Vanderbilt Law School Faculty Publications   Faculty Scholarship

2007

Allocating Responsibility for the Failure of Global Warming Policies

Joni Hersch

W. Kip Viscusi

Recommended Citation

Joni Hersch and W. Kip Viscusi, *Allocating Responsibility for the Failure of Global Warming Policies,* 155 University of Pennsylvania Law Review. 1657 (2007)
Available at: https://scholarship.law.vanderbilt.edu/faculty-publications/694

ALLOCATING RESPONSIBILITY FOR THE FAILURE OF GLOBAL WARMING POLICIES

JONI HERSCH[†] & W. KIP VISCUSI[††]

INTRODUCTION

A recent series of climate change lawsuits has sought to mimic the "regulation through litigation" approach of the claims brought by the states against cigarette manufacturers.[1] What is distinctive about the cigarette cases relative to conventional tort claims is that they were not brought on behalf of individual smokers, but rather sought to recoup the Medicaid-related costs of smoking. A parallel climate change litigation approach seeks payments from public utilities, energy producers, and other parties responsible for greenhouse gas emissions to reflect the long-term societal damages that the plaintiffs claim will be caused by this pollution.

While environmental litigation of this type is unprecedented, the cigarette cases were novel as well. The cigarette litigation did not establish legal precedents because the cases were settled without any court verdicts, but the threat of the suits was sufficiently real that it led to damages payments of close to $250 billion.[2] Here we examine the similarities and differences between lawsuits seeking to recoup the value of financial externalities caused by smoking and lawsuits targeted at the value of environmental damages due to global warming.

The climate change litigation may not be only about money; it may have a policy purpose as well. Depending on how the damages payments are structured, this litigation may also be viewed as an at-

---

[†] Professor of Law and Economics, Vanderbilt University.

[††] University Distinguished Professor of Law, Economics, and Management, Vanderbilt University.

[1] *E.g.*, Connecticut v. Am. Elec. Power Co., 406 F. Supp. 2d 265, 274 (S.D.N.Y. 2005) (dismissing on justiciability grounds the complaints in a major environmental public nuisance lawsuit). For a general discussion of climate change litigation, see Vincent S. Oleszkiewicz & Douglas B. Sanders, *The Advent of Climate Change Litigation Against Corporate Defendants*, 27 Int'l Env't Rep. (BNA) No. 936 (Nov. 17, 2004).

[2] W. KIP VISCUSI, SMOKE-FILLED ROOMS: A POSTMORTEM ON THE TOBACCO DEAL 4 (2002).

tempt to use the incentives created by the court system to generate the policy changes needed to curb the risks of global climate change. In this Article, we examine whether current policies have failed, the sources of any such failure, and the overall context of climate change litigation and policy design more broadly.

In order to identify what market failure might be addressed by climate change litigation, we begin in Part I by exploring whether emissions controls are currently at efficient levels. Even apart from emissions related to climate change, there is a shortfall in the stringency of regulation. This failure is one of inadequate policy responses to air pollution externalities. Recognition of the expected costs of global warming bolsters the case for more stringent regulation.

In Part II we explore whether litigation can play a constructive role by comparing the proposed climate change litigation approach to the cigarette litigation. There are fundamental differences in the economic structures of smoking and climate change externalities and in the nature of their associated risks. Careful comparison with the cigarette litigation indicates that the situations are not analogous.

Empirical evidence presented in Part III traces the main short-coming of climate change policy to the public's unwillingness to incur substantial costs to reduce global warming risks. Given the lack of detailed U.S. data and the prominence of Europe in the climate change debate, this Article examines two large European data sets reporting information on individual beliefs about climate change and the actions that Europeans are willing to take to address their concerns. This exploration of the public's risk beliefs and policy preferences highlights many of the pitfalls that could impede support for climate change policies—notably, the failure of people to properly understand the risks associated with global warming and the presence of substantial self-interest across generational lines that is important given the long time periods over which the risks of climate change will materialize.

In addition to these political economy rationales affecting support for climate change policies, there are also a variety of sources of irrationality that influence the public's preferences and, in turn, government policy. First, people may not properly understand what factors lead to climate change or the importance of climate change risks. Second, there is substantial uncertainty about these risks, which may lead to a failure to view the risks as being real. Third, because the risks are very distant, all the anomalies associated with failure to make rational intertemporal choices will come into play.

Overall, the problems associated with current policies and market operations with respect to the risks of climate change are attributable to factors that are much broader than possible wrongful conduct on the part of the defendants in these suits. Although the mismatch between the policy failure problem and the pending litigation is substantial, damages remedies along the lines of those implemented in the cigarette litigation conceivably might play a constructive role. However, there is no assurance that the plaintiffs' incentives will mirror society's broader interests or that the damages structure that emerges from the litigation will create appropriate incentives to reduce emissions in an efficient manner. Regulation through litigation is a less desirable climate change policy approach than a sound regulatory policy that reflects society's broad interests.

I. THE FAILURE OF GOVERNMENT ACTION

Climate change and global warming are classic examples of standard economic textbook externalities situations. Private actions generate harms that are not adequately addressed by incentives in the marketplace. The solution for such inadequacies is to impose government regulation or implement some kind of pollution tax that will align the private incentives with socially efficient incentives. [3]

As an economic principle, the efficiency objective should be to maximize the spread between benefits and costs.[4] In the usual situation, in which marginal benefits are declining as pollution control becomes more stringent and marginal costs are rising, the maximization of the net social benefits occurs where marginal benefits equal marginal costs. If there is a policy shift that leads to a higher level of marginal benefits for any given level of policy stringency, then the optimal level of pollution control is increased. For the purposes of our discussion, we assume that there are additional benefits to reducing climate change.

With this background information, it is useful to consider the external costs of emissions. Table 1 presents the summary of the social

---

[3] *See* W. KIP VISCUSI, JOSEPH E. HARRINGTON, JR. & JOHN M. VERNON, ECONOMICS OF REGULATION AND ANTITRUST 745-50 (4th ed. 2005) (identifying environmental regulation as one way to mitigate externalities).

[4] This basic principle of benefit-cost analysis is articulated in a variety of texts, such as EDITH STOKEY & RICHARD ZECKHAUSER, A PRIMER FOR POLICY ANALYSIS 137-38 (1978).

costs associated with different energy sources.[5]   The first column of the table indicates the tax rate per unit (gallon, cubic foot, or ton) for the different energy sources (e.g., for gasoline, the tax is per gallon). The second column lists the current tax as a percentage of the price. The third column is the externality cost as a percentage of the price, where these externality cost estimates are based on a variety of government assessments, including regulatory impact analyses undertaken by the U.S. Environmental Protection Agency (EPA). These external costs do not include impacts on global climate change.

For gasoline, the tax rate and the externality cost are almost identical, as they are each 17%. If these average cost values are also indicative of the level of costs, then that would suggest that the current tax structure is efficient, excluding climate change effects. However, if there is an additional marginal benefit associated with environmental regulation through reduction of the risks of climate change, then the externality cost estimate would be greater than the current tax. This would be a rationale for increasing the tax.

The emissions component of particular pertinence to global warming is carbon.[6]   The final column in Table 1 indicates the relative carbon tax that would be appropriate given the carbon emissions per unit of each type of fuel. Each of the energy sources is rated according to its carbon content relative to natural gas. Natural gas is the cleanest of these energy sources and, consequently, serves as the numeraire in rating the different energy sources. The carbon emissions burden is presented in relative terms rather than in absolute dollar cost terms because of the difficulty in monetizing the costs associated with carbon emissions. As indicated, this relative carbon tax amount for gasoline is fairly substantial, but it is below that of coal, diesel fuel, and heating oil.

---

[5] This tabulation is as of 1986 and, unfortunately, no update exists. Consequently, for the purposes of our analysis, we will assume that the same relationships embodied in this table hold true today.

[6] For a more general discussion of the appropriate role of carbon taxes, see Roy Boyd, Kerry Krutilla & W. Kip Viscusi, *Energy Taxation as a Policy Instrument To Reduce CO_2 Emissions: A Net Benefit Analysis*, 29 J. ENVTL. ECON. & MGMT. 1 (1995).

Table 1: Summary of Energy Externalities and Taxes
Assuming Compliance with Existing Environmental Standards[7]

	Current Tax per Unit[a]	Current Tax as a Percent of Price	Externality Cost Estimate as Percent of Price[b]	Relative Carbon Tax[c]
Gasoline (gal)	0.15	16.60	16.74	27.89
Diesel Fuel (gal)	0.12	12.90	50.40	52.88
Aircraft Fuel (gal)	0.10	15.50	12.94	n.a.
Natural Gas (1000 cu. ft.)	0.25	6.40	1.11	1.00
Heating Oils (gal)	0.10	14.60	63.69	47.99
Wood (tons)	0.00	0.00	152.43	0.00
Coal (tons)	11.95	35.90	528.01	104.87

[a] Current tax per unit includes federal, state, and local excises, severance taxes, public utility taxes, and windfall profits taxes. It excludes taxes designated for particular uses, the Federal Highway Trust Fund, Superfund Tax, and Black Lung Tax. Viscusi et al., *supra* note 7, at 32.

