Our Doctrinal Disability: How Pollution Control Efforts Are Handicapped by Theory

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For more than a generation economic doctrine has dominated analysis of pollution problems. Presented as a set of postulates and illustrated appealingly in one or more "thought experiments," the doctrine has come to be taken as self-evident by its adherents and accepted as a foundation for policy-making by many more.[1] With so many environmental problems before us now, it is a good time to ask whether the doctrine is correct. Specifically, has it correctly assessed the cause of pollution, and has it based its remedies upon that assessment? We will consider these questions first logically, then empirically.

1. The Ontological Argument

The explanation economics has postulated as the cause of environmental pollution is expressed through the theory of market failure. Under this construct, markets are presumed to operate optimally except when specific, enumerated conditions causing market failure are present. On the list, pollution is attributed principally to "externalities," a concept developed from the work of A. C. Pigou in *The Economics of Welfare* in the 1920s.[2] The mechanism that produces pollution, according to externality theory, is quite simple: pollution occurs because people act on their incentive to pollute. The incentive results from their ability to pass onto others the cost of their pollution, to which they are indifferent because it has no direct cost to themselves.[3] As costs that are passed by the cost-causer onto others, they have come to be called “externalities.” Externalities are considered undesirable, and therefore in theory a market failure, when they cause the outcome to be sub-optimal, that is, when maximum value is not achieved.[4] The remedy economists have traditionally prescribed for market failure follows logically — to reverse that condition by forcing the economic actor to "internalize the externality." This is accomplished by imposing certain taxes or fees (known as "Pigouvian remedies") that cause the activity which resulted in the pollution to price at its full cost and thereby eliminate the incentive.[5] These fundamental premises have become standard for economics textbooks.

In 1960, with Pigou's analysis already widely accepted, the theory was critiqued by Ronald Coase. Coase's well known article, "The Problem of Social Cost,"[6] argued that Pigou had failed to take into account the reciprocality of the problem — that both the emitter and the receptor have stakes in the outcome, and that in consequence it is not necessarily the emitting (i.e., externalizing) party whose behavior needs correcting. Thus, the right answer comes not by designating one party as being in the wrong but by resolving disputes in favor of the outcome that creates the greatest economic efficiency.[7] Coase argued that if transaction costs were low enough the parties could resolve the externality between themselves, which would achieve an optimal result more often than using Pigouvian remedies. Coase's insight (thereafter given the name "Coase Theorem"[8]) was an astute observation, but it was strictly downstream. That is, it focused on finding the right remedy but did not challenge the fundamental

premises of the model — that the starting point for analysis is market failure, that a market failure is defined as inefficiency, and that the malady underlying the inefficiency is the presence of an incentive to pollute. Moreover, to illustrate his points Coase used variants of the same set of hypothetical examples that Pigou had used.[9] Fundamentally, then, the Coasian approach remains a creature of the traditional market-failure/externalities model. Thus, there is a single model with two variants that share its fundamental premises.

The theory is very neat and tidy, but it comes apart quickly when one considers a simple proposition. As a construct that seeks to identify the factor that leads to pollution, the model must contain a variable, for it must explain not only when and why pollution occurs but also when and why pollution does not. This it seeks to do by tying the occurrence or non-occurrence of pollution directly to the existence or non-existence of the incentive to externalize. It thus sets up the incentive as the independent variable and pollution as the dependent variable. But on reflection one will recognize that the incentive to externalize is more like a constant than a variable, for incentives to externalize are almost universal. Indeed, it is difficult to imagine when, in the absence of constraint, an economic actor would not have — or could not rearrange things to produce — an incentive to externalize. An economic actor may decline to follow the incentive or be restrained from taking action on it, but the incentive is hardly ever lacking. Thus, if taken to its literal and logical end the model systematically over-predicts pollution, for in tying pollution to a near-constant it forecasts more pollution than actually occurs. As much pollution as we see now, the world described by theory would contain much more.

This flaw can be illustrated by a parallel example. If one were to hypothesize that the cause of criminal behavior among young adults is drinking milk as children, and we all agree that (at least in North America) virtually all criminals drank milk as children, would that hypothesis be proved correct? Certainly not, for the non-criminals also drank milk. Given the widespread consumption of milk by children, if the association of milk-drinking with crime were correct then many if not most of the children would have grown up to be criminals. But since that did not happen we must find the hypothesis to be false. Likewise, while one finds incentives to externalize where pollution occurs, one also finds incentives to externalize where pollution does not. Thus, incentives do not account for the non-pollution, nor, as a result, for the pollution. The two cases are entirely parallel, except for the fact that the widespread drinking of milk by children is easily recognized while the widespread existence of incentives to externalize is easily overlooked, especially in a thought experiment.

