Regulating Risk: The Cost-Effectiveness of Federal Efforts To Reduce Health and Safety Risks

Protecting and enhancing human health and welfare has long been an essential purpose of government. The Federal Government has, however, since World War II taken on an ever-expanding list of responsibilities focused on improving public health and reducing risks of death and injury.

As one means of accomplishing these goals, the Federal Government promulgates regulations that compel private parties, including State and local governments, to dedicate resources to the protection of health and safety. It regulates the discharge of pollution that may harm human health and the environment. It administers comprehensive regulatory programs to assure the safety of the food people eat and the pharmaceuticals that they rely on to make them well. It establishes extensive safety standards across the full range of transportation technologies, from automobiles and aircraft to roads and railways. From the shop floors where people work to the consumer products they use, the Federal Government has a visible and authoritative presence that is grounded on the conviction that life and health are highly valued resources.

This rapid expansion of Federal involvement in protecting public health and safety has not been achieved without cost. Indeed, the American people bear a burden that totals billions of dollars each year to obtain these benefits. Although attempts to measure the total costs and benefits of health and safety regulation are necessarily fraught with difficulty, the available estimates are instructive and sobering.

The recent study by Hahn and Hird, mentioned above, which attempted to pull together many individual benefit and cost estimates, places the costs of Federal health and safety regulation at between $78 billion and $107 billion as of 1988.[4] Because significant social costs were not counted in this estimate, it is primarily useful as a lower bound.[5]

Figure 1 summarizes the three major categories of aggregate costs and benefits assembled by Hahn and Hird. Logarithmic scales have been used on both the cost (horizontal) and benefit (vertical) axes. Thus, doubling the distance from the origin implies a tenfold increase in benefit or cost. The width of each rectangle represents the range in cost estimates; the height of each rectangle captures the range in benefit estimates.

The elongation of each rectangle indicates the relative magnitude of uncertainty in estimating aggregate benefits and costs. As can be seen from the height of the rectangles along the vertical or benefits axis in figure 1, this uncertainty is particularly great in estimating benefits. More accurate estimation requires the establishment of common units of measurement that enable risk-reduction benefits and costs to be compared across a range of options.