[b] These figures are based on midpoint environmental damage estimates. *Id.*

[c] These figures are based upon carbon emissions per unit of fuel. Relative carbon tax values are normalized with natural gas equal to 1. *Id.*

Diesel fuel is the second energy source listed in the table. The current tax rate of 13% is comparable to that of gasoline. However, diesel fuel is much more polluting than gasoline, as diesel fuel's externality cost estimate is just over 50% of the price. Even when considering only those pollution emissions unrelated to global climate change, the tax on diesel fuel is inordinately low. Moreover, if one were to take into account the carbon emissions per unit of diesel fuel, then the appropriate tax rate would be even higher, given that the relative carbon tax value in the final column of Table 1 is almost 53.

Two other major energy sources in Table 1 are related to the production of electricity by coal-fired electric power and heating plants: heating oils and coal. In each instance, the externality cost estimate is

---

[7] Table 1 is from W. Kip Viscusi, Wesley Magat, Alan Carlin, & Mark Dreyfus, *Environmentally Responsible Energy Pricing*, 15 ENERGY J. 23, 32 tbl.2 (1994). All cost estimates are based on 1986 damages estimates.

considerably greater than the current tax per unit price. Moreover, the relative carbon tax value is considerable, particularly compared to that for gasoline, which often is the focus of policy discussions about global warming.

In brief, for these energy sources, even if we ignore the externality costs of climate change, there is still a strong rationale for increasing the tax values above their current levels. Moreover, if the climate change consequences of these energy sources are accounted for, the additional marginal benefit derived from reducing these emissions warrants even more aggressive policies to control the emissions sources.

Notwithstanding the failure of the United States to ratify the Kyoto Protocol, the scientific evidence suggests that there are, in fact, significant benefits associated with reducing emissions related to climate change.[8] There is, of course, a probability distribution associated with these benefit values at different points in time, but there seems to be little dispute that there are nonzero benefits associated with reducing emissions related to global warming.[9]

A broad range of options is available to address the risks associated with climate change. These include carbon taxes, cap-and-trade policies, command-and-control types of interventions, and various forms of remediation.[10] What is noteworthy is that, despite the availability of a variety of policies to address climate change hazards, to date there has been very little initiative of any type specifically targeting this environmental threat. Thus, from the standpoint of policy assessment, the failure in dealing with global warming hazards includes a government or regulatory failure rather than simply a failure of private markets.

---

[8] *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE [IPCC], WORKING GROUPS I, II & III, CLIMATE CHANGE 2001: SYNTHESIS REPORT 19-23 (Robert T. Watson ed., 2001) [hereinafter IPCC, 2001 SYNTHESIS REPORT] (assessing the effects of emissions reduction on climates, environments, and economies).

[9] *See id.* at 8-13 (analyzing the consequences of present emissions policies over the next 25, 50, and 100 years).

[10] For examples of the kinds of policy options that could be mustered to address the risk of climate change, see Joseph E. Aldy, Scott Barrett & Robert N. Stavins, *Thirteen Plus One: A Comparison of Global Climate Policy Architectures*, 3 CLIMATE POL'Y 373 (2003); Alan Carlin, *Global Climate Control: Is There a Better Strategy than Reducing Greenhouse Gas Emissions?*, 155 U. PA. L. REV. 1401 (2007). For an examination of cap-and-trade policies, see Ted Gayer & John K. Horowitz, *Market-Based Approaches to Environmental Regulation*, 1 FOUND. & TRENDS MICROECONOMICS 201 (2005).

In view of this government failure, the use of litigation to address the consequences of climate change might be viewed as being under the general purview of the overall regulation through litigation movement.[11] To the extent that litigation can replicate what a meaningful government policy can do, it will do so by establishing appropriate incentives to control emissions related to global warming at efficient levels. What is missing from the litigation process is any internal check to ensure that an efficiency-based pollution control objective is being fostered and that the preferences reflected in the incentives created by the litigation coincide with those of society more generally. It is likely, for example, that the private gain that the litigators stand to reap from such litigation is a strong motivation. There is no assurance that these private gains are in line with societal benefits and costs.

It is also relevant that the mix of activities that leads to carbon emissions is quite diverse and may not encompass all of the defendants named in any particular case. Gasoline, for example, is quite different from heating oil and electricity produced in coal-fired plants. Wholly apart from the problem of allocating responsibility among potentially responsible parties, there is the additional difficulty that any comprehensive litigation-based approach to addressing global warming problems must encompass a broad set of activities that generate these emissions rather than focusing on a single component alone.

II. THE CIGARETTE LITIGATION MODEL

It is instructive to examine the cigarette litigation model in detail and to compare the components of that litigation to those of the climate change cases. The main similarity is that the cases involve external harms of various types, for which there is an attempt to recoup damages. In addition, in each instance the financial stakes involved in the litigation are at an unprecedented high level. But these similarities mask many fundamental differences.

In 1998, the major cigarette manufacturers settled a series of lawsuits filed by states to recoup the Medicaid costs associated with smoking. Four states—Florida, Texas, Mississippi, and Minnesota—settled separately with the industry, and the remaining states settled in what is

---

[11] *See generally* REGULATION THROUGH LITIGATION (W. Kip Viscusi ed., 2002).

known as the Master Settlement Agreement.[12] The overall stakes asso-ciated with the settlement were close to $250 billion.

The structure of the cigarette lawsuit was novel in several respects. As with the climate change lawsuits, the probability of success for such cigarette litigation initially seemed low. In contrast to earlier tobacco suits, these claims did not seek damages for the personal health costs and income losses suffered by individual smokers. Instead, the claims were for the financial costs incurred by the states because of smoking behavior. The mere existence of financial costs due to a product does not trigger liability. For example, over 40,000 people a year die in motor vehicle accidents, yet the automobile companies are not liable for all of the medical expenses attributable to these fatal accidents.[13]

The litigation landscape for climate change lawsuits is quite dis-similar to that of cigarettes. To begin, consider the evidence on the health risks of smoking in comparison to evidence on the health risks of global warming. What is distinctive about our knowledge of the risks of smoking relative to climate change risks is that many smoking risks are known with substantial precision. Beginning with the 1964 report by the U.S. Surgeon General that concluded that smoking in-creased the risk of lung cancer,[14] there has been a steady stream of studies by the Surgeon General and other government entities docu-menting the risks associated with smoking. The 1989 report of the Surgeon General summarized much of this evidence with respect to a broad range of health risks.[15] Under the usual criteria for statistical significance, there is firm evidence of large and statistically significant risks of smoking for a broad range of ailments, including coronary heart disease, hypertensive heart disease, ulcers, influenza and pneu-monia, bronchitis and emphysema, and a wide variety of cancers.[16]

---

[12] For a discussion of the Master Settlement Agreement and the associated costs, see VISCUSI, *supra* note 2, at 40-45.

[13] Statistics on the number of people killed in motor vehicle accidents each year are from NAT'L SAFETY COUNCIL, NATIONAL SAFETY COUNCIL INJURY FACTS 2005-2006, at 86 (2006). For a discussion of the limitations on generalizing the cigarette litigation precedent, see Gary T. Schwartz, *Cigarette Litigation's Offspring: Assessing Tort Issues Re-lated to Guns, Alcohol, & Other Controversial Products in Light of the Tobacco Wars*, 27 PEPP. L. REV. 751 (2000).

[14] U.S. DEP'T OF HEALTH, EDUC. & WELFARE, SMOKING AND HEALTH: REPORT OF THE ADVISORY COMMITTEE TO THE SURGEON GENERAL OF THE PUBLIC HEALTH SERVICE 31 (1964).

[15] U.S. DEP'T OF HEALTH & HUMAN SERVS., REDUCING THE HEALTH CONSE-QUENCES OF SMOKING: TWENTY-FIVE YEARS OF PROGRESS: A REPORT OF THE SURGEON GENERAL 100 (1989).

[16] *See id.* at 148 (comparing health risks to current and former smokers).

To understand the difference between our knowledge of cigarette health risks versus climate change health risks, consider why we know so much about the hazards to individuals from smoking. The main reason is that we have available substantial information from numerous scientific studies based on a large number of observations. With over one-fifth of the adult U.S. population continuing to smoke,[17] and an even higher smoking prevalence rate in earlier decades, there are millions of people who have smoked, and a substantial scientific literature has documented the quite serious health consequences of smoking based on epidemiological studies and other statistical evidence.

The precision of our knowledge is not attributable to large numbers alone. The long time period over which we can observe the consequences of smoking is relevant as well. Many of the ailments associated with smoking have a latency period. Smoking a cigarette on one's eighteenth birthday will not give one lung cancer tomorrow, but a commitment to continuing smoking behavior after one's eighteenth birthday will generate a substantial risk of lung cancer in one's later years. The availability of data over a long time period as well as information on personal histories with respect to smoking enable us to obtain a retrospective and relatively precise assessment of the risks of smoking.

In contrast, the risks associated with climate change are based on substantially weaker information. While there are millions of individual decisions that may affect the risks of climate change, there are not millions of independent experiments. Pollution emissions have broader effects, so the effect of different emissions on climate change is measurable only at the level of large regions. Thus, our effective sample size with respect to assessing how pollution exposures cause climate change is much more limited than for smoking.