From this it is clear that the possibilities go beyond those contemplated by the theoretical model. The best way to sort these out is by building a table that maps them categorically. Because the theory is presented as the association of two factors — incentives and externalities — we will represent the possibilities as a simple two-by-two proposition.

Table 1. Associating Externalities with Incentives — The Four Logical Possibilities

is there incentive to externalize?	**does externality (pollution) occur?**	
	No	**yes**
Yes	**2-** pollution does not occur where an incentive to pollute is present — *not contemplated by theory, assumed to be a null set; but in fact it is populated*	**1-** pollution occurs where incentives are present, as postulated by theory
No	**3-** pollution does not occur where no incentives are present, as postulated by theory	**4-** pollution occurs where no incentive to pollute is present — *not contemplated by theory, assumed to be a null set; but in fact it is populated*

In Table 1 we see that the model's central premise — that pollution occurs where there are incentives and doesn't occur where there aren't — contemplates only Cells 1 and 3. And of those two cases we hear little about Cell 3, which if mentioned at all is explained as the logical counterpart to Cell 1. Once that possibility has been accounted for, the next step in environmental economics is to examine relationships that take place within Cell 1, which thereafter become the entire focus of concern.

As the model takes into account only Cells 1 and 3, how shall we regard the two remaining Cells, 2 and 4?

Our critique so far has focused on Cell 2. As we have observed, theory's association of pollution with incentives, and non-pollution with non-incentives, does not contemplate the possibility that pollution might not occur where incentives are present. But, as we have noted, many opportunities to pollute are refrained from, resulting in the non-occurrence of pollution despite the presence of incentives. Thus, while Cell 2 has been treated in theory as a null set, it is actually populated. The possibility of pollution not occurring where an incentive to pollute is present is an anomaly that the theory cannot abide, for nothing in the theory accounts for it.

Then what about Cell 4? While it was stated above that incentives to externalize are almost universal, that is not an absolute, especially in a dynamic economy. It is thus possible to find situations where there is no incentive to pollute, or even incentives to not pollute, and yet pollution does occur. At first that may seem counter-intuitive, for what it asserts is that it would be cheaper not to pollute but firms pollute nevertheless. In fact, as environmental advocates love to point out, firms actually pollute even when their private costs in doing so exceed their private benefits. Thus, while Cell 4 has been treated in theory as a null set, it too is actually populated, creating once again an anomaly that theory can neither abide nor account for.

Thus, each of the four logical possibilities represents a reality that actually occurs, though economic theory acknowledges only two of them and focuses on only one. Accordingly, the cell from the

Table that remains for economic analysis after the other three are put aside, and which becomes the logical zone in which economic analysis is conducted, is Cell 1.

If one permits a little imagination one will see what it means to say that Cell 1 is the logical zone in which economic analysis is conducted. If Cell 1's lower and left-hand boundaries are treated as the *x* and *y* axes, respectively, with numeric values assigned to them, then quantitative analysis of such relationships within Cell 1 becomes possible.[10] Thus, the analytical exercise of environmental economics with which we are all familiar is nothing more than a quantification that takes place within the logical assumptions portrayed in the Table.[11]

But that is to accept the constraints imposed by theory. Given our finding that all four cells of the Table represent meaningful possibilities, we are required to consider the Table in its entirety. When transformed for quantitative purposes, the four cells would create the four quadrants of the familiar Cartesian plane. Such a construct would force analysts to reconsider the normal practice of plotting variables as positive values on the *x* and *y* axes. Thus, while conventional economic analysis looks only at Quadrant 1 of the plane, in which incentives and outcomes (represented as costs and benefits, or the marginal damage function and marginal abatement cost) always have values greater than zero, one would have to address the question, could any of these values actually be less than zero?[12] that is, would a true representation of these variables be plotted in Quadrant 4? In fact, we have actually seen this occur in our own time.[13]

In sum, a logical walk through the possibilities finds that pollution both occurs and does not occur where there are incentives, and it both occurs and does not occur where there are not incentives. Given the theory's recognition of only two of those four cases, and its focus on only one, we must conclude that pollution causality has dimensions that go beyond those contemplated by the theoretical model, indicating that it is fundamentally flawed. In the final analysis, it does not posit a mechanism to determine whether there will be pollution.