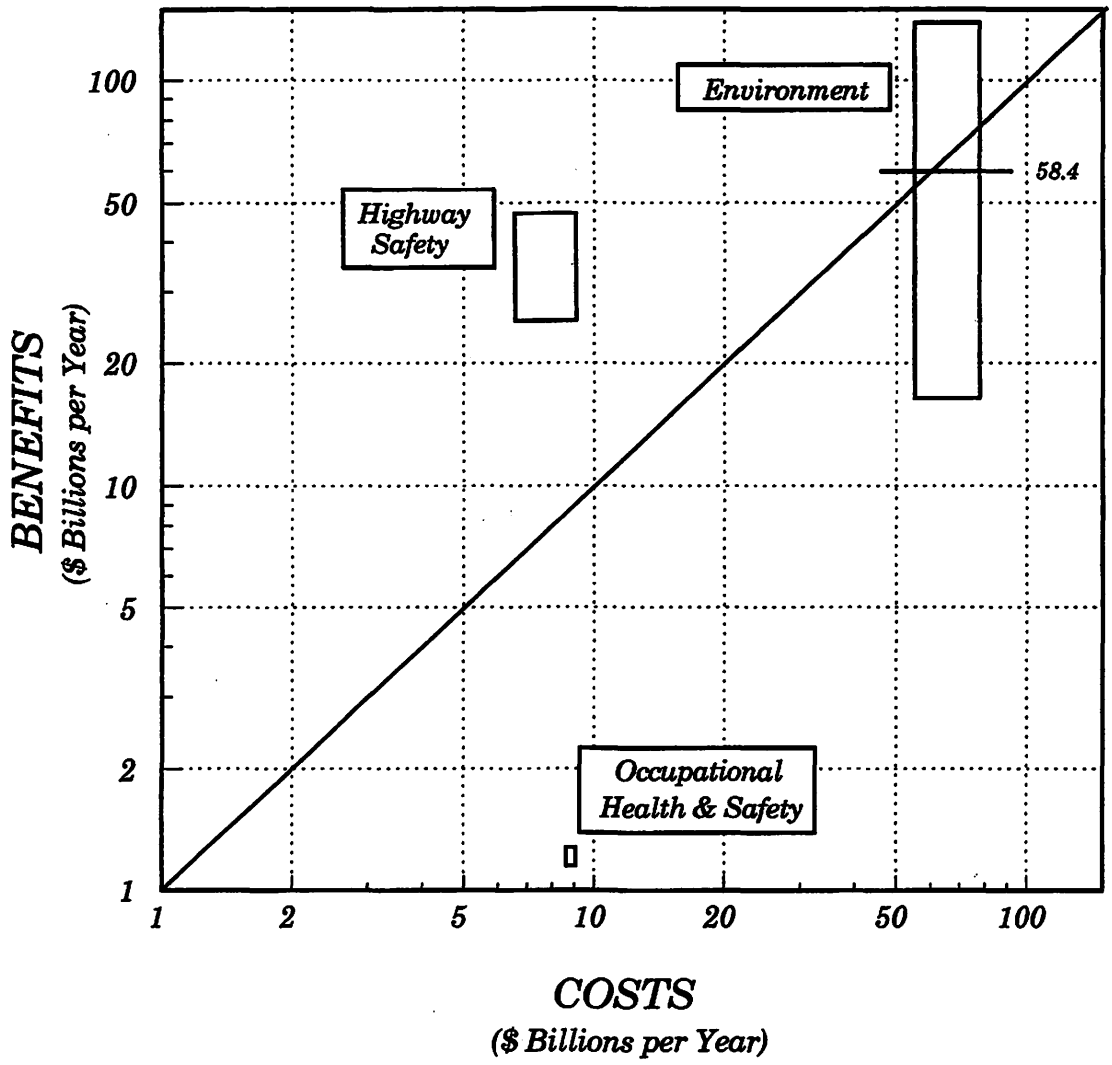
Figure 1 shows that highway safety regulation has, on average, provided substantially more benefits than costs. Hahn and Hird estimate benefits of $25 billion to $46 billion per year and costs of $6 billion to $9 billion per year. In contrast, Hahn and Hird estimate that regulations aimed at reducing occupational safety and health risks have imposed costs of about $9 billion per year, but offered negligible risk-reduction benefits. Hahn and Hird's results are mixed for environmental regulations. They estimate costs of $55 billion to $78 billion per year and annual benefits of $16 billion to $136 billion. The horizontal line in figure 1 represents Hahn and Hird's "best estimate" for annual benefits of $58.4 billion.

As the demands mount for ever-increasing levels of safety and new or expanded Federal program

[4] Robert W. Hahn and John A. Hird, "The Costs and Benefits of Regulation: Review and Synthesis," *Yale Journal on Regulation*, Vol. 8, No. 1 (Winter 1991), pp. 233–278. As noted above, Hahn and Hird estimate *total* costs of Federal regulation at between $327 billion and $401 billion. The costs of Federal health and safety regulation are, of course, a subset of these costs.