A second difference in the risk information base concerns the time period. Most of the risks and potential damages of climate change are prospective. Thus, we are not making a judgment with respect to levels of pollution emissions that were present in the 1940s and 1950s and the harms they have caused. Rather, we are in comparatively uncharted territory in which we are attempting to assess the future consequences of current pollution emissions that are at a much

---

[17] U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES: HEALTH AND NUTRITION 130 tbl.190 (2006), *available at* http://www.census.gov/compendia/statab/2006/health_nutrition/health.pdf.

higher level than they were decades earlier.[18] Making these linkages is not entirely guesswork, but it does lack the same level of experimental evidence that we have regarding the harms attributable to smoking.

Both the risks of smoking and the risks associated with climate change have a latency period. What differs is that, in the case of cigarettes, the time period that has elapsed since people have begun smoking cigarettes is sufficiently long that the risks can be manifested. In contrast, it may not be until much later in the twenty-first century that the consequences of continuing our current emissions practices will be manifested in climate outcomes.

The natures of the harms resulting from smoking and from emissions that cause climate change are quite different as well. Smoking poses substantial risks to the health of the individual product user. The health consequences of smoking are clearly adverse. These health impacts then lead to financial costs that can be well documented. In contrast, the risks associated with climate change cause worldwide climatological shifts of uncertain magnitude and of uncertain desirability that may vary regionally. Climate change does not necessarily imply climate-related damages. As an extreme example, perhaps Finland may benefit by being a bit warmer than it is today.

An additional difference between the risks of smoking and those of climate change is the potential for adaptation. In the case of many ailments associated with smoking, such as lung cancer and emphysema, there are medical treatments available, but there are few behavioral changes that one can adopt to make life with a fatal form of cancer as lengthy and as enjoyable as life without the disease. In contrast, global warming may lead to a shift in the types of crops that are produced and other behavioral responses that will mute much of the damages as compared to what would occur if there were no behavioral adaptive responses.[19]

The context of the decision involving the alleged wrongful conduct is quite different for cigarettes than for emissions that generate greenhouse gases. In the case of the consumer choice for cigarettes, the issue is whether consumers are adequately informed of the health risks to themselves and the addictive properties of cigarettes that will affect their future smoking behaviors. If consumers are not ade-

---

[18] *See* IPCC, 2001 SYNTHESIS REPORT, *supra* note 8, at 30-34 (listing the "robust findings" and "key uncertainties" in current projections about the consequences of pollution).

[19] The possibility of adaptive responses to climate change is discussed in *id.* at 12.

quately informed, the question arises whether the wrongful conduct by the cigarette industry defendants led people to misperceive the risks in a way that influenced smoking decisions that people would not have made had they possessed sound information. Note that in the cigarette context, the company is directly involved in providing information about the product and selling the product to consumers, and the product itself generates health risks for its users.

The market analog in the case of greenhouse gases does not have a parallel structure. Consider, for example, automobile emissions. Should the counterpart for a cigarette industry defendant be a manufacturer of automobiles and trucks? Alternatively, should the pertinent defendant be a company that produces and sells gasoline? From an economic standpoint, the decisions people make regarding how much they will drive and how much they commute will be guided by the economic incentives that they face, which will include the price of gasoline and the cost of fuel-efficient cars. The risks posed by one's personal greenhouse emissions are negligible for the owner and operator of the automobile, whereas the individual who smokes cigarettes is exposed to considerable risks. From the standpoint of individual decision making, unless a person has a substantial altruistic interest in protecting the environment, gasoline usage decisions will be governed by the private payoffs to the individual user.

How could the potential corporate defendants have reduced these environmental damages? Unlike in the case of cigarettes, providing accurate information to consumers would not have sufficed, as the risks involved are external to the individual decision maker. At most, providing information might have generated some altruistic interest in the environment. Similarly, if a particular seller of gasoline chose to market its gasoline at an extra fifty cents a gallon to discourage usage and to curb greenhouse emissions, then consumers would simply buy gasoline from competitors, driving it out of business. Ultimately, the world market price for oil will be the main force influencing domestic gasoline consumption, not firm-specific pricing that seeks to set a price above the market price.

In a similar vein, automobile companies could also choose to produce cars that achieve high gas mileage. Thus, for example, Toyota could abandon its diverse product line and sell only the Prius, a fuel-efficient, gas-electric "hybrid." However, if it did so, it would lose substantial market share to manufacturers of automobiles that are less fuel efficient but provide other offsetting advantages to the consumer, such as more horsepower.

Public utilities likewise do not have complete leeway to address the climatological consequences of their activities. Public utilities, such as electric power plants, are natural monopolies that are subject to stringent regulation of their price structures.[20] In some instances, rigid legislative price caps may impose an upper bound on the retail price of electricity.[21] As a result, utilities cannot simply raise the price of electricity to encourage conservation. Nor can they engage in unlimited investments in emissions reductions, as these costs ultimately must be covered through higher price levels, which are constrained.

It may be more appropriate to frame the potential defendants of the climate change litigation in terms of tobacco farmers rather than cigarette manufacturers. In much the same way that Shell sells gasoline that is used in cars, tobacco farmers grow tobacco for use in cigarettes. Each of these parties could choose to exit the market altogether. Tobacco farmers could replant their fields with soybeans or other crops, and Shell could stop selling gas. The exit of any particular farmer or gasoline retailer will not affect prices because the market is large. The manufacture of tobacco is worldwide, as is the production of oil.

It may also be more appropriate to compare the risks that emissions pose for global warming to those associated with environmental tobacco smoke rather than to primary cigarette smoking risks. Environmental tobacco smoke creates externalities that affect people exposed to the smoke.[22] The cigarette industry itself has no control over where people smoke, so the absence of smoking restrictions or the failure of smokers to smoke in areas that will not expose others to the risks is not under company control. In addition, the risks associated with environmental tobacco smoke are highly uncertain and much debated, much like the continuing controversy with respect to the societal harms caused by climate change. Perhaps because of these various externalities, all of which bear a strong resemblance to the climate change litigation, there has been very little litigation activity with re-

---

[20] *See* VISCUSI, HARRINGTON & VERNON, *supra* note 3, at 429-62 (presenting various regulatory models for the electric power industry).

[21] *Id.* at 441, 458.

[22] For an exploration of the literature on these externalities, see U.S. EPA OFFICE OF HEALTH & ENVTL. ASSESSMENT, RESPIRATORY HEALTH EFFECTS OF PASSIVE SMOKING: LUNG CANCER AND OTHER DISORDERS (1992). For a critique of this evidence, see Gary L. Huber, Robert E. Brockie & Vijay K. Mahajan, *Smoke and Mirrors: The EPA's Flawed Study of Environmental Tobacco Smoke and Lung Cancer*, 1993 REGULATION 44, 45-47.

spect to environmental tobacco smoke.[23] Instead, there has been a major surge in regulation of the risks posed by environmental tobacco smoke. The preferability of a regulatory solution rather than a litigatory solution to climate change risks also parallels the trajectory of interventions affecting environmental tobacco smoke.

Cigarette litigation does, however, provide a blueprint for thinking about damages associated with actions by defendants in climate change cases, should such litigation occur. The central question in the state attorneys' general suits, and in cigarette litigation more generally, is what the harms to the smokers would have been without the alleged wrongful conduct of the cigarette manufacturer. Smoking causes well-established and identifiable harms that are both financial and health related. In the states' lawsuits, the harms were financial; in cases brought by individuals, the harms also included the health loss to the individual smoker. The harms caused by global climate change are diverse, but the distribution of possible effects is much more diffuse and uncertain.

It can be difficult to link the harms to the actions of the defendant. For individual cigarette lawsuits, the questions often are what brand the plaintiff smoked and for what time period. The state cigarette litigation focused more on a market share approach to account for the share of medical expenses attributable to each brand. As a general rule, market share liability and various proportional liability approaches remain controversial, but if there is going to be any linkage of the damages associated with climate change to the defendants in such cases, there must be some mechanism for allocating damages.

Whatever harms are accounted for in these damages tallies should be attributable to the wrongful conduct of the defendant. The underlying economic reasoning behind linking damages payments to the harms generated by the defendant's actions is that doing so will create incentives for efficient behavior, as indicated by the full social cost energy framework in Table 1. By imposing costs that reflect the social damages on the generator of pollution, the level of pollution generated will be at the socially efficient level, taking into account the full value of the harms associated with the polluting activity. This ap-

---

[23] Perhaps the most prominent environmental tobacco suit was brought on behalf of the flight attendant Norma Broin for damages she suffered from exposure to smoke in airplane cabins. VISCUSI, *supra* note 2, at 133-34. The case was Broin v. Philip Morris, Inc., No. 91-49738 (Fla. Cir. Ct. Feb. 5, 1998) (unpublished mem.).

proach is the well-known Pigovian tax methodology in the economics externalities literature.[24]

Even after accepting this overall approach, there remains the matter of how to calculate damages that occur over a long period of time. In the case of cigarettes, the appropriate approach for calculating economic losses is the net present value of the costs over the lifetime. Thus, one calculates a trajectory of costs year by year, where these costs are calculated assuming smoking behavior and then compared with a situation in which the same individual is not a smoker. The calculation of damages associated with global warming should likewise be on a year-by-year basis. Moreover, such damages must be net damages amounts. For example, even if global warming leads to hurricane damages in any given year, the appropriate measure is the net increase in the hurricane damages, because even in the absence of global warming, we face hurricane risks.

