tandem with target risk reductions. For example, exercising frequently at the gym might reduce the risk of a heart attack and the risk of a stroke at the same time.

Many risk-risk tradeoffs are unique to the circumstances involved with a particular public policy action. For example, not every policy is going to lead to more coal-fired power plant emissions, as was the case with the German nuclear policy. However, there are some risk-risk tradeoffs that are more general, such as those related to income losses. All public policies cost resources to varying extents, and consuming resources for one purpose means those resources can't be utilized for other purposes. The corresponding loss of private income owing to the taxing and spending of resources to support public policies increases some private risks, since reducing household incomes limits individuals' ability to mitigate risks using their own resources.

Cost-Effectiveness Analysis and Mortality Risk Analysis

In the early 1990s, economists and risk analysts began estimating the extent of the income-safety relationship using real-world data. One such scholar was a decision scientist named Ralph Keeney. Relying on the correlation between income and mortality, Keeney published a paper that argued that when a $5 million cost is spread across American society, this will likely produce one additional death due to the income-loss effect (Keeney 1990). This $5 million number is known as the "value of an induced death," or VOID.

Keeney's paper was fairly primitive and suffered from some statistical problems, which were quickly pointed out by critics (Sinsheimer 1991). As a result, future studies improved on Keeney's model by better controlling for variables that might correlate with income and also have an influence on mortality, thereby leading to improved estimates of the effect that a loss of income has on mortality.

One recent study we wrote (Broughel and Chambers 2022) found that for every $38.6 million in lost income among Americans, one death can be expected. Newer studies like ours do not completely overcome the statistical problems identified by Keeney's critics, but they do a much better job. Moreover, a separate line of research relying on theoretical models (rather than correlations in data) has also been developed to explain the income-mortality relationship. These models yield somewhat higher VOID estimates and are also useful. For example, a recent study by one of us and a coauthor (Broughel and Viscusi 2021) estimated that the VOID was closer to $108.6 million. Thus, it is reasonable to conclude that the average VOID for the United States lies somewhere between these two recent estimates, perhaps near the midpoint of these values (if one gives each estimate equal weight), which is $73.6 million. For the purposes of this chapter, we will use a VOID of $75 million.

An interesting use of the VOID concept is that it can be paired with cost-effectiveness analysis to determine whether a policy increases or reduces mortality on balance. As noted earlier, cost-effectiveness analysis estimates the cost per unit of the result desired. If the policy goal is to save lives, a cost-effectiveness analysis will estimate the cost to save one life. Therefore, a policy that costs $100 million and saves 100 lives would have a cost effectiveness of $1 million per life saved. This kind of information can be used to determine which policy among several saves the most lives for a given level of spending. For example, if one policy has a cost effectiveness of $10,000 per life saved and another a cost effectiveness of $1 million per life saved, spending on the first policy is often better because devoting a given amount of resources toward it saves more lives. (In this case $1 million could save 100 lives with the first policy but just one life with the second.)

Former Office of Management and Budget analyst John Morrall published an article in 1986 highlighting how a suite of lifesaving regulations from the federal government ranged in their cost effectiveness from $100,000 to $72 billion (1984 dollars) per life saved. Another cost-effectiveness study from the 1990s suggested that if the US federal government reallocated existing resources more efficiently, it could save 60,000 additional lives per year without spending any additional money (Tengs and Graham 1996). These examples highlight how cost-effectiveness analysis can be a powerful tool to make policy more beneficial to the public.

The cost effectiveness of a policy or regulation can also be combined with the VOID to ascertain whether, on balance, a policy is risk reducing or risk increasing. For example, if the VOID is $75 million and a regulation costs $75 million per life saved, then the risk benefits exactly offset the risk costs from income losses. In other words, in this simple case, for every dollar spent addressing target risks, countervailing risks increase to exactly offset the risk benefits. Therefore, the policy's overall impact on risk is neutral. In this way, the VOID value acts as a kind of cost-effectiveness cutoff whereby when a regulation or other policy's cost effectiveness exceeds the VOID value, the regulation can be expected to increase, rather than decrease, mortality risk.[2]

Limitations Of Cost-Effectiveness Analysis

Cost-effectiveness analysis is an incredibly valuable tool. However, it does have some shortcomings that are worth noting. To understand these limitations, it helps to compare cost-effectiveness analysis to an alternative policy analysis tool known as cost-benefit analysis. Whereas a cost-effectiveness analysis for a lifesaving policy would count up how many lives are saved by a policy or regulation, a cost-benefit analysis would try to assign a dollar value to the expected lives saved. For example, if a regulation saves 10 expected lives and a life is valued at $500,000, then the benefits from the regulation would be worth $5 million.