[5] Hahn and Hird offer several important caveats to guide the interpretation of these data. First, their cost estimates do not include the indirect effects of regulation on innovation, particularly where regulation mandates specified technologies instead of specified performance standards. Second, they recognize that the trend is toward increasing use of regulation to achieve health and safety objectives. Third, aggregation tends to conceal many regulations which do not appear to be cost-effective. *See* Hahn and Hird, op. cit., p. 259. In addition, the analysis by Hahn and Hird does not include certain important areas of safety regulation (e.g., airline travel) and health regulation (e.g., food additives). Hahn and Hird also acknowledge that their estimates for environmental regulation do not include hazardous waste site cleanup, nor do they include other major regulations under development (e.g., municipal solid waste landfill standards). *See* Hahn and Hird, op. cit., p. 254, especially footnote 79. Finally, their estimates necessarily exclude regulations expected under significant new statutory enactments (e.g., the Clean Air Act Amendments of 1990, the Americans With Disabilities Act). Hahn and Hird's estimates for environmental regulation differ considerably from other recent figures. For example, the Environmental Protection Agency recently estimated that the annual regulatory costs in the environmental sector alone amounted to $98 billion in 1987 (1990 dollars). EPA forecast annual costs to grow to $120 billion per year by 1990, and as much as $179 billion per year by 2000. *See* EPA, *Environmental Investments: The Cost of a Clean Environment* (July 1990 draft), p. ES-vi. EPA's cost estimate for 1987 exceeds Hahn and Hird's upper-bound cost estimate by $20 billion (26%).

Figure 1. Benefits and Costs of Federal Social Regulation



commitments, policymakers and the public alike have begun to ask whether the Nation's resources are being invested wisely. Responsible stewardship demands that the Government carefully examine its regulations to ensure that the American people obtain the best possible return on their investment. This means taking a hard look at the objectives of Federal regulations to verify that they are appropriate, and to strive to achieve these objectives in the most cost-effective manner.

This section analyzes the cost-effectiveness of a substantial number of Federal regulatory decisions. In this context, cost-effectiveness refers to the average amount of societal resources expended to obtain a fixed amount of societal benefit—in this case, the prevention of injuries and premature deaths. This review suggests that the cost-effectiveness of Federal regulation aimed at reducing human health risks varies enormously. These variations can be seen both across and within Federal agencies according to the nature of the risk regulated, and over time.

REASONS FOR GOVERNMENT INTERVENTION TO REDUCE RISK

Risk is an essential part of life. The rewards and penalties that flow from risk-taking are at the heart

of individual choice and the free market. Yet individuals, associations, corporations, and governments take a variety of actions in specific cases to reduce risks where they perceive the potential consequences of risk-taking to outweigh the benefits of choice and the costs of curtailing choice. Individuals may reduce cancer risks by choosing not to smoke, modifying their diets, living at sea level instead of in the mountains, or selecting occupations and workplaces that involve less exposure to carcinogenic substances. Similarly, transportation risks may be reduced by driving more cautiously or, at least for long distances, traveling by air instead. When people choose how and where they live, work, and play, they make implicit or explicit decisions concerning the risks they prefer to reduce or avoid. Businesses and other organized associations of individuals also take actions to avoid or mitigate risk. For example, companies often work to reduce occupational injuries and illnesses because both diminish productivity and profits.

Beyond these individual and corporate actions, government may be called upon to reduce or eliminate certain risks. Risks to health and life are important elements of some market settings, and systematic biases may exist that prevent or inhibit efficient risk-bearing decisions. Such "market failures" justify government intervention as long as government can do better than the imperfect marketplace.[6] Needless to say, citizens inevitably lose some degree of freedom to make their own choices when government acts to reduce risks. In addition, failures in private markets are more frequently alleged as reason for government intervention than is justified. Considerable analysis is generally necessary to verify claims of market failure, and to determine the form and extent of intervention that is most appropriate for solving the underlying problem.[7]

The Government also acts to reduce health and safety risks for reasons of equity. Society may decide that government intervention is justified to reduce certain risks because a disproportionate share of the burden falls on identified groups or individuals. Where individual mortality risks are exceptionally high, or where the costs of medical treatment are prohibitively expensive for individual citizens to bear, the public appears willing to share the burden through public funding. This may be particularly evident in cases where individuals face relatively high risks through no fault of their own. For example, the Government helps fund costly neonatal intensive care, burn, and trauma centers, in an effort to save particular lives, especially those of children.