2. The Empirical Case

Our consideration of the model up to this point has addressed its tenets in the form that they are advanced — as hypotheses evaluated logically within a thought experiment. While we have found non-trivial anomalies, it might be argued that these could be overcome by tweaking theory to make the model accommodate these additional considerations.

Tweaking in a vacuum will not suffice. The problems in the model we have identified so far result generally from the failure of theory to consider the actual conditions that give rise to pollution. Given its reliance on assumptions, no reconsideration that does not examine actual experience will satisfy.

Accordingly, we now test the theory on an empirical basis. As a case study, we will examine a pollution controversy that was contemporaneous with the formulation of externalities theory in the 1920s. This concerns tetraethyl lead, the lead additive used in gasoline in the U.S. from 1923 to 1995.

Case study: The Surgeon General and tetraethyl lead. In December 1921 the General Motors ("GM") Research Corp. discovered that an obscure compound, tetraethyl lead, when added to gasoline, was incredibly effective as an antiknock. For GM and its chief shareholder, E. I. du Pont de Nemours & Co., this held tremendous profit potential.[14]

From the beginning GM was concerned about the toxic implications. On March 13, 1922, GM contacted Dr. Yandell Henderson of Yale to ask his assistance. Dr. Henderson had designed the gas masks used by American troops in World War I and had worked on determining the safe level of carbon monoxide in the Holland Tunnel. GM hoped he would work on its behalf to "refute false propaganda," but Henderson did not go along with GM's plan. He already knew of tetraethyl lead as a proposed chemical weapon, and he was appalled by the prospect that it might be used commercially. He and GM did not come to terms, but failure to resolve the public health issue did not stop GM from going forward. In February 1923, anxious to get its new gasoline additive on the market, but with only minimal controls in place for preventing lead exposure, GM first sold leaded gasoline to the public.

The hazards of tetraethyl lead first came to the public's attention in October 1924, when five tetraethyl lead workers at Standard Oil's refinery in Bayway, New Jersey died and several dozen more were seriously injured. News accounts raised broader concerns about possible hazards to the public in the ambient setting, specifically whether lead exhausted from cars would accumulate and present a general public health hazard.

After much debate over the health risks the parties turned to U.S. Surgeon General Hugh Cumming, who convened a conference on May 20, 1925 to obtain the views of a broad set of parties. Dr. Henderson raised his concerns, but they were overridden by the argument made by Dr. Robert Kehoe, the expert GM had ultimately hired. Dr. Kehoe gave what would be the most decisive statement of the day, promising on behalf of the proprietors of gasoline lead additive that they would withdraw it from the market if it were shown to be an actual danger; but absent a showing of danger, based on facts rather than opinions, the fuel efficiency and conservation benefits should not be sacrificed.[15]

Ultimately, it was Dr. Kehoe's statement that guided the outcome, for contained within it was a decision rule — which I call "the Kehoe Rule"[16] — designed to produce a decision, despite the uncertainties, using a crude cost-benefit analysis. Taking the proprietors up on their offer, the conference attendees turned over the fact-finding to a committee of seven experts, to be appointed by the Surgeon General. By discounting hazards that could not be immediately proved, the Committee reported in January 1926 that it could find "no good grounds for prohibiting" leaded gasoline. Misinterpreting this to be an affirmative finding of the absence of toxicity, rather than the product of a decision rule, the press gave leaded gasoline a "clean bill of health."[17] GM resumed the sale of leaded gasoline on May 1, 1926.

Following the Surgeon General's review of lead in the U.S., other countries took action, including Great Britain, which conducted a more extensive review lasting from early 1928 to early 1930.[18] This put an end to the controversy, as its findings seemed to confirm those already reached in America.

Significance of the Surgeon General's review. The Surgeon General's review of tetraethyl lead was significant in several respects.