By assigning dollar values to benefits—even those, like human lives, that aren't traded in markets—analysts can consider more of the benefits a regulation produces, whereas cost-effectiveness analysis typically considers only a single benefit. This is not so controversial with a benefit like saving lives, but in other cases, people may not agree that a particular policy goal is a good idea. For instance, some policy makers might think building more public parks is a good idea while others might think we have too many public parks as it is. In this case, the goal is not agreed upon, so it's easy to see why finding the most cost-effective ways to build public parks may not be very useful.

Decisions about which goals should be prioritized depend on value judgments, and it should not be the job of analysts to make these kinds of value judgments. That said, once a particular goal is identified—for example, through legislation—analysts can proceed with that information and identify the cheapest ways to achieve the goals already decided upon.

There are also some problems with the way cost-effectiveness analysis has historically been implemented, though these problems are sometimes easy to address. First, the costs estimated are often accounting expenditures, not economic costs. To see the difference, consider a simple regulation that forces $1 million to be spent on compliance by businesses. An accounting analysis would value the costs at $1 million because that is what is spent. But the true economic cost to society likely differs from $1 million. Had there been no regulation, some of the funds spent on compliance might have been invested and might have grown in value (a concept known as the opportunity cost of capital). Other funds might have gone toward consumption or even been wasted. The true economic cost of the regulation likely differs from the $1 million accounting cost.

A related issue with cost-effectiveness analysis is that health-related benefits are usually discounted in cost-effectiveness analysis.[3] In other words, a life saved or another health-related benefit is treated as less valuable the further it is in the future. This is a problem because the rate at which health-related benefits are discounted is basically arbitrary (or "normative," because it depends on a value judgment).

Also problematic is that discounting health-related benefits converts health benefits into a measure of lifetime welfare. (The idea behind discounting is that lifetime welfare is lower when the health benefits arrive later than when they arrive sooner.) This is problematic because welfare in economics is measured on an ordinal scale (see Broughel and Baxter 2022)—that is, a scale that involves rankings but not intensities. This is a problem for cost-effectiveness analysis because cost-effectiveness values become difficult to interpret when they involve rankings. To make the issue more concrete, imagine that an analysis of major league baseball teams finds that for each $50 million in total player payroll, a team can expect to move up one place in their end-of-season ranking. This statistic doesn't offer much general guidance about how much to spend on player personnel, because the value of going from 11th place to 10th place is probably not as valuable as going from 2nd place to 1st place. In the latter scenario, spending $50 million might be worthwhile to become a championship contender; in former scenario, the team will simply be less mediocre. The relative positions are hard to compare.

When the outcome analysts are interested in is welfare, the problem becomes even harder than this baseball example illustrates, because we don't know where we are starting from on the scale. Whether to spend $1 million to move up five notches on a welfare scale is pretty abstract—not much guidance for practical policy use. The simplest way around this issue is to evaluate cost effectiveness in units of outcomes (e.g., actual lives saved) as opposed to units of welfare (e.g., discounted lives saved).

In the sections that follow, we will outline a process for conducting a cost-effectiveness analysis that overcomes the problems with both discounting and measuring opportunity costs appropriately. The discounting problem is fairly easy to address—we can simply measure cost effectiveness in terms of lives saved rather than in terms of welfare. The problem with opportunity cost analysis is slightly trickier, but it is not impossible to correct.

Mortality Risk Analysis: Step By Step

This section provides a more detailed explanation of the procedure a state like Wisconsin can use to conduct proper mortality risk analysis. As the name implies, mortality risk analysis aims to predict whether policies (on balance) are expected to increase or reduce mortality. It compares a regulation or other policy's target risk reductions with the countervailing risk increases stemming from lost household income. Such analysis can be produced by regulatory agencies, centralized analytical offices in the government, independent economists in the private sector, or academic experts.