The financial costs of smoking are quite diverse, with both positive and negative effects. In much the same way, climate change may also have positive and negative effects. According to Viscusi's estimate of the financial costs of smoking, the net present value of the financial externalities associated with smoking are negative, not positive.[25] The largest cost imposition consists of the medical care cost increase, which is $0.58 per pack. Next in terms of order of magnitude are the foregone contributions to Social Security and Medicare that smokers would have made had premature mortality not shortened their work lives. The offsetting financial components are those that represent cost savings resulting from smokers' premature mortality, notably the reduced costs for Social Security, pensions, and nursing homes. On balance, there are net financial savings to society of $0.32 per pack. Thus, from the standpoint of financial externalities alone, there is no cost imposition associated with smoking.

Given that, on balance, cigarettes do not impose net financial costs, what was the rationale for damages in the state attorneys' general lawsuits? The state litigation focused on one component, the Medicaid segment of the medical cost share, which is necessarily positive. However, if one were to design an optimal tax strategy for ciga-

---

[24] *See* DAVID A. ANDERSON, ENVIRONMENTAL ECONOMICS AND NATURAL RESOURCE MANAGEMENT 298-99 (2004).

[25] These and other statistics cited below are from VISCUSI, *supra* note 2, at 73. These calculations use a 3% discount rate in bringing the costs back to their present value.

rettes, it would reflect the overall net costs, not the isolated component amount. Whether there are costs and how great they are depend on which costs get counted.

The cigarette litigation approach could be applied in the context of global warming. Suppose that the task is to calculate the financial externalities associated with gasoline. One could assess the different components of the costs, such as the effects on agriculture, flooding, hurricanes, and more general harms to the ecosystem, and then calculate their total. In each instance, the costs calculated should be the net costs for each component.

The appropriate remedy for market failures is also quite different for cigarettes than for climate change. In the case of cigarettes, it is sufficient for manufacturers to provide accurate information to consumers about the product so that buyers can make rational decisions. If people are fully informed of the risks and take all these risks into account when making their smoking choices, then there is no need to tax the product or undertake any other actions associated with the private risks of smoking. For environmental tobacco smoke, matters are quite different. Regulation or smoking restrictions of some kind may be the appropriate remedy. There remains the issue of financial externalities associated with smoking, but whether these are positive or negative depends in large part on what costs are counted.

That the Master Settlement Agreement (MSA) was driven by political factors rather than by efficiency concers is reflected in the structure of the MSA proposals. Ideally, a state's share of the MSA should correspond to its share of the medical cost damages that were the object of the litigation. However, wide disparities exist.[26] The state of Washington received 1.396 times its medical cost share, perhaps because its attorney general, Christine Gregoire, brokered the MSA. New York and California each received 13.0% of the MSA payments despite quite different medical cost shares of 15.2% for New York and 8.6% for California. The four leading tobacco-producing states— North Carolina, Virginia, Kentucky, and Tennessee—each received considerably less than their medical cost share.

Litigatory solutions to problems that should be governed by regulatory policies also entail substantial transactions costs. Although data are not available for the costs incurred by the defendants in the state smoking lawsuits, the plaintiffs' legal fees were quite substantial. For

---

[26] See VISCUSI, *supra* note 2, at 46-47, for the supporting data below.

example, the attorneys received $1.43 billion or 35% of the Mississippi settlement, $3.43 billion or 26% of the Florida settlement, and $3.3 billion or 19% of the Texas settlement.[27]   The substantial payoff amounts for these and other states not only indicate the high level of transactions costs, but also highlight the potential opportunities for rent-seeking behavior on behalf of these attorneys, who are paid on a contingency fee basis.

III. Ignorance and the Generational Divide: Perceptions

Why have government policies failed to meet the challenge posed by climate change?   Our hypothesis that the shortcomings of global climate change policies can be traced to citizen preferences can best be explored by examining the patterns of these citizen beliefs and choices that are made with respect to global climate change.

Because of the prominence of climate change policies in Europe, where there has been widespread support for the Kyoto Protocol, there is substantial data available on how Europeans perceive the risks of global warming and what actions they have taken to address these risks.   These data are far more comprehensive than survey evidence for the United States.

We primarily use data from *Eurobarometer 57.0: Agriculture, Energy, and Discrimination Issues, February–April 2002.*[28]   We also use data from *Eurobarometer 51.1*, described in Part IV.   The Eurobarometer surveys have been conducted since 1970 and currently query about 1000 respondents in each of the fifteen European Union (EU) member countries in the spring and fall of each year.[29]   The surveys are used to monitor social and political attitudes, especially attitudes toward the EU, and include special topics in different waves.   The Agriculture, Energy, and Discrimination Issues survey asks respondents a number

---

[27] *Id.* at 51.

[28] Thomas Christensen, Inter-Univ. Consortium for Political & Soc. Research, Eurobarometer 57.0: Agriculture, Energy, and Discrimination Issues, February-April 2002 (2d ed. 2005).

[29] These fifteen countries are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom.   East Germany and West Germany are identified separately, as are Ireland and Northern Ireland, and we analyze them as separate countries, bringing the total number of countries to seventeen for the purposes of our analysis.   Norway has occasionally been included in the surveys, but did not participate in the survey we use here.

of questions about their perceptions of energy use and the actions they take to curb energy use.

The 2002 Eurobarometer survey provides a detailed perspective on how a large sample of 16,032 respondents perceives different consequences of energy use. The results considered in this Part pertain to the public's perceptions of energy use, while the next Part examines the data regarding the public's actions.

We hypothesize that there are two factors that lead to inadequate public support for global warming policies. First, ignorance may play an important role. If people are not aware that there are substantial risks associated with global warming, this lack of awareness will subsequently influence their willingness to support policies addressing risks of climate change and to incur costs personally to address these risks. Second, because the time frame embodied in climate change policies extends far into the future, we hypothesize that older generations will be more reluctant to support climate change policies than younger generations.[30] People who are 15 years old have a considerably longer life expectancy than those 65 or older. Ignoring the risk of premature mortality, having an additional half century of life gives one a substantial advantage in experiencing directly the effects of climate change policies and in having one's children experience those effects. Thus, our hypothesis is that there will be a substantial decline in support for climate change policies among those whose motivation is the altruistic concern for future generations, as opposed to a self-interest in reaping the benefits of these policies.

Table 2 reports answers to a series of questions regarding people's perceptions of various risks associated with climate change.[31] The first column of perception results is the percentage of the sample that agrees with the following statement: "Global warming and climate change are serious issues which need immediate action." While the overwhelming majority of respondents agree with that statement, the lowest figure observed is that for the ages-65-and-over group, of whom 81.6% agree. This level of agreement is significantly lower than the group average for ages 15-64, which is 88.6%.

---

[30] For a discussion of this hypothesis, see Joni Hersch & W. Kip Viscusi, *The Generational Divide in Support for Environmental Policies: European Evidence*, 77 CLIMATIC CHANGE 121 (2006).

[31] These questions are all subparts of the following question from the Eurobarometer survey: "For each of the following, please tell me if it is the case or not." CHRISTENSEN, *supra* note 28, at 5.

Table 2: Percentage Agreeing with Global Warming Statements, by Age Group

Age Group	N	Global Warming Needs Immediate Attention	Fossil Fuels Contribute to Global Warming	Transport Largely Responsible for Global Warming	Nuclear Power Contributes to Global Warming
15-24	2505	88.9	78.1	73.5	51.4
25-34	2830	89.4	78.2	71.6	49.5
35-44	2976	88.2	76.2	72.1	45.2
45-54	2569	90.3	78.0	74.5	44.5
55-64	2207	85.8	76.5	72.1	43.3
65+	2945	81.6*	69.7*	69.8*	40.4*
All Ages 15-64	13,087	88.6	77.4	72.7	46.9

Source: Authors' calculations are based on *Eurobarometer 57.0*. CHRISTENSEN, *supra* note 28. Asterisks indicate statistically significant differences between the ages-15-64 and ages-65-and-over groups, 1% level, two-tailed test.

The second question, indicated in the second column of perception results in Table 2, is whether respondents agree with the following statement: "The use of fossil fuels (coal, oil, gas, etc.) contributes significantly to global warming and climate change." Once again, the same type of pattern is exhibited, as just under 70% of those ages 65 and over agree with this true statement that fossil fuels contribute to global warming, compared to over 77% for younger age groups. Very similar results appear for the third statement: "Transport is largely responsible for global warming and climate change."

The final question indicated in Table 2 attempts to assess the accuracy of the public's risk beliefs. It elicits opinions regarding a statement that is incorrect: "Nuclear power contributes significantly to global warming and climate change." This statement is not correct because there are no pollution emissions from nuclear power that contribute to global warming, and indeed, nuclear power is often suggested as an alternative mechanism for reducing the risks of climate change. Yet almost half of all respondents agree with this incorrect

statement. The perception that nuclear risks contribute to global warming is highest among the youngest age groups, and this pattern may reflect a general skepticism of nuclear power among the young.

To examine the contribution of personal characteristics to the different preferences, we report multivariate probit regressions in Table 3. The continuous variables pertain to income levels, which have been converted to dollars; education in years; and individual age in years. The categorical variables include whether the respondent is male, married, or still attending school.