Analytically, leaded gasoline presented a novel pollution/public health scenario, introducing a human exposure that was:

(1) industrial- involving a product or condition that was neither naturally occurring nor produced by traditional or agrarian technologies;
(2) chemical- involving a substance whose effects resulted mainly from its chemical rather than its physical properties;
(3) toxicological- involving an agent whose harms were experienced as specific health effects, rather than as hygienic conditions that were merely unhealthful or unsanitary; *and*

(4) ambient- involving a pollutant whose exposure pathways were through the ambient media.[19]

It is this combination of four characteristics that defines a modern environmental health problem as distinct from traditional pollution problems. Historically, scenarios had contained as many as three of these characteristics, but not all four. For example, by 1900 urban smoke had become industrial and ambient, but it was considered neither chemical nor toxicological. And the use of toxic substances in the workplace was industrial, chemical and toxicological, but it was not ambient. Leaded gasoline introduced a pollution scenario that for the first time presented all four of these characteristics. Accordingly, the Surgeon General's review of lead was the first-ever federal review of a modern environmental health hazard.

Among these four characteristics it was the fact that the use of leaded gasoline was both toxicological and ambient that gave the scenario novel public health implications:

(1) because the hazard was ambient, (a) large numbers of individuals could be exposed; (b) the emissions would suffuse an entire area, so that individuals had no easy escape from involuntary exposure; and (c) the connection of those exposed was indirect and potentially remote temporally and causally from the emission source; and
(2) because the effects were toxicological, assessing the impacts required predicting unknown and never-before-experienced health effects.

Such a combination presented new challenges, for when brought together these two characteristics produced a high degree of uncertainty. By contrast with traditional smoke nuisances, in which the causes and effects, costs and benefits were visible and in close proximity, in this new scenario nothing was easily defined.

The appearance of a scenario in which the exposure hat was both toxicological and ambient was unanticipated. No one had considered how to address a scenario having both characteristics, as the occasion had not arisen.[20] It was very clear from testimony given at the Surgeon General's hearing that this presented an unprecedented institutional challenge. Given the scientific uncertainty inherent in the scenario, traditional common law private remedies could not provide adequate deterrence, for the uncertainty would significantly discount claims for damages. Nor did the Surgeon General have regulatory authority, and states which did have authority did not have policies in place to address such a scenario. In the absence of preexisting policies or institutions to define the appropriate response, remedies to address this new class of hazard had to be created ad hoc.

It was for this reason that a decision rule was necessary, for a decision could not be made on a factual basis, as the facts remained uncertain. Thus, the Kehoe Rule was devised as a doctrinal means to resolve the question, and here again uncertainty was key. It appeared to operate as a balancing of factors, a sort of crude cost-benefit analysis, but in fact what drove the outcome was the uncertainty factor. In resolving the Surgeon General's proceedings no party made any attempt to quantify the values used in the balancing, but that didn't seem necessary because the economic benefits of leaded gasoline (whatever they were) appeared to be highly certain, while the environmental health costs (whatever they were) appeared to be highly uncertain, indeed, hypothetical. Thus, it was the comparison of relative certainties, rather than a comparison of economic values (which were never calculated), that actually yielded the decision. Given that comparison, going to the trouble of actually finding numbers to assign to these factors seemed unnecessary. In a comparison of the certainties the answer seemed easy and obvious. Under the Kehoe Rule there was little reason to ever determine the true consequences of the decision it governed.

Though Surgeon General Cumming wrote no decision document, and though the regulations

issued for the control of tetraethyl lead were never adopted as law, the principles used in resolving it stuck. As a case of first impression the principles adopted therein stood alone as the single approved approach, and because a wide variety of industry and public health officials had participated in its creation it was an approach that had broad acceptance. Over the next several decades the principles developed there became deeply rooted in the practices of American companies, not only for tetraethyl lead but for any industrial product that had toxic properties. While the Surgeon General's review of tetraethyl lead itself would be almost entirely forgotten, its principles would be taught as accepted doctrine in public health programs and internalized by the industries. Ultimately, as the Surgeon General's review receded over the historical horizon, its practitioners came to regard its principles as natural and inevitable, and not the product of a specific event. As a result, when new modern environmental controversies appeared decades later, both the state of forgottenness and the institutional legacy would manifest themselves: the controversies themselves seemed new, but the remedies the industries advocated for them seemed (to them at least) to be as easy and obvious as if they derived from natural law. Being both toxicological and ambient they had the same nature as the tetraethyl lead scenario. But by then no one realized that the accepted remedies advocated by the industries had been decided into place, and not evolved into place.