Step 1: Evaluate whether the policy is lifesaving

The first step in a mortality risk analysis is to determine if the goals of a particular policy under review are related to health or safety risks. Many policies do not target health or safety hazards. For example, a financial services or insurance regulation might reduce the risk of fraud but not the risk of death. This is not necessarily a drawback, because reducing mortality is not the purpose of such regulations. Nonetheless, in addition to having these other benefits, such regulations will affect mortality risk through their impact on household income, and this is pertinent information that may prove useful to policy makers.

If a policy does not save any expected lives but imposes positive costs on the community, it can be expected to increase mortality risk. In such a case, the cost-per-life-saved ratio is infinite since there are zero lives saved in the denominator of the ratio. Since the cost-per-life saved exceeds the VOID level, this signals that the policy increases mortality risk.

It is also possible for a policy to save the community money by reducing costs—for example, costs on businesses. Such policies will impose negative costs and therefore tend to reduce mortality risk when there are no other direct health effects to target risks.

Step 2: If the policy is lifesaving, estimate how many lives it will save

If a policy is intended to save lives, the next step is to estimate the number of lives it will save. This requires that analysts understand the magnitude of the risk involved and how (as well as why) the policy is expected to reduce the risk. For example, if a regulation is targeting a hazardous waste site, the regulatory agency should try to ascertain how many individuals die from this hazard annually and how many of these deaths the regulator believes its regulation can prevent if it conducts a cleanup.

The timeline over which lives are saved is also important and should be determined. Despite the fact that discounting lives can be problematic for the reasons described above, the timing of lives saved still matters because of the time value of money. Saving lives often saves money or boosts economic output (for example, because individuals work and earn incomes), and it is preferable to accrue these benefits earlier because they can be invested and earn positive returns.

Step 3: Calculate the accounting costs of the regulation over time

Once an analyst ascertains how many lives a policy is expected to save, it's time to estimate the accounting cost of the regulation. Accounting costs are the actual public and private financial expenditures (or savings) caused by the policy. For example, if a regulation forces businesses to spend a million dollars on capital expenditures, this would be considered a part of the accounting costs of the regulation. Similarly, if a regulation causes a business to forgo revenues—or close altogether—this would be an additional accounting cost on top of any spending on compliance. Analysts should also tally the expected accounting costs borne by the government to administer and enforce a given regulation. The timing of these expenditures should also be calculated.

As noted, some policies save money; money saved can be counted as negative costs (or cost savings). For example, a new government regulation might streamline or repeal previously existing inefficient regulations, resulting in a lower compliance burden on individuals and businesses. Additionally, saving lives also generates benefits. Additional production or earnings stemming from saved lives can be conceptualized as cost savings and should be deducted from the total gross cost of the regulation.

Step 4: Determine the opportunity cost of the regulation and its cost effectiveness

The expenditures calculated in step 3 represent accounting costs, not economic opportunity costs. To understand why, consider a manager at a company who must devote more time to compliance because of a new regulation. A regulatory analyst might calculate the cost of the regulation as the additional time the manager spends on compliance multiplied by the manager's salary. However, the new compliance activities also displace other productive activities, such as developing new product lines. With or without the regulation, the manager's salary is likely to be the same, but the manager's productive output will likely fall with the regulation in place. Consequently, multiplying a manager's hourly wage by required compliance time results in a measure of accounting cost but not of economic opportunity cost. To determine the latter, we need to estimate the value of the productive activities that never occurred because of the regulation.

The opportunity cost of expenditures—what is forgone when the regulation is enacted—is not the value of the expenditures themselves, in this case the manager's salary, but rather the value associated with the manager's activities in a setting where the regulation was never enacted. In theory this value could be positive, negative, or zero. For instance, if in the absence of the regulation the manager would have been playing video games on the job, then the opportunity cost of the manager's time could be zero. On the other hand, if the manager would have been rolling out software enhancements to boost employees' productivity, then the opportunity cost is probably quite high.