COST-EFFECTIVENESS OF FEDERAL REGULATIONS AIMED AT REDUCING HEALTH AND SAFETY RISKS

In the Fiscal 1992 Budget, table C–2 listed 53 regulatory actions dating back to 1970. For each regulatory action, the baseline risk was identified, measured as the probability of a fatality per million persons exposed, as well as the cost per premature death prevented.[8] For convenience, this table is reproduced here as table 2.

The table shows that the cost-effectiveness for the regulatory actions listed varies over more than *eight orders of magnitude*, from about $100,000 (for certain automotive safety features) to more than $5 *trillion* per premature death prevented (for treating wood-preserving chemicals as hazardous wastes).[9] While the regulatory actions captured in table 2 are not a random selection of Federal regulatory decisions, they illustrate the inconsistency of current Federal risk-management practices. On average, spending $2

[6] The traditional comparison has been between an *imperfect* marketplace and a *perfect* government program. This bias often leads to an unjustified preference for government intervention. See Charles Wolf, Jr., *Markets or Governments?* (Cambridge, Mass.: MIT Press, 1988).

[7] It is important to distinguish between genuine instances of market failure and situations in which the mere presence of health and safety risk is alleged to be evidence of such a failure. The existence of risk is evidence of market failure only in the rare instance where properly functioning markets would have resulted in zero risk. The presence of risk also may be a convenient lever for special-interest groups to manipulate for purposes other than genuine societal risk reduction. Government intervention provides an alternative mechanism to generate private rewards which cannot be sustained through unfettered market transactions.

[8] Many of these regulations offered other health and safety benefits, such as reduced cases of illness or injury. Failing to adjust for illnesses and injuries would cause cost-effectiveness ratios to be biased upward. Thus, illnesses or injuries with fatalities were aggregated to obtain a composite nonmonetized measure of health benefits. All statistical cancer cases were treated as fatalities, which biases the cost-effectiveness ratios downward. Survival rates from cancer vary considerably across cancer types and sites, and according to the stage at which it is detected. See General Accounting Office, *Cancer Patient Survival: What Progress Has Been Made?*, GAO/PMED–87–13, March 1987, table 4.1.

[9] All cost-effectiveness ratios provided are in constant 1990 dollars. These estimates can be compared to what can be discerned from individual behavior concerning the willingness-to-pay for risk avoidance. A recent survey of this literature found estimates ranging from $1.6 million to $8.5 million per statistical death prevented. The authors placed more confidence in the estimates at the lower end of this range. See Ann Fisher, Lauraine G. Chestnut, and Daniel M. Violette, "The Value of Reducing Risks of Death: A Note on the New Evidence," *Journal of Policy Analysis and Management*, vol. 8, no. 1 (1989), pp. 88–100.

million today on highway safety would save at least one life in just a few years. However, the same amount spent regulating the cancer risks posed by wood preserving only prevents one cancer case every 2.9 million years.

Analysis of these data reveal several interesting and provocative features that are missing from the aggregate estimates presented in figure 1.

Variations by Regulatory Agency

Figure 2 shows how the cost-effectiveness of Federal regulations varies by agency.[10] Safety regulations promulgated by the major Department of Transportation (DOT) regulatory agencies—the Federal Aviation Administration (FAA) and the National Highway Traffic Safety Administration (NHTSA)—have remained consistently below $5 million per premature death prevented. In addition, there is no apparent trend in the cost-effectiveness of rules from these agencies over the past 20 years.

In contrast, regulations promulgated by the Environmental Protection Agency (EPA) and the health standards division of the Occupational Safety and Health Administration (OSHA) are considerably more costly per unit of social benefit obtained. Many of these regulations have cost-effectiveness ratios in the tens of millions per premature death prevented; some have cost-effectiveness ratios that are well into the billions. Furthermore, for both agencies, the trend is clearly upward. Prior to 1985, only one regulatory action from table 2 imposed costs in the neighborhood of $100 million per statistical life saved. Since that date, however, eight significant regulatory actions have exceeded this threshold.