Let us focus on the first of our two hypotheses: lack of risk knowledge and individual ignorance come into play and affect global warming beliefs. Education is the main variable reflecting knowledge, and this variable has a consistently significant effect in the expected direction. In particular, people with more education are more likely to agree with the first three true statements regarding global warming and are less likely to agree with the false statement regarding nuclear power. Income levels, which are highly correlated with education, have similar directional effects.

Table 3: Probit Regressions for Agreement with Global Warming Statement

	Global Warming Needs Immediate Attention	Fossil Fuels Contribute to Global Warming	Transport Largely Responsible for Global Warming	Nuclear Power Contributes to Global Warming
Income x 10,000	-0.003	0.011**	-0.000	-0.031**
	(0.002)	(0.003)	(0.003)	(0.003)
Income Missing	-0.019**	-0.001	-0.038**	-0.021*
	(0.007)	(0.009)	(0.010)	(0.011)
Male	0.001	0.056**	0.022**	-0.038**
	(0.005)	(0.007)	(0.007)	(0.008)
Married	0.014*	0.011	0.038**	0.033**
	(0.006)	(0.008)	(0.008)	(0.009)
Education	0.004**	0.010**	0.002*	-0.012**
	(0.001)	(0.001)	(0.001)	(0.001)
Education– Still Studying	0.012	0.015	0.009	-0.032
	(0.011)	(0.014)	(0.015)	(0.017)
Age	0.002**	0.002	-0.000	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Age Squared/ 100	-0.004**	-0.003*	-0.001	-0.003
	(0.001)	(0.001)	(0.001)	(0.001)

Source: Authors' calculations are based on *Eurobarometer 57.0*. CHRISTENSEN, *supra* note 28. Standard errors are in parentheses. Asterisk (*) indicates significance at 5% level; double asterisks (**) indicate significance at 1% level.

Our second hypothesis pertains to age and the differential attitudes of older respondents toward global warming. The first column of regression results in Table 3, which concerns whether global warming needs immediate attention, reflects the nonlinear age effect that rises and then falls with age. The second column of results, which pertains to fossil fuels, yields a negative effect of the quadratic age variable, which once again indicates that those 65 and older are less likely to agree with the global warming statement. The final two columns of results exhibit no statistically significant age effects, as the inclusion of the other variables in the analysis accounts for the significant age differences that were exhibited in the overall mean values in Table 2.

Closely related to the age effect is that people who are married, and consequently are more likely to have children with a stake in future global warming policy benefits, are more likely to agree with the various statements regarding global warming. That relationship is in fact borne out, with the only exception being fossil fuels, for which the coefficient is positive but not statistically significant.

The other variables have more mixed effects. Men seem to have a stronger belief that fossil fuels and transport contribute to global warming than do women, and they are also less skeptical of the dangers of nuclear power.

Exploration of the perceptions of global warming risks consequently indicates that ignorance, as captured by the education variable, is perhaps the most dominant factor in the difference in beliefs. Generational issues arise as well with respect to risk beliefs, but they are dampened and in some instances eliminated by the inclusion of the influence of a full set of demographic variables.

IV. IGNORANCE AND THE GENERATIONAL DIVIDE: ACTIONS

This Part continues the exploration of the roles of ignorance and generational interest with respect to global warming, but it does so within the context of individual actions as opposed to perceptions. Do education and age affect pollution-reducing actions directly? Do risk beliefs also affect actions so that there is an additional indirect effect of the demographic variables via risk beliefs?

One of the most prominent policy remedies that has been advocated with respect to global climate change is a gasoline tax, which will reduce gasoline consumption and automobile emissions. To what extent are our hypotheses regarding attitudes toward climate change

borne out in people's support for gas taxes? An earlier wave of the Eurobarometer, undertaken in 1999, included questions asking respondents how much more they were willing to pay for petrol that would be less harmful to the environment.[32] Rather than simply asking respondents if they thought that gasoline was harmful to the environment, the question actually elicits an additional amount that people would be willing to pay for gasoline if doing so would be protective of the environment.

Table 4 summarizes the distribution of these willingness-to-pay amounts per liter of petrol.

Table 4: Willingness To Pay for Petrol That Is Less Harmful
to the Environment, by Age Group

Age Group	Percentage Who Are Willing To Pay More	Percent Amount More Willing To Pay	Cents More per Liter Willing To Pay if Positive	Cents More per Liter Willing To Pay
15-24	22.1	2.8	11.8	2.6
25-34	21.2	2.8	12.5	2.7
35-44	19.4	2.3	11.7	2.3
45-54	18.3	2.1	10.7	2.0
55-64	16.4	1.6	9.5	1.6
65+	10.9	1.0	9.1	1.0
All ages 15-64	19.7*	2.4*	11.5*	2.3*

Source: Authors' calculations are based on *Eurobarometer 51.1.* MELICH, *supra* note 32. Asterisk (*) indicates statistically significant differences between the ages-15-64 and ages-65-and-over groups, 1% level, two-tailed test.

The first column gives the percentage who are willing to pay more for petrol; the second column presents the percentage amount more they are willing to pay; the third column presents in dollar terms the cents more per liter that people are willing to pay provided that the response is a nonzero value; and the final value is the cents more per liter that people are willing to pay including the zero responses. What is striking about these statistics is that almost invariably there is a

---

[32] ANNA MELICH, INTER-UNIV. CONSORTIUM FOR POLITICAL & SOC. RESEARCH, EUROBAROMETER 51.1: ENVIRONMENTAL ISSUES AND CONSUMER ASSOCIATIONS, APRIL-MAY 1999 (2001).

steady decline in willingness to pay with age. The starkest drop occurs when we move from the ages-55-64 group to the ages-65-and-over group. In terms of the percentage who are willing to pay more and the percentage amount more they are willing to pay, the ages-65-and-over group expresses roughly half of the willingness to pay as compared to all people ages 15-64. The existence of this pattern supports our hypothesis that there is a generational divide in support for climate change policies.[33]

The 2002 Eurobarometer survey does not repeat the gas price question but does include a diverse set of questions pertaining to actions that people are taking to save energy that are likely to affect global climate change.[34] The first set of questions presented in Table 5, Panel A, pertains to actions that people could take at home and at work. The home-related behaviors are the following: "Cut down on heating and/or air conditioning," "Cut down on lighting and/or the use of domestic electrical appliances," "Insulate(d) my house (walls, windows, etc.)," and "Taking initiatives to save energy at work." Roughly one-third to one-half of all respondents have undertaken one or more of these actions, where the main outlier is saving energy at work. Many people do not work, and those who do may not have control over energy savings.

In terms of the age distributions of the patterns in Table 5, Panel A, there is an inverted U-shaped relation. Precautions rise with age until middle age and then subsequently decline. For two of the four categories, there is a statistically significant difference between the precautions taken by the ages-65-and-over group and those taken by all those ages 15-64, with a somewhat greater percentage of the oldest group undertaking the precaution of cutting lighting/appliances.

---

[33] Hersch & Viscusi, *supra* note 30, at 121. This paper provided the mean values' counterpart regression results, but did not include the statistics presented in Table 4.

[34] The questions in Table 5 are based on *Eurobarometer 57.0* question 24. CHRISTENSEN, *supra* note 28, at 11.

Table 5: Percentage Taking Action To Save Energy

Panel A: Home and Office Energy Usage

Age Group	Cut Heating/Air Conditioning	Cut Lighting/ Appliances	Insulate House	Save Energy at Work
15-24	29.9	42.2	16.3	5.1
25-34	41.8	49.6	29.5	8.5
35-44	45.2	52.8	41.0	10.7
45-54	47.6	52.5	39.5	10.7
55-64	45.3	52.5	39.3	6.2
65+	42.0	52.3*	34.2	2.6*
All ages 15-64	42.0	50.0	33.2	8.3

Panel B: Transportation Energy Usage

Age Group	Reduce Travel	Reduce Car Fuel Use	Buy Car That Uses Less Fuel	Use Public Transportation More
15-24	7.6	13.4	10.1	24.0
25-34	8.6	20.6	16.4	18.1
35-44	9.7	24.4	20.3	16.0
45-54	9.8	24.6	22.0	16.7
55-64	9.4	23.1	18.3	18.0
65+	9.0	19.0*	12.5*	19.0
All ages 15-64	9.0	21.3	17.5	18.4

Source: Authors' calculations are based on *Eurobarometer 57.0*. CHRISTENSEN, *supra* note 28. Asterisk (*) indicates statistically significant differences between the ages-15-64 and ages-65-and-over groups, 5% level, two-tailed test.

Table 5, Panel B gives the percentage of respondents who have undertaken various travel- and transportation-related actions. These reductions in energy usage are less prevalent than the efforts with respect to home heating and electricity use shown in Panel A. As with the results in Panel A, there is an evident inverted U-shaped relationship for many of the categories, as the reduction in car fuel usage and the purchase of cars that use less fuel rises with age and then subsequently declines. The only effects for the ages-65-and-over group that differ significantly from the effects for all those ages 15-64 are that

members of the oldest group are less likely to reduce their car fuel usage and/or buy a car that uses less fuel.