Identifying the opportunity cost can be tricky, but essentially it involves considering what the most likely use of resources would be in the absence of a policy and identifying a rate of return associated with that use of resources. This may sound hard, but it is no different from what businesses do routinely when they identify a weighted average cost of capital or a minimum required rate of return (a hurdle rate) for projects.

Government analysts should adopt similar methodologies to establish a reasonable opportunity cost rate that projects need to overcome to be deemed worthwhile.

At this point, accounting expenditure flows should be divided into resources that would have been consumed in absence of the regulation and those that would have been invested. The investment flows can be discounted at the rate of return associated with those investments, and this information can be compiled to generate a cost-per-life-saved estimate. Note that the opportunity cost discount rate serves a different purpose from a discount rate intended to discount health or other social benefits because they occur in the future.

Step 5. Compare the cost effectiveness of the policy to the VOID

Suppose that a policy saves lives at the cost of $50 million in present value terms for each life saved. Furthermore, suppose that the VOID is $75 million. In this case the policy reduces mortality risk, at least initially, because the direct cost of saving a life ($50 million) is less than the cost at which policies unintentionally take an additional life ($75 million). If policy makers decide to scale up this policy by tripling spending to a total of $150 million, then we would expect it to save three lives ($150 million divided by $50 million per life saved). However, since the cost of this program reduces household incomes by $150 million, we can also expect the loss of two lives ($150 million divided by $75 million per induced death). On net, this policy can be expected to save one life.

By contrast, if a policy has a cost effectiveness with a present value that exceeds the VOID (e.g., if the policy costs $100 million per life saved), then the policy increases mortality risk in the near term. In this case, the expected deaths resulting from lower household income exceed the expected lives saved directly by the policy.

These risk calculations, however, are just the beginning of the story, because the two inputs in a cost-effectiveness analysis—cost and the outcome variable estimate—are not evolving over time in the same way. Displaced investments are growing at the rate of return associated with the opportunity cost of capital, while the lives saved may be a fixed amount, may be an amount that is ongoing (e.g., five lives saved each year), or may be growing over time.

Step 6: Produce a table of outcomes, tracking the policy's impact over time on real resources and risk

A very simple equation for calculating the opportunity cost of capital is f × ROI, where f is the fraction of the return on an investment that is reinvested each period and ROI is the rate of return on the investment. For example, if f is 0.75 and ROI is 10 percent, then f × ROI will be 7.5 percent. We believe a reasonable hurdle rate for projects is in the range of 5 to 7 percent since it is likely that most of the marginal return displaced for compliance purposes is invested, and because market rates are often estimated to be in the range of 7 to 10 percent annually on marginal investments.[4]

Table 7.1 shows a hypothetical regulation that saves 35 lives five years after being enacted (with no additional lives saved thereafter). The economic costs have a present value of $250 million. Meanwhile, the VOID in this example is assumed to equal $75 million in the current year.

In the first period, the regulation has an economic cost of $250 million (labeled in table 7.1 as the "total cost"). The VOID in period 1 is $75 million, so this regulation increases risk in the initial period because it imposes positive costs immediately but no lives are saved until year 5. Thus, for the first five years after the regulation goes into effect, overall risk is increased since the cost effectiveness (i.e., the cost to save a life) of the regulation exceeds the VOID during that timeframe.

The economic costs are changing over time, however, because of the opportunity cost of capital. To understand what is happening, the total costs accrued must be broken down into units of real resources (in other words, they must be divided between forgone consumption and forgone investment). Because *f* is assumed to be 0.7 here, $175 million of the $250 million in initial economic costs would have been

Table 7.1 The Mortality Costs of a Hypothetical Regulation

Year	Total Lives Saved	Total Cost (millions)	Forgone Consumption (millions)	Investment Value (millions)	Cumulative Forgone Consumption (millions)	Cost per Life Saved (millions)	VOID (millions)	Cumulative Expected Deaths from Lost Income	Net Lives Saved	Risk Increasing?
0	0	$250	$75	$175	$75	$∞	$75	3	–3	yes
1	0	$318	$56	$187	$131	$∞	$76	4	–4	yes
5	35	$643	$74	$245	$398	$18	$80	8	27	no
10	35	$1,195	$103	$344	$851	$34	$85	14	21	no
25	35	$4,578	$285	$950	$3,628	$131	$102	45	–10	yes
50	35	$26,087	$1,546	$5,155	$22,912	$802	$140	201	–166	yes

Note: $f = 0.7$, ROI = 10%, VOID = $75 million, $p = 1.25\%$. Source: Authors' calculations.

invested in the absence of the regulation and $75 million would have been consumed in the initial period.