It is natural that the characteristics of such a scenario would appear with tetraethyl lead for the first time, for its intersection of chemistry, petroleum, and the internal combustion engine gave it several hallmarks of a Second-Industrial-Revolution technology. The pollution scenario it introduced was categorically different from pollution scenarios (such as traditional smokes and stenches) that resulted from First-Industrial-Revolution technologies. Thus, it is fitting that the Surgeon General's review of tetraethyl lead was the first-ever federal review of a modern environmental health hazard. In consequence of its intersection of key technologies and its role in developing the institutions to address this new class of hazard, tetraethyl lead is the archetypal Second-Industrial-Revolution pollutant.

The significance of the tetraethyl lead case to economic theory. What is striking about the story of tetraethyl lead is that there is so much in its history that is not captured by theory. For example, the market failure/externalities model gives little significance to public opinion, though that was a significant motive in GM's decisions to assent to controls. Nor does the model give significance to the influence of doctrine in both deciding the controversy and determining the treatment of such public health scenarios in the future. If one is seeking an explanation for the cause of pollution one would want to account for variables as important as these.

But even these difficulties are minor by comparison with the handicap placed on decision-making because of the model's orientation toward traditional environmental problems. When the model is applied to modern environmental problems one finds it requiring inputs that cannot be easily generated, a situation that favors certain parties. In this way, the Kehoe Rule is still with us. This is not an extrinsic or occasional occurrence, it is an endemic and persistent dilemma. Thus, one must conclude that in its present form the market-failure/externalities model, in addition to its logical flaws, is poorly tailored to modern environmental health problems, as we have defined them here.

The failure of the model to capture important features of the phenomenon becomes significant when one compares the historical and doctrinal timelines. Putting the timelines of economic theory and technological development side by side, one finds that even after the first modern environmental health controversy had occurred (i.e., regarding tetraethyl lead) economic theory was still occupied with conceptualizing the pollution problems of the previous era — 19th Century smoke nuisances. Thus, by the time Pigou published his last edition (1932) the conditions it described had already been superseded by a new pollution scenario it did not contemplate and for which its premises were poorly adapted. Having failed to address issues already in controversy, it was in part obsolete at the time it was

formulated. And thirty years later, though Coase advanced the analysis with his critique of Pigouvian remedies, theory remained locked in the same conceptual framework that had become, by then, decades obsolete.[21] Neither Pigou nor Coase grasped the idea that pollution problems arising in the Second Industrial Revolution had dimensions that were not considered in their analyses.

What this tells us is that the deficiencies in the market failure/externalities model are not only logical but chronological.

The failure of theory to grasp the dimensions of the problem became evident in the *American Trucking* case, in which American Trucking ("ATA"), a trade association, appealed the new particulate standards issued by the U.S. Environmental Protection Agency under Section 109 of the Clean Air Act. ATA argued that EPA's issuance of the new rules was irrational, hence unconstitutional. Of great interest was that a group of economists filed an amicus brief in the case arguing that the EPA decision was "unsound" because it was not made according to the principles of economics.[22] What the economists failed to recognize was that one of the underlying purposes of Section 109 of the Act was to insulate medical judgments from interference by economic considerations, especially those deliberately placed there by interested parties. In effect, Section 109 was part of Congress' effort to reverse the failed regime put in place by the Surgeon General in 1926.[23] In the end the economists' amicus effort came to nothing, but it remains today as a symbol of adherence to doctrine in disregard of the institutional dynamics that cause pollution to occur.

3. Conclusions

Logic and history compel the finding that the market-failure/externalities model, while descriptive in part, does not account for the cause of pollution as a whole. Indeed, it is framed by theory in terms that apply better to traditional pollution maladies than to those arising in the modern era. One must therefore conclude that it does not offer a suitable explanation for the cause of pollution. Nevertheless, in the policy world the model remains dominant.[24]

This is not a harmless error. What concerns me is the fact — and both the logic and the evidence show that it is a fact — that we are attempting to address 21st Century problems with an early 20th Century understanding. By using a model that fails to capture the actual dimensions of the phenomenon we fail to address the dynamics that actually apply.[25] And where the diagnosis is wrong, the remedy we apply will be right only by coincidence. There are many occasions when the economically-prescribed remedy is workable, but in how many other occasions does the model ignore signals pointing to solutions that are appropriate for other reasons, such as the need to offset the uncertainty that is characteristic of modern environmental problems? And what political consensus for pollution control initiatives can be built when accepted doctrine assumes that the abatement cost always has a positive value?