The inverted U-shaped relationship between these energy conservation measures and age is particularly intriguing in that it may reflect a more general U-shaped relationship between environmental benefit valuation and age. Such a relationship is not unprecedented. A considerable recent literature has documented an inverted U-shaped relationship between people's willingness to pay for risk reductions involving fatality risk to themselves and their age.[35] The impetus for such a relationship is that individual consumption and income follow a pattern over the life cycle, as people's income rises through middle age and subsequently declines through their elderly years. Thus, the economic resources that they can draw upon to fund either energy-saving methods or other risk reduction activities are likely to track this inverted U-shaped relationship observed for life-cycle consumption patterns.

To account for the differential role of age and other demographic variables, Table 6 presents the probit regression results that are the counterparts to the percentage figures in Table 5. These variables parallel those in the earlier regressions, with the addition of the four perceptional variables that were the subject of the analysis in the previous tables.

---

[35] A review of this literature appears in Joseph E. Aldy & W. Kip Viscusi, *Age Differences in the Value of Statistical Life: Labor Market Evidence*, 1 REV. ENVTL. ECON. & POL'Y (forthcoming 2007) (on file with authors).

Table 6: Probit Regressions for Actions To Save Energy

Panel A: Home and Office Energy Usage

	Cut Heating/Air Conditioning	Cut Lighting/ Appliances	Insulate House	Save Energy at Work
Income x 10,000	0.016**	0.008**	0.022**	0.006**
	(0.003)	(0.003)	(0.003)	(0.001)
Income Missing	-0.004	-0.065**	0.067**	0.010
	(0.011)	(0.011)	(0.011)	(0.006)
Male	-0.040**	-0.077**	0.003	0.013**
	(0.008)	(0.008)	(0.008)	(0.004)
Married	0.009	-0.003	0.108**	0.002
	(0.009)	(0.009)	(0.008)	(0.004)
Education	0.007**	0.003**	0.009**	0.003**
	(0.001)	(0.001)	(0.001)	(0.000)
Education– Still Studying	-0.043**	-0.018	-0.050**	-0.031**
	(0.017)	(0.017)	(0.016)	(0.006)
Age	0.012**	0.007**	0.015**	0.005**
	(0.001)	(0.001)	(0.001)	(0.001)
Age Squared/100	-0.011**	-0.006**	-0.013**	-0.006**
	(0.001)	(0.001)	(0.001)	(0.001)
Global Warming Needs Immediate Attention	0.019	0.048**	0.026*	-0.000
	(0.013)	(0.013)	(0.012)	(0.007)
Fossil Fuels Contribute to Global Warming	0.009	0.011	0.020*	0.000
	(0.010)	(0.010)	(0.010)	(0.005)
Transport Largely Responsible for Global Warming	0.019	0.041**	-0.013	0.006
	(0.010)	(0.010)	(0.009)	(0.005)
Nuclear Power Contributes to Global Warming	0.002	-0.011	-0.020*	0.007
	(0.008)	(0.008)	(0.008)	(0.004)

Panel B: Transportation Energy Usage

	Reduce Travel	Reduce Car Fuel Use	Buy Car That Uses Less Fuel	Use Public Transportation More
Income x 10,000	-0.002	0.007**	0.010**	-0.004
	(0.002)	(0.002)	(0.002)	(0.002)
Income Missing	-0.021**	-0.020*	0.028**	-0.038**
	(0.006)	(0.009)	(0.008)	(0.008)
Male	-0.001	0.023**	0.019**	-0.033**
	(0.005)	(0.006)	(0.006)	(0.006)
Married	0.012*	0.040**	0.033**	-0.049**
	(0.005)	(0.007)	(0.006)	(0.007)
Education	0.001*	0.008**	0.006**	0.008**
	(0.001)	(0.001)	(0.001)	(0.001)
Education– Still Studying	-0.018*	-0.048**	-0.029*	0.063**
	(0.009)	(0.012)	(0.012)	(0.014)
Age	0.000	0.007**	0.010**	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)
Age Squared/100	-0.000	-0.007**	-0.011**	0.003*
	(0.001)	(0.001)	(0.001)	(0.001)
Global Warming Needs Immediate Attention	-0.009	0.035**	0.008	0.041**
	(0.008)	(0.010)	(0.010)	(0.010)
Fossil Fuels Contribute to Global Warming	0.008	0.025**	0.011	0.021**
	(0.006)	(0.008)	(0.008)	(0.008)
Transport Largely Responsible for Global Warming	0.022**	0.030**	0.013	0.023**
	(0.005)	(0.008)	(0.007)	(0.007)
Nuclear Power Contributes to Global Warming	-0.001	-0.028**	-0.009	-0.018**
	(0.005)	(0.007)	(0.006)	(0.006)

Source: Authors' calculations are based on *Eurobarometer 57.0*. CHRISTENSEN, *supra* note 28. Standard errors are in parentheses. Asterisk (*) indicates significance at 5% level; double asterisks (**) indicate significance at 1% level.

It is useful to begin with these perceptional variables, as they indicate how people's beliefs regarding global warming affect various energy-saving activities. Controlling for other influences, people who believe global warming needs immediate attention are significantly more likely to cut their use of lighting/appliances, insulate their houses, re-

duce car fuel usage, and increase public transportation usage. People who believe fossil fuels contribute to global warming are also more likely to insulate their houses, reduce car fuel usage, and increase public transportation usage. Similarly, there is a significant positive effect on cutting lighting/appliances, reducing travel, reducing car fuel usage, and increasing public transportation usage if the respondent believes that transport is largely responsible for global warming. Perception of various problems associated with global warming and understanding of the pertinent linkages with respect to these sources of emissions and global warming consequently lead to energy-saving activities, controlling for other factors. The various demographic variables that influence these perceptions consequently have an indirect effect on energy saving through their effect on risk beliefs.

The nuclear power perceptional results are particularly interesting. People who incorrectly believe that nuclear power contributes to global warming are less likely to insulate their houses, less likely to reduce car fuel usage, and less likely to increase public transportation usage. Quite simply, people who are misinformed and whose beliefs are based on factual errors with respect to their understanding of global climate change are less likely to undertake the kind of substantive actions that are needed on an individual basis to reduce pollution emissions.

The age variable has a more prominent effect with respect to actions than with respect to perceptions. In every instance except for reducing travel and the use of public transportation, the significant age influence is that of a positive age effect followed by a negative quadratic age effect. Thus, the influence of age is that there is a rise in taking actions to save energy as one ages, but there is a decline over the life cycle. For the older age groups there will be less concrete action to reduce energy, which is consistent with the results for the willingness to pay for gas taxes to protect the environment.

Similarly, marital status has a role similar to that of life-cycle factors. People who are married are more likely to have children and so have a longer-term interest in protecting the environment. Marriage has a positive and statistically significant effect on insulating the house, reducing travel, reducing car fuel usage, and buying a car that uses less fuel. The only negative effect is that people who are married are less likely to use public transportation, which may be attributable to the greater inconvenience associated with transporting children by public transit as opposed to by private vehicles.

Education continues to have a prominent role as well; income is also influential. Even accounting for people's perceptions of the four global warming questions, there is a positive effect of education on every one of the energy-saving activities. To the extent that education is another measure of information, being informed about the risk clearly leads to greater protective behaviors. Both education and income level will capture wealth effects. People who are richer have greater financial resources. Because environmental quality is a normal economic good, those with higher income will undertake these various energy-saving actions to protect the environment and to save energy. A countervailing factor is that poor people may have greater economic needs, and saving energy may better enable them to stay within a more limited budget. The linear income effects are statistically significant in six of the eight instances, and these effects are always positive. Richer people, better-educated people, and better-informed people are all more willing to undertake actions to conserve energy.

V. WHY SOCIETY FAILS: UNCERTAINTY AND DISCOUNTING

There are two key features of the risks of climate change that intersect with various forms of irrationality: uncertainty and discounting. Because government policies result at least in part from pressures exerted by the public, analyzing the sources of public preferences as they relate to the characteristics of global warming policy assessments provides some insight into why such policies have failed. In particular, we hypothesize that the policy failures can be traced in part to individual irrationality, both with respect to the uncertainties involved in climate change risk assessments and the long time periods that are involved. These two factors bring into play the potential irrationalities involved in discounting distant outcomes.

The role of uncertainty is quite complex, both from the standpoint of uncertainty at any point in time as well as uncertainty over time. How do people react to such uncertainty? At any particular time, if there is a distribution of possible losses around some mean level, then people will generally be more averse to the variable loss situation than to facing a risk of losing the mean value of the loss.[36]

---

[36] By definition, this is what we mean by risk aversion. A risk-averse person would prefer the mean value of a lottery to the lottery itself if there is some risk of loss. *See, e.g.*, ANDREU MAS-COLELL ET AL., MICROECONOMIC THEORY 185-86 (1995) (presenting the utility calculations that accompany risk-aversion measurement).

That pattern of behavior is a standard result in economics, assuming that people are risk averse. Because of the presence of risk aversion as a component of many people's preferences with respect to risky choices, people are willing to buy insurance and pay an amount that is greater than their expected losses to reduce the potential variability of outcomes that would occur had they not been insured.

While this risk aversion relationship is true on a theoretical basis, premised on the usual assumption that people are risk averse, on a practical level it may not always be borne out. Kahneman and Tversky developed a model called "prospect theory," which incorporates many forms of individual irrationality.[37] One anomaly that they found is that people would be willing to take a gamble on a potentially large loss rather than incur a loss that will occur with certainty. To the extent that this experimentally documented irrationality holds true, it would suggest that the public is unwilling to make real sacrifices to avert a distribution of possible harms where the extent of the real sacrifice required exceeds that of the lowest possible harm that might occur. Thus, if climate change might either pose no social cost or a very large social cost, then someone might be unwilling to incur a substantial cost now to avert this lottery on climate change damages.