The value of the capital investment grows at a rate of $f \times$ ROI each year going forward. So, for example, by year 5, the capital investment "fund" that has been lost because of the regulation will have grown to be worth $245 million. In the first year after implementation, the value of forgone investment is $187 million ($175 × 1.07). This investment fund would have generated consumption worth $56 million in the first period ($187 × 0.3). The value of this displaced consumption stream also grows at a rate of $f \times$ ROI going forward. For example, the consumption stream the capital fund would have generated would have grown to an annual value of $74 million by year 5, and the cumulative consumption forgone over the first five years of the regulation being in place would equal $398 million.

What is called total cost in table 7.1 is equal to the total consumption stream lost up until that point in time plus the value of investment capital at that point in time (as if it were to be cashed in and all the proceeds consumed in that period). This total cost can also be used to estimate the expected deaths a regulation has indirectly generated up until that point in time.

In year 0, there are three expected deaths ($250 million divided by a $75 million VOID). The VOID is assumed to grow at the rate of productivity, here assumed to be 1.25 percent annually. Once the regulation saves 35 lives in year 5, the regulation becomes risk reducing because the total cost per life saved is less than the VOID at that time. By year 25, however, this situation reverses, since in year 22 the expected deaths imposed by the regulation overtake the number of expected lives saved, and thus the regulation cumulatively increases mortality risk from that point forward.[5] Such reversals could be grounds for building sunset provisions into regulations so that they expire before their more detrimental impacts take hold.

Step 7: Report information to decision makers

The example above highlights how the effects of a regulation on mortality risk can differ depending on the time period being analyzed. Many regulations initially increase risk since compliance expenditures are often made up front while benefits are realized with a lag. This situation often reverses once some of the benefits accrue. However, the situation can then reverse again (as in the example above), because money can be reinvested (with compound returns) while lives cannot. Thus, a critical question for policy makers is not just *whether* a policy increases risk but *when* it does so.

Ultimately, it's a value judgment whether policies are worth implementing when they increase mortality risk at various points in time. Such value judgments depend on a variety of factors, including the number of lives a policy saves, whose life specifically is saved (e.g., how old they are), and the overall costs. That said, some value judgments are easier to make than others. If a regulation aims to reduce risk but increases risk across all time periods, it is hard to see what the justification could be for that regulation. But without a formal mortality risk analysis, the likelihood that policy makers will identify such counterproductive regulations is low.

Case Study: Wisconsin Regulations

In this section, we consider several actual Wisconsin regulations to demonstrate how mortality analysis can be used in a real-world context. Wisconsin already has a law in place that requires state regulatory agencies to produce budgetary and economic analysis for new regulations. Specifically, agencies fill out a standardized form, known as a "Fiscal Estimate & Economic Impact Analysis," when they enact new regulations. This is a form from the Wisconsin Department of Administration (2016),[6] and there is a similar template for analyzing existing rules (Wisconsin Department of Administration 2012). It is worth noting that there is no mention of risk issues in either of these templates.

Unfortunately, there is no publicly available central repository for these economic impact statements in Wisconsin, making them difficult to collect and analyze. Creating such a repository would be beneficial both for transparency purposes and for the purposes of research. Given this shortcoming, we relied on internet searches to identify a few examples of agencies using these forms. We found two regulations from the Department of Natural Resources, which we will examine in this section.

We chose these rules primarily because (1) they are relatively recent; (2) they could in theory be risk-related, given their relation to environmental programs (although the agency does not calculate lives saved in either instance); and (3) one regulation imposes net costs, according to the agency, while the other is cost saving. Thus, they offer useful examples to demonstrate the kind of information a properly conducted risk assessment can uncover. However, we caution readers that these regulations should not be construed as representative of all regulations in Wisconsin. We merely offer them as examples.