Having limited both our diagnostic ability and our remedies, it seems clear that we are handicapped by doctrine. That is, our efforts to address modern pollution problems suffer from a doctrinal disability.

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Endnotes

1. By the 1960s, when environmental consciousness rose rapidly and was transformed into a political force, environmental economics was already well developed. Enthusiasm for the economic approach rose during that decade with the addition of creative new insights. See, e.g., Ronald H. Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3, no. 1, 1-44 (1960), and J. H. Dales, Pollution, Property, and Prices (Toronto, University Press, 1968); see also Harold Wolozin, ed., The Economics of Air Pollution, A Symposium (Norton, New York, 1966), at 23, 25. By the end of the decade many legal scholars felt that economic doctrine provided the policy foundation for building a system of environmental laws in the U.S.

However, Congress did not follow the economic path. Instead, it adopted a framework for environmental law based largely on the rejection of existing policies, which it concluded had failed, and on their replacement with a new set of principles influenced greatly by Ralph Nader and his organization. See Ralph Nader, Unsafe at Any Speed: The designed-in dangers of the American automobile (Grossman, New York, 1965), and John Esposito, Vanishing Air: Report of the Ralph Nader Study Group on Air Pollution (1970). Nader and his associates saw pollution not as a plain externality but as an act of "intentional externalization." See Loeb, A.P., "Paradigms Lost: A Case Study Analysis of Models of Corporate Responsibility for the Environment," *Business and Economic History*, Vol. 28, No. 2, Winter 1999, at 95. Naturally, the Nader diagnosis and the remedies adopted were closely related, leaving little room for other approaches in the legislation. See Loeb, A.P., "Surmountable Obstacles to the Adoption of Emissions Trading Programs: The Historical Perspective," unpublished conference presentation, June 20, 1995. This cut economics out of critical parts of environmental decision-making. For example, the courts interpreted the Clean Air Act, as amended 1970, as not allowing economic costs to be considered in the setting of National Ambient Air Quality Standards under Section 109. Lead Industries Association, Inc. v. EPA, 647 F.2d 1130 (D.C. Cir. 1980), and Whitman v. American Trucking Assns., Inc., 531 U.S. 457 (2001). If the marginal abatement cost cannot be considered at the same time the marginal damage function is determined, then the economically prescribed exercise of optimizing the level of emission control cannot take place. In effect, economic doctrine was pushed aside.

In the 1970s economists attempted to regroup to consider what could be done. They were encouraged by strong statements from Kneese, Allen V. and Charles L. Schultze, Pollution, Prices, and Public Policy (Brookings, Washington, 1975), and Charles L. Schultze, The Public Use of Private Interest (1977), both asserting the virtues of the traditional economic model and its prescribed remedies. These made no effort to deny that environmental problems existed but focused instead on the inefficiency of the remedies that had been enacted under existing laws. In particular, these propagated the characterization of the new environmental laws as "command-and-control" approaches and recommended the adoption of"market-based" approaches instead. However, the remedies prescribed by reformers could not be simply adopted, for the issue was no longer a blank slate legally. They would have to be either integrated within existing legislative mandates or adopted in new legislation.

One way to inject economic analysis into laws already on the books was to adopt a centralized review. During the 1970s, each of the presidents initiated programs for executive review of the cost side of regulatory decisions. The first was the Quality of Life review process established by President Richard Nixon in October 1971. Under President Ford this was followed by the establishment of the Council on Wage and Price Stability in August 1974 and by Executive Order 11821 in November 1974, which established procedures for preparing Inflation Impact Statements. In December 1976, Ford's program was extended by Executive Order 11949, which changed the name of the required analysis to the Economic Impact Statement. In March 1978, President Carter issued Executive Order 12044 replacing Ford's Economic Impact Statement with the Regulatory Analysis. This required that all new regulations having an economic impact of $100 million or more be reviewed prior to proposal in the Federal Register, and that the review for the first time be made public. While these programs forced federal agencies to develop economic capabilities internally to comply with the regulatory analysis requirements (for example, Occupational Safety and Health Administration ("OSHA") hired economists for this purpose in 1978), none of this changed existing legislation. For example, in American Textile Manufacturers Institute v. Donovan, 452 U.S. 490 (1981), the Supreme Court ruled that the law required OSHA to use feasibility rather than cost-benefit analysis as a basis for regulation. Economist Murray Weidenbaum lamented, "There was no requirement that an agency refrain from promulgating a regulation whose costs would exceed benefits." Thus, the cost-benefit standard remained only advisory, and efforts by both Ford and Carter to change that by legislation were not successful. See Murray Weidenbaum, "Regulatory Process Reform From Ford to Clinton," www.cato.org/pubs.