Variations by Type of Risk

Figure 3 shows that when regulatory actions are separated into health and safety categories, the disparity in cost-effectiveness between the categories becomes self-evident.[11] Regulatory actions aimed at reducing safety hazards (represented in figure 3 with open circles) have consistently remained below $10 million per premature death avoided. There are many recent safety regulations that have stayed below the $1 million threshold. However, health-related regulations (represented by solid squares) have consistently imposed higher costs per unit of risk reduction obtained. There is no discernible trend over time for safety-related regulations, but cost-effectiveness ratios appear to have risen significantly for regulations aimed at reducing occupational and environmental health risks.

Finally, it is worth noting that Federal risk-management priorities display a powerful bias toward reducing certain health risks. The scientific evidence strongly suggests that cancer risks from environmental exposures (excluding smoking) are very small relative to other threats to human health. Nevertheless, about half of the significant regulations listed in table 2 (and a much larger percentage of the most expensive actions) are aimed at reducing these very small cancer risks. None of these regulations involves a natural hazard.

From these data, it appears that safety regulation is far more cost-effective at reducing threats to life than regulations directed toward health-related mortality risks—especially cancer risks plausibly attributed to occupational or environmental exposure. If these regulations are representative, aggregate mortality risk would be substantially reduced at considerably less cost by shifting the Federal Government's regulatory focus away from relatively small occupational and environmental cancer, threats toward other health risks and causes of injury.

NEED FOR MORE CAREFUL CONSIDERATION OF COST-EFFECTIVENESS

Cost-effectiveness provides a useful way to compare regulatory actions to determine the extent to which the American people are getting their money's worth from the investments they make in reducing health and safety risks. It is not intended to be an all-purpose arbiter of decisionmaking; there is no magic cost-effectiveness threshold beyond which regulatory actions should be automatically rejected.

Nevertheless, cost-effectiveness analysis forces policmakers and the general public to consider carefully the regulatory choices made by Government. Decisions that have high costs per unit of benefit received deserve careful scrutiny to ensure that the societal benefits obtained are reasonable given the investments that must be made to achieve them. It is in the interest of both the Federal Government and the American people which it serves that costs mandated by Government—like taxes—be reserved for cases where these costs are most warranted.

[10] The vertical axis of the figure incorporates a logarithmic scale. This means that each unit increase in height implies a *tenfold* increase in social cost per premature death prevented.

[11] As before, the vertical axis of the figure incorporates a logarithmic scale. Each incremental increase in height implies a *tenfold* increase in social cost per premature death prevented.

Table 2. Risks and Cost-Effectiveness of Selected Regulations
[From the Budget for Fiscal Year 1992—Table C–2, Part 2, p. 370]