Example 1: Hazardous Waste Disposal

Our first example is a Wisconsin Department of Natural Resources (DNR) regulation, finalized in 2019, related to disposal of hazardous waste (Wisconsin Department of Natural Resources 2019). The primary aim of the regulation was for the state to stay in compliance with the US Environmental Protection Agency's Resource Conservation and Recovery Act requirements, which were updated in the years leading up to this regulatory action. According to the Wisconsin DNR, the regulation will increase compliance costs for regulated entities by between $334,785 and $617,785 per year while at the same time saving regulated entities approximately $840,533 to $2,146,805 per year. Thus, even if one assumes a worst-case scenario for both compliance costs ($617,785) and savings ($840,533), this regulation is predicted to generate net cost savings.

The Wisconsin DNR makes no claims that this regulation will save lives. Rather, the DNR notes that many aspects of the regulation are related to "paperwork reductions" and "relaxations of regulations," though there appear to be several "new information collection burdens." This helps explain why the regulation is cost saving, because it is most likely a deregulatory action.

In many respects, the analysis of this regulation can end here. The cost analysis demonstrates that the regulation is cost saving, thereby reducing some mortality risks through the household-income channel. There are no other apparent mortality benefits or costs; thus, this regulation is likely to reduce mortality risk overall, assuming that the agency's calculations are correct.

It may be worth digging a little deeper into the DNR's calculations, however, in order to better ascertain the magnitude and timing of these risk reductions. There are several issues worth noting about the DNR's calculations. First, the agency has calculated both costs and cost savings, and these estimates are presented transparently. This represents a best practice.

However, the DNR's estimates, as stated, are not suitable for use in a cost-effectiveness analysis without some adjustment. First of all, the dollar year these numbers are reported in is not stated in the economic analysis. The regulation is from 2019, so presumably these estimates are reported in 2019 dollars, but it would be helpful if this were stated explicitly by the agency.[7] Second, the costs are presented in annualized form: that is, these are estimates of ongoing costs averaged on a per-year basis. Far more useful for our purposes is the present value of costs, which better reflects the total cost of the rule. (Much as a monthly mortgage payment provides an incomplete picture of the total amount of money owed on a mortgage, an annualized value of cost does not fully capture the total cost of a rule.)

An additional problem with reporting annualized values is that they conceal the fact that costs are often growing at some rate over time, owing to the opportunity cost of capital. An annualized value, because it is an average, appears to flatten out costs. This can be misleading because it can give the false impression that benefits exceed the costs, though this may not be the case if costs are growing over time and benefits are not (or vice versa).

For simplicity's sake, we will use the midpoint between $334,785 and $617,785 in annual costs, which is $476,285. In table 7.2 we compare this DNR regulation to another regulation that imposes costs in 2021. To make the two regulations comparable, we present costs in inflation-adjusted 2021 dollars. According to the consumer price index, this is $494,961. If we assume that the opportunity cost of capital rate is 7 percent, then the present value of this stream of annualized costs (assuming the annualized cost continues in perpetuity) is $7.1 million in 2021 dollars.

When we do similar calculations for costs savings, we get an estimate of $22.2 million in cost savings expressed as a prevent value (in 2021 dollars), for a net improvement of $15.1 million in reduced costs. This is roughly two-fifths of our estimate of the VOID. Therefore, this regulation initially produces indirect benefits worth two-fifths of a saved life. This regulation can be expected to save more lives in the future as cost savings compound over time. The first life saved would be expected to occur in 2025 if the 2019 VOID is $75 million and is growing at 1.25 percent annually.[8] See table 7.2.

Example 2: Stormwater Discharge Permits

Our second example is another Wisconsin DNR regulation. This one is from 2021 and is related to stormwater discharge permits (Wisconsin Department of Natural Resources 2021). Like the previous regulation, this rule is also intended to bring the state of Wisconsin's regulatory regime in line with federal regulations. However, in this case the regulation is anticipated to impose net costs. According to the agency, the regulation will generate total costs of $2,778,900 per year. Additionally, it will generate savings of $1,118,400 annually, for a net compliance cost burden of $1,660,500. As with the previous regulation, the DNR does not claim that this regulation will save any lives. Thus, this regulation can be expected to increase mortality risk on balance since its cost effectiveness (which is infinite in this case) exceeds the VOID.