A second aspect of the uncertainty is not with respect to the distribution of the losses but rather the precision with which they are estimated. There are many kinds of risks for which we have precise data. Automobile accidents are chief among these; we have a large sample of outcomes regarding fatal and nonfatal accidents so that the risks associated with automobile transportation are well known. In contrast, we do not have a sufficient experience base with respect to the kinds of prospective climate change risks that might happen in the future. Scientists estimate various models regarding temperature shifts, and based on these models there are scientific predictions as to the consequences. However, there are broad bands of error associated with these estimates, as we are dealing with a situation of uncertainty rather than simply one of risk.

Situations of uncertainty are well known in the economics literature and come under the general heading of ambiguity regarding the risk. For choices involving an ambiguous chance of success, Ellsberg

---

[37] *See* Daniel Kahneman & Amos Tversky, *Prospect Theory: An Analysis of Decision Under Risk*, 47 ECONOMETRICA 263, 274-89 (1979) (proposing prospect theory as an alternative to expected utility theory).

documented that people will exhibit ambiguity aversion.[38] Thus, a precisely understood 50% chance of winning a particular prize is preferable to a 50-50 chance that is less precisely known. This phenomenon is known as the Ellsberg Paradox.[39] Viscusi and Magat found that this phenomenon also extends to the environmental loss domain, as people exhibit ambiguity aversion with respect to uncertainty regarding environmental losses.[40]

While people may often exhibit ambiguity aversion, they may not do so if the prospect of losses has a very high probability.[41] In particular, environmental risk ambiguity could have the opposite influence. An experimental study of this issue focused on extreme risks associated with global warming.[42] The study was based on a survey that asked a sample of business managers in North Carolina how they would respond to different risks associated with storm damage linked to climate change. The pertinent result for thinking about climate change policy is that while people exhibit ambiguity aversion for intermediate level risks, when the probability of damage becomes very high, people regard greater ambiguity as desirable, thus muting the level of concern with climate change risks.

What could be driving such a surprising result? The underlying intuition is captured in the following medical scenario. Suppose that you go to the doctor and undergo some tests to discover whether you have a fatal form of cancer. The doctor tells you that the risk is only 1 in 100 that you have this fatal cancer. For that kind of low probability, people would prefer to know that the risk is precisely estimated rather than being told the risk might be lower or greater than 1 in 100. If, however, the cancer risk probability is quite high, such as a 90% chance that your cancer is fatal, it would provide some reassurance for the doctor to say that this probability is very imprecisely estimated so that in fact it could be much lower than 90%. Thus, for high probabilities of an adverse outcome, the imprecision of the probability en-

---

[38] *See* Daniel Ellsberg, *Risk, Ambiguity, and the Savage Axioms,* 75 Q.J. ECON. 643, 669 (1961) (illustrating that, in situations with highly ambiguous information, reasonable people will violate the Savage axioms due to a "specified decision rule": ambiguity aversion).

[39] W. Kip Viscusi & Wesley A. Magat, *Bayesian Decisions with Ambiguous Belief Aversion,* 5 J. RISK & UNCERTAINTY 371, 385 (1992).

[40] *Id.* at 384-85.

[41] W. Kip Viscusi & Harrell Chesson, *Hopes and Fears: The Conflicting Effects of Risk Ambiguity,* 47 THEORY & DECISION 153, 153-56 (1999).

[42] *Id.* at 158-73.

ables the person facing the adverse risk to seek some refuge in the possibility that the risks might not be as high as the mean values suggest.

This kind of phenomenon might come into play with respect to both individual choice and the climate change debate. From the standpoint of individuals, if there is some chance that the doomsayers regarding the substantial risks of climate change are wrong, then the imprecision of the estimates makes people think that the risks are equivalent to a lower value of a precisely known risk as opposed to an uncertain risk.

The existence of this scientific uncertainty can also be exploited politically. Because of the substantial uncertainty affecting estimates of the extent of climate change and its consequences, those opposing regulatory action may suggest that there might be no risk at all. If there might be no risk at all, why take action? Exploiting the rhetorical features of uncertainty consequently may serve to undermine efforts to take action. The claim that we should await further research may resonate with the public because of the presence of ambiguity-seeking behavior for large risks, coupled with the reluctance of people to incur a certain cost now to address a lottery on uncertain damages.

Another way in which uncertainty affects the policy debate is that in situations in which risks are imprecisely estimated, information often has a substantial value. If we can resolve many of the key uncertainties, we will be able to make more sensible decisions regarding which risks should be addressed. Because acquiring information takes time, in a statistical decision theory context it may be desirable to postpone a decision and obtain additional information before committing resources.[43] This general principle, coupled with the ability of political administrations to push off the imposition of cost so that it will be borne by subsequent administrations, creates the incentive for inordinate amounts of examination and exploration of the uncertainties as opposed to taking concrete actions to address the risks that we perceive to be present based upon the best available scientific evidence.

Whether we should incur costs now to address uncertain risks will depend in part on the irreversibility of the harms that are occurring. Thus, if current emissions will have an irreversible effect on the envi-

---

[43] The value of information is stressed in a variety of statistical decision theory texts. *See, e.g.,* HOWARD RAIFFA, DECISION ANALYSIS: INTRODUCTORY LECTURES ON CHOICES UNDER UNCERTAINTY (2d ed. McGraw-Hill 1997) (1968).

ronment, there is a general result in economics that we should invest more in preventing the irreversible harms than we should if they were not irreversible.[44] Thus, while information acquisition may create a rationale for some postponement of decisions, the presence of substantial expected losses due to climate change, combined with the irreversibilities associated with failures to take policy actions now, suggests that the current failures to address the uncertain risks do not represent a rational policy response, but instead represent a policy failure.

A second class of irrationalities influencing preferences with respect to climate change policies pertains to the time periods involved. The risks of climate change are relatively remote, extending to the end of the twenty-first century and beyond.[45] The extent to which people discount these effects will have a substantial influence on the level of public support for making current sacrifices now to generate distant benefits. The influence of these payoffs in the future from policies undertaken now raises the fundamental normative policy issue of whether future effects should be discounted and, if so, to what extent.

In many respects, this policy approach in which future effects are recognized but discounted should be regarded as placing a substantial weight on the future. Simply counting the climate change reduction benefits in the future as zero is what would happen if there were no altruistic concern of current generations for future well-being. However, a fully efficient social welfare function that takes into account these future generations will value these benefits according to the willingness to pay for the benefits that these future generations might have if they were able to express their preferences. This approach will fully recognize the valuations of future generations if they were able to express them, but it will discount them back to their present value using the same kind of discounting approach that would be applied if the benefits were more immediate.

We advocate consistent discounting of choices both within and across generations. In particular, if the benefits for policies to current generations are discounted at some interest rate r, then consistent pol-

---

[44] One of the first discussions of irreversible environmental choice problems appears in Kenneth J. Arrow & Anthony C. Fisher, *Environmental Preservation, Uncertainty, and Irreversibility*, 88 Q.J. ECON. 312, 314-19 (1974).

[45] *See* IPCC, 2001 SYNTHESIS REPORT, *supra* note 8, at 8-14 (presenting data projecting gradual change over the next 100 years).

icy choices across time will continue to use that discount rate r in weighting the benefits at different points in time that occur to future generations.[46] Thus, policies will be based on the present value of their benefits and costs using some discount rate r that is identical for current and future generations.

This seemingly even-handed approach to weighting the benefits to future generations is not the only analytical strategy that one might pursue in converting future effects into their present value. One might, for example, use a preferential discount rate that is lower for future generations than for current generations.[47] In the extreme, this preferential rate could be zero, in which case there is no discounting of distant future effects. The rationale for advocating this approach is that use of a preferential discount rate will increase the weight given to future effects, which otherwise would be substantially reduced by the influence of discounting. While it is true that meaningful discounting will reduce future effects' present value, doing so is consistent with rational intertemporal choice. Moreover, from a political standpoint, decisions are being made by the present generation to expend resources to advance social welfare as they perceive it. If the people alive today express intertemporal preferences that are captured by some interest rate r, then they would have to be extremely altruistic with respect to future generations to use a lower discount rate for effects that benefit future generations but do not benefit themselves. Indeed, the full recognition of benefits to future generations according to their expected willingness to pay for these benefits already represents an enormous altruistic aspect of the policy assessment.

An intriguing counterexample to the conventional discounting approach is offered by Dean Richard Revesz.[48] Suppose there are two periods, generation 1 and generation 2. There are 100 units of a good to allocate across these periods, and there is no production. Suppose the preferences $U(x)$ for the good x are the same in each period and that the discount factor $(1/(1 + \text{interest rate}))$ is given by β, where β is less than 1.0. The standard economic prescription is to

---

[46] A more complete articulation of the approach we take here appears in W. Kip Viscusi, *Rational Discounting for Regulatory Analysis*, 74 U. CHI. L. REV. (Winter 2007).