Regulation[1]	Year Issued	Health or Safety?	Agency	Baseline Mortality Risk per Million Exposed	Cost per Premature Death Averted ($Millions 1990)
Unvented Space Heater Ban	1980	S	CPSC	1,890	0.1
Aircraft Cabin Fire Protection Standard	1985	S	FAA	5	0.1
Auto Passive Restraint/Seat Belt Standards	1984	S	NHTSA	6,370	0.1
Steering Column Protection Standard[2]	1967	S	NHTSA	385	0.1
Underground Construction Standards[3]	1989	S	OSHA–S	38,700	0.1
Trihalomethane Drinking Water Standards	1979	H	EPA	420	0.2
Aircraft Seat Cushion Flammability Standard	1984	S	FAA	11	0.4
Alcohol and Drug Control Standards[3]	1985	H	FRA	81	0.4
Auto Fuel-System Integrity Standard	1975	S	NHTSA	343	0.4
Standards for Servicing Auto Wheel Rims[3]	1984	S	OSHA–S	630	0.4
Aircraft Floor Emergency Lighting Standard	1984	S	FAA	2	0.6
Concrete & Masonry Construction Standards[3]	1988	S	OSHA–S	630	0.6
Crane Suspended Personnel Platform Standard	1988	S	OSHA–S	81,000	0.7
Passive Restraints for Trucks & Buses (Proposed)	1989	S	NHTSA	6,370	0.7
Side-Impact Standards for Autos (Dynamic)	1990	S	NHTSA	NA	0.8
Children's Sleepwear Flammability Ban[4]	1973	S	CPSC	29	0.8
Auto Side Door Support Standards	1970	S	NHTSA	2,520	0.8
Low-Altitude Windshear Equipment & Training Standards	1988	S	FAA	NA	1.3
Electrical Equipment Standards (Metal Mines)	1970	S	MSHA	NA	1.4
Trenching and Excavation Standards[3]	1989	S	OSHA–S	14,310	1.5
Traffic Alert and Collision Avoidance (TCAS) Systems	1988	S	FAA	NA	1.5
Hazard Communication Standard[3]	1983	S	OSHA–S	1,800	1.6
Side-Impact Stds for Trucks, Buses, and MPVs (Proposed)	1989	S	NHTSA	NA	2.2
Grain Dust Explosion Prevention Standards[3]	1987	S	OSHA–S	9,450	2.8
Rear Lap/Shoulder Belts for Autos	1989	S	NHTSA	NA	3.2
Standards for Radionuclides in Uranium Mines[3]	1984	H	EPA	6,300	3.4
Benzene NESHAP (Original: Fugitive Emissions)	1984	H	EPA	1,470	3.4
Ethylene Dibromide Drinking Water Standard	1991	H	EPA	NA	5.7
Benzene NESHAP (Revised: Coke Byproducts)[3]	1988	H	EPA	NA	6.1
Asbestos Occupational Exposure Limit[3]	1972	H	OSHA–H	3,015	8.3
Benzene Occupational Exposure Limit[3]	1987	H	OSHA–H	39,600	8.9
Electrical Equipment Standards (Coal Mines)[3]	1970	S	MSHA	NA	9.2
Arsenic Emission Standards for Glass Plants	1986	H	EPA	2,660	13.5
Ethylene Oxide Occupational Exposure Limit[3]	1984	H	OSHA–H	1,980	20.5
Arsenic/Copper NESHAP	1986	H	EPA	63,000	23.0
Haz Waste Listing for Petroleum Refining Sludge	1990	H	EPA	210	27.6
Cover/Move Uranium Mill Tailings (Inactive Sites)	1983	H	EPA	30,100	31.7
Benzene NESHAP (Revised: Transfer Operations)	1990	H	EPA	NA	32.9
Cover/Move Uranium Mill Tailings (Active Sites)	1983	H	EPA	30,100	45.0
Acrylonitrile Occupational Exposure Limit[3]	1978	H	OSHA–H	42,300	51.5
Coke Ovens Occupational Exposure Limit[3]	1976	H	OSHA–H	7,200	63.5
Lockout/Tagout[3]	1989	S	OSHA–S	4	70.9
Asbestos Occupational Exposure Limit[3]	1986	H	OSHA–H	3,015	74.0
Arsenic Occupational Exposure Limit[3]	1978	H	OSHA–H	14,800	106.9
Asbestos Ban	1989	H	EPA	NA	110.7
Diethylstilbestrol (DES) Cattlefeed Ban	1979	H	FDA	22	124.8
Benzene NESHAP (Revised: Waste Operations)	1990	H	EPA	NA	168.2
1,2-Dichloropropane Drinking Water Standard	1991	H	EPA	NA	653.0
Haz Waste Land Disposal Ban (1st 3rd)	1988	H	EPA	2	4,190.4
Municipal Solid Waste Landfill Standards (Proposed)	1988	H	EPA	<1	19,107.0
Formaldehyde Occupational Exposure Limit[3]	1987	H	OSHA–H	31	86,201.8
Atrazine/Alachlor Drinking Water Standard	1991	H	EPA	NA	92,069.7
Haz Waste Listing for Wood-Preserving Chemicals	1990	H	EPA	<1	5,700,000.0

[1] 70-year lifetime exposure assumed unless otherwise specified.
[2] 50-year lifetime exposure.
[3] 45-year lifetime exposure.
[4] 12-year exposure period.
NA=Not available.