We assume that the DNR's estimates are expressed in 2021 dollars, since this was the year the rule was finalized and no other information is available. The annualized cost has a present value of $23.7 million at a 7 percent discount rate. Since we are evaluating the regulation in 2021, there is no need to adjust this value for inflation. $23.7 million is about one-third of our estimate of the VOID, and this initial value would be expected to grow over time. One could produce a cost-effectiveness table similar to what is presented in table 7.2 to track this growth. We forgo doing that here for simplicity's sake.

Discussion

There are several takeaways worth noting after reviewing the regulatory analyses performed for the two DNR example

Table 7.2	The Mortality Cost of the Wisconsin DNR's 2019 Hazardous Waste Disposal Regulation									
Year	**Total Lives Saved** (target risk)	**Total Cost** (millions)	**Forgone Consumption** (millions)	**Investment Value** (millions)	**Cumulative Forgone Consumption** (millions)	**Cost per Life Saved**	**VOID** (millions)	**Cumulative Expected Deaths from Lost Income**	**Net Lives Saved**	**Risk Increasing?**
2019	0	−$15	−$5	−$11	−$5	−$∞	$75	0	0	no
2020	0	−$19	−$3	−$11	−$8	−$∞	$76	0	0	no
2024	0	−$39	−$4	−$15	−$24	−$∞	$80	0	0	no
2029	0	−$72	−$6	−$21	−$51	−$∞	$85	−1	1	no
2044	0	−$275	−$17	−$57	−$218	−$∞	$102	−3	3	no
2069	0	−$1,684	−$93	−$309	−$1,375	−$∞	$140	−12	12	no

Sources: Wisconsin Department of Natural Resources (2019); authors' calculations.

Note: $f = 0.7$, ROI = 10%, VOID = $75 million, $p = 1.25\%$.

regulations in the previous section. First, the DNR deserves credit for calculating both the costs and the cost savings associated with its regulations. This is clearly a best practice, and thus avoids a common practice of many federal agencies of intermingling financial costs and savings with nonpecuniary benefits and costs, which often aren't directly comparable.

However, the DNR's analyses may be unintentionally misleading because they present costs in annualized rather than present-value form. Although regulatory costs can be expressed in both annualized and present-value form, present values are more useful since these better reflect total costs and make cost-effectiveness analysis easier to produce.

These two examples are also interesting because the risk reduction benefits of the deregulatory action offset some of the risk-increasing costs of the regulatory action. At first glance, the costs of stormwater permit regulation exceed the cost savings generated by the hazardous waste regulation. However, it is important to note that a cost borne in 2019 is not the same as an equivalent cost borne in 2021. A dollar in compliance is more costly to society in 2019 than in 2021 owing to the opportunity cost of capital, and this difference must be accounted for in order to make an accurate comparison between the two regulations.

Taking a step back, Wisconsin's rulemaking process is notable because it involves the production of economic analysis (Broughel and Hoffer 2021), which the examples above show can include useful information that is easily converted into a format usable for cost-effectiveness and mortality analysis. This implies that risk analysis could be incorporated into the existing rule evaluation process in Wisconsin without much difficulty.

Cost-effectiveness analysis requires in its most basic form just two inputs: the accounting costs of the policy in question and an estimate of the primary benefit achieved by the policy. A cost-effectiveness estimate based on these inputs could be required as a standard part of regulatory analysis. That said, to ensure that analysis is useful, Wisconsin may also need to invest in personnel capable of performing rigorous analysis. Most of what seems to constitute economic analysis for regulations in the state seems to be little more than a form that is filled out by agencies according to a short, standard template. If Wisconsin is under-investing in analysts qualified to produce economic analysis, analysis will necessarily be of low quality. That said, owing to the relatively simple nature of cost-effectiveness analysis, a small investment may be all that is needed to start performing some basic, but useful, risk analysis.