[47] Intergenerational preferences are advocated in Richard L. Revesz, *Environmental Regulation, Cost-Benefit Analysis, and the Discounting of Human Lives*, 99 COLUM. L. REV. 941, 1015-16 (1999).

[48] This example, which is based on his Symposium comments, also appears in his article. *Id.* at 998-99.

choose the amount x consumed in period 1 to maximize the discounted utility over the two periods, or $U(x) + \beta U(100 - x)$. Because β is less than 1, it will be desirable to consume more than half of the good for period 1, leading to a solution such as 55 units for generation 1 and 45 units for generation 2.[49] Note that this discounted welfare maximization is quite different from the completely selfish generation 1 approach, which is to consume all 100 units in the first period.

Revesz suggests instead that the morally fair outcome is an even 50-50 split across the generations. This outcome is not only fair, but it is also efficient in a no-discounting world that maximizes $U(x) + U(100 - x)$. Note that if there is no discounting of effects for future generations, then a \$1 annual future environmental cost imposes an infinite loss and is sufficient to swamp any near-term concerns.[50]

For those who find this example compelling, suppose instead that there is a random 50-50 chance that you would live in generation 1 or generation 2. Then the allocation that maximizes your discounted expected utility is $0.5U(x) + 0.5\beta U(100 - x)$, which can be written as $0.5[U(x) + \beta U(100 - x)]$. Because the 0.5 factor simply alters the scale, it does not affect the division of the good across the two periods, so the earlier 55-45 split remains optimal. Equal division only becomes efficient if there is, in effect, no concern about time delay so that β equals 1.0.

The main debate should not be whether there should be a preferable discount rate, but whether, apart from discounting, there is full weight given to the preferences of future generations. Are we close to being in a world in which there is a 100-0 split across generations, so that future preferences simply are ignored? If that is the case, proper discounting of fully recognized future effects may offer a major advance toward the equalization of resource division advocated by scholars like Revesz.

These discounting issues pertain to the normative policy analysis use of discounting, but temporal preferences come into play from a behavioral standpoint as well. Because the political reality of choices is based on the preferences of present generations, we hypothesize that the greatest progress that might be made on the intertemporal

---

[49] We assume utility functions of the usual shape, implying decreasing marginal utility with positive first derivatives and negative second derivatives.

[50] For further discussion of the anomalies that arise from failure to discount, see Viscusi, *supra* note 46.

choice front would not be achieved by using a discount rate that is inconsistent with rational discount rates for present generations, but rather by focusing greater attention on the role of intertemporal irrationalities. Behavioral discounting anomalies may be of greater consequence than normative discounting policy assessment practices because they affect the level of public support for making current sacrifices to generate future benefits. A considerable literature has documented the influence of hyperbolic discounting.[51] The discount rates revealed through individual decisions often are not inconsistent over time, as they reflect an inconsistently high weighting on immediate benefits.

The study on water quality benefit valuation by Viscusi and Huber found that people place an enormous weight on water quality improvements that would occur immediately rather than in more distant years.[52] The survey considered water quality improvements that would occur in the current year or after a lag of two years, four years, or six years. The strong preference that people exhibited with respect to having the improvement occur now as opposed to after two years was reflected in the fact that the rate of interest r that they used to discount benefits after two years ranged from 12.7% to 14.3%.[53] There was a substantial undervaluation if benefits were deferred for a two-year period.[54] Subsequent delays were less disadvantaged relative to the two-year delay. Thus, for delays of four years or more, people had a rate of time preference ranging from 8% to just under 9%.[55] In terms of how intertemporal preferences affect policies, the biggest source of irrationality is in terms of the present versus any benefits that may occur in the future. Benefits that occur fifty years from now as opposed to twenty-five years from now are not especially hard hit.

---

[51] Among the many contributions to the hyperbolic discounting literature are: Shane Frederick, George Loewenstein & Ted O'Donoghue, *Time Discounting and Time Preference: A Critical Review*, 40 J. ECON. LIT. 351 (2002); David Laibson, *Golden Eggs and Hyperbolic Discounting*, 112 Q.J. ECON. 443 (1997); and R.H. Strotz, *Myopia and Inconsistency in Dynamic Utility Maximization*, 23 REV. ECON. STUD. 165 (1956).

[52] The discussion below and all empirical evidence are drawn from W. Kip Viscusi & Joel Huber, *Hyperbolic Discounting of Public Goods* (Nat'l Bureau of Econ. Research, Working Paper No. 11935, 2006), *available at* http://papers.nber.org/papers/w11935.pdf.

[53] *Id.* at 38.

[54] *Id.*

[55] *Id.*

Rather, it is simply the deferral of benefits that is most instrumental in driving the irrational preoccupation with immediate consequences.[56]

Because of the inordinate weight that people give to immediate effects, there will be a reluctance for the general public and for their representatives to incur current losses now to achieve distant benefits. Immediate effects receive full weight, indeed, an inordinate weight, compared to any deferred benefits. This intertemporal myopia will create a substantial bias against forward-looking policies. Environmental regulations that confer a near-term payoff will fare relatively well as compared to environmental regulations for which there is a time delay after the costs have occurred and before the benefits are experienced. Such a deficiency suggests that even if the public correctly valued the benefits and costs of global warming policies at different points in time, there would still be a substantial inadequacy in the public's willingness to support policy interventions because of the devaluation of all deferred benefits that increases because of hyperbolic discounting. The challenge for government policy is to overcome these and other irrationalities that have undermined a meaningful policy approach to managing the risks of global warming.

CONCLUSION

The climate change litigation has a much more tenuous economic basis than the cigarette litigation, notwithstanding some superficial parallels. The harms associated with global warming involve current and past actions, but the harms are largely prospective rather than current. The uncertain magnitude and timing of the harms complicate the analysis, but under the most optimistic scenario, it might be possible to develop a present value estimate of the expected damages associated with greenhouse gas emissions.

Unfortunately, these emissions cannot be traced to any particular inadequacy on the part of likely defendants in these cases. Pollution emissions involve an inherent externality that is associated with all common forms of energy usage. If there are a variety of competitors in a market, these problems simply cannot be addressed unilaterally. By definition, a competitive market implies that no individual firm can set prices; rather, prices are driven by the market. As a result, the option of raising prices to discourage energy usage is not a viable option for any particular firm. Similarly, providing information to consumers

---

[56] *Id.* at 26-28.

and other usual remedies of market failures will not suffice. The problem is not one of wrongful conduct on the part of the defendants but rather is that they are selling a good that inherently generates adverse environmental consequences.

A remedy for such environmental externalities situations is some form of government regulation or pollution tax. Ideally, we want all energy sources to reflect their full social costs. Energy taxes that account for the global warming damages could establish appropriate incentives. A substantial literature has explored the appropriate level of carbon taxes, for example.[57] Other types of restraints, such as pollution reduction targets, also could play a productive role. However, these all involve collective action rather than unilateral action by a particular firm.

Climate change litigation is not particularly well suited to establishing these incentives. A lump sum damages payment by energy companies will not alter market prices, production decisions, or consumption decisions. By definition, these lump sum costs are fixed. As a result, current behaviors will be unaffected due to the lack of any incentives pertaining to these behaviors. Consequently, if there is a settlement of climate change litigation that consists largely of a fixed damages payment, then this litigation will only serve the redistributive function of transferring money from energy producers to plaintiffs' attorneys but will not foster a reduction in greenhouse gas emissions.

What could promote such reductions is an energy tax, which could be implemented by structuring the settlement of the litigation appropriately. For example, the cigarette litigation settlement did not consist of a substantial lump sum payment. Rather, it embodied a formula that was roughly tantamount to a $0.40 per pack tax on cigarettes.[58] In much the same way, the settlement of the climate change litigation could impose an energy usage tax that would discourage consumption. There is, however, no guarantee that this would be the approach followed in structuring any damages amount for the litigation.

There is also a more fundamental concern about whether litigation is the appropriate venue for setting such tax levels. There is no assurance that the plaintiffs in these cases will seek tax equivalent penalty levels that reflect the marginal damages associated with the energy usage. The incentives of the plaintiffs are presumably to maximize

---

[57] *E.g.*, Boyd, Krutilla & Viscusi, *supra* note 6.

[58] VISCUSI, *supra* note 2, at 41.

their own welfare rather than to maximize social welfare. Rent-seeking behavior rather than social welfare maximization may be the driving force. Any resolution of the litigation will be driven by the private incentives in the negotiation between the plaintiffs and the defendants. In contrast, energy tax policy will be the result of collective political action in which the legislature, representing the citizenry, will vote to impose the tax that is reflective of society's preferences.

That there has been a policy failure to date does not necessarily imply that there will continue to be a policy failure in the future. The unwillingness of the United States to ratify the Kyoto Protocol perhaps reflects the substantial costs that would be involved in meeting the pollution reduction targets rather than a simple lack of concern with respect to climate change problems. The policy task is to develop public support for more aggressive global warming policies.[59] The appropriate remedy for the climate change policy failures is to improve these policies rather than to shift responsibility for government regulation to the courts.

---

[59] Indeed, the recent book and movie by former Vice President Gore might be viewed as a major contribution to that effort. AL GORE, AN INCONVENIENT TRUTH: THE PLANETARY EMERGENCY OF GLOBAL WARMING AND WHAT WE CAN DO ABOUT IT (2006); AN INCONVENIENT TRUTH (Paramount Pictures 2006).