Agency Abreviations. CPSC: Consumer Product Safety Commission; MSHA: Mine Safety and Health Administration; EPA: Environmental Protection Agency; NHTSA: National Highway Traffic Safety Administration; FAA: Federal Aviation Administration; FRA: Federal Railroad Administration; FDA: Food and Drug Administration; OSHA–H: Occupational Safety and Health Administration, Health Standards; OSHA–S: Occupational Safety and Health Administration, Safety Standards.

Source: John F. Morrall, III, "A Review of the Record," *Regulation*, Vol. 10, No. 2 (1986), p. 30. Updated by the Author, et. al.

Figure 2. Cost-Effectiveness of Selected Federal Regulations by Year of Promulgation by Agency

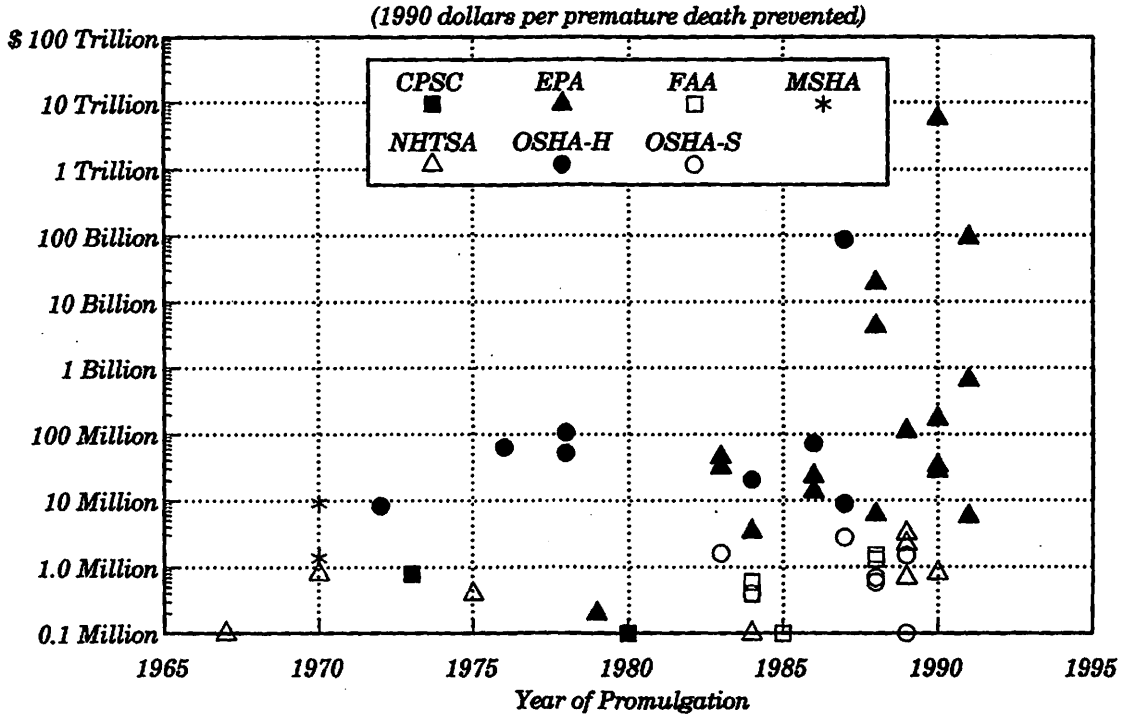


Figure 3. Cost-Effectiveness of Selected Federal Regulations by Year of Promulgation by Type of Risk