Conclusion and Policy Recommendations

The analysis of risks is important both in our daily lives as individuals and at a collective level when governments set policy. Wisconsin policy makers should consider requiring risk analysis like that outlined in this chapter. It may be fairly easy to incorporate risk analysis into existing regulatory analysis (or to add it as an additional requirement), thereby improving the objectiveness and transparency of Wisconsin regulations' impacts. If such analysis is conducted properly and used in decision making, it could save lives and reduce costs simultaneously.

To produce a risk analysis, policy makers could use a simple checklist that follows the steps outlined in this chapter. We have included an example of such a template in the appendix. Moreover, interested parties in Wisconsin need not wait until government officials adopt this kind of analysis before they use it to inform policy. Academic economists, industry trade associations, advocacy groups of various kinds, and even private citizens could perform such analysis themselves with the appropriate training. Indeed, as this chapter has shown, it is fairly easy to produce a mortality risk analysis by drawing on information from agencies' existing economic analysis or by supplementing those reports with data from other sources, such as academic studies.[9]

As one analysis recently put it, "On paper, Wisconsin's process for reviewing new and existing rules appears to be quite thorough, especially relative to some other states" (Broughel and Hoffer 2021). However, risk analysis is a glaring omission from a system that otherwise appears to be tailored for producing evidence-based regulations. We see abundant opportunities for improving the regulatory system in Wisconsin by creating a more robust role for the economic analysis of risks.

APPENDIX: Risk Analysis Template For State Regulations

1. Is the regulation lifesaving?
2. If yes, how many lives will the regulation save?
3. What compliance expenditures are likely to result from this regulation (including forgone expenditures because of lower income or revenues, as well as government expenditures)?
4. What cost savings are likely to result from the regulation?
5. What is the opportunity cost of the regulation? In other words, what fraction of foregone expenditures would have been consumed vs. invested, and what rate of return would have been earned on the foregone investments?
6. On the basis of the regulation's opportunity cost, what is the present value of the regulation's costs (net of cost savings)? Clearly state the dollar-year and year in which the cost is evaluated (e.g., a cost borne in 2019 expressed in 2021 dollars).
7. Calculate the cost effectiveness of the regulation (i.e., the present value of costs net of cost savings per life expected to be saved).
8. Based on the relevant value of an induced death, is the regulation expected to increase risk in present-value terms?
9. Will the regulation increase risk in the future? If so, when?
10. Provide a table detailing how the regulation will affect real resources (e.g., consumption and investment), as well as risk, over several decades.

Notes

[1] An important caveat here involves so-called deaths of despair. These tend to be deaths related to drug overdoses, suicide, and alcoholism, which are contributing to life expectancies falling among some groups in high-income countries, in particular in the United States. See Case and Deaton (2020).

[2] When a policy is said to cost $75 million per life saved, this does not imply that $75 million will actually be spent. For example, a regulation that costs $7.5 billion in order to save 100 lives has a cost effectiveness of $75 million per life saved. The same cost effectiveness applies if one spends $750,000 in order to save an expected one-hundredth of a life. In fact, many regulations have high cost-effectiveness values not because they cost a lot of money but because they don't produce much in the way of benefits.

[3] Opportunity cost and discounting are related because health benefits are sometimes discounted on the basis of an argument that capital has an opportunity cost in that it can be invested. This line of argumentation confuses two concepts: the rate of return on capital and the rate of time preference of society.

[4] Arguably, public project hurdle rates should include risk and irreversibility premiums as well. On the marginal rate of return to private investment, see Broughel and Baxter (2022). See also Harberger and Jenkins (2015).

[5] Note that a cumulative change in risk and a marginal change in risk can occur in different periods. For example, a regulation might increase risk for a few years before all the mortality benefits from previous years are offset.

[6] Wisconsin has a cost-benefit analysis template as well, but it appears to be for procurement purposes only. See Wisconsin Department of Administration (2019).

[7] Notably, the estimated compliance costs did not change from 2017 (when the rule was first proposed) to 2019 (when the rule was finalized). See Wisconsin Department of Natural Resources (2017).

[8] The expected life is saved in 2025 owing to rounding. In actuality, the predicted total cost savings would exceed the VOID in 2031.

[9] For a similar example of a risk analysis that applies this methodology, see Broughel and Baxter (2022).

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