The turnaround for environmental economics came with the election of Ronald Reagan as President in 1980. This brought to power a man who was heavily influenced by free-market economist Milton Friedman. See Milton Friedman, Capitalism and Freedom (Univ. Chicago Press, Chicago, 1962), and Milton Friedman and Rose D. Friedman, Free to Choose (Harcourt Brace Jovanovitch, New York, 1979) (which when released in paperback in January 1981 displayed an endorsement from Reagan himself). Friedman argued that none of the New Deal programs had worked better than the free market would have, had it been left to its own devices. He concluded that not only was regulation inefficient (the traditional argument of economists), and that therefore it did not work, but that it also threatened personal liberty.

In has campaign Reagan had promised the industries that he would ease their regulatory burdens. This was expressed in two initiatives. First, Reagan set up the "Task Force on Regulatory Relief" chaired by Vice-President Bush, which was announced in a televised address on February 5, 1981. Second, Reagan extended and expanded the executive review of federal regulations for cost-benefit and cost-effectiveness. Within a month of taking office Reagan established the Regulatory Impact Analysis ("RIA") under E.O. 12291, 46 Fed.Reg. 13193 (Feb. 17, 1981).

The trap set for these initiatives by misdiagnosis and false assumption was shown in their application to the lead phasedown, the U.S. EPA's program for taking the lead out of gasoline. The Task Force's flagship initiative was a review of the lead phasedown, announced by Bush on August 12, 1981. However, the Administration's push for regulatory relief was turned aside by evidence provided by EPA and the medical community showing that deregulation was unjustified. This set up a dilemma for the Administration, which had promised regulatory relief to refiners but found that the benefits of the phasedown, which it had not previously taken into account, would not allow it to give that relief by recision of the whole program. This forced the Task Force to turn instead to regulatory reform. EPA's Office of Policy Analysis seized upon a form of "market-based regulation" — emissions trading — as the way out of its dilemma. This approach was based on the ideas of Coase and Dales, who were seeking efficiency. In the end EPA established the lead credit market, the first freely traded market in emission rights in the world, so far as we know. 47 Fed.Reg. 49322 (Oct. 29, 1982). While the lead credit market was originally proposed as a way to provide relief to industry, environmentalists came to see that the efficiency savings could be shared also by environmental interests in what NRDC attorney David Hawkins would later call "a dividend for the environment." The lead credit market, by creating efficiency, also had the political effect of generating consensus. See Loeb, A.P., "Three Misconceptions about Emission Trading," Air and Waste Management Association No. 90-155.8, June 1990. The success of the lead credit market spawned numerous markets, including for chlorofluorocarbons, acid rain, and conventional pollutants, with support of both industry and environmentalists.

Instead of shutting down its RIA analysis of the lead phasedown at the conclusion of these proceedings EPA accelerated it, and by March 1984 it concluded that the benefits of lead reductions through regulation were justified not only for public health reasons but also for consumer reasons. U.S. EPA, Office of Policy Analysis, Costs and Benefits of Reducing Lead in Gasoline, Final Regulatory Impact Analysis, Feb. 1985 (which projected that dramatic reductions in lead use would save motorists $50 billion in only eight years). When the results were presented, EPA Administrator William Ruckelshaus described the decision to mandate new lead reductions as a "no-brainer," and EPA dramatically reduced the amount of lead allowed in leaded gasoline 50 Fed.Reg. 9386 (Mar. 7, 1985). This of course was not the regulatory relief refiners had asked for, but it was the result that was made possible by actually considering the consequences of the regulatory alternatives. Environmentalists began to think more highly of — and be less threatened by — the RIA process. In the end history shows that centralized regulatory review, which its advocates had assumed would demonstrate regulatory costs, instead flushed out unrecognized regulatory benefits and as a result triggered regulatory innovations.

Reagan's E.O. 12291 was superseded by E.O. 12866 (1993) and by E.O. 13422 (Jan. 18, 2007). Economic analysis of regulations has become a routine function throughout the government where not specifically contrary to law, and it has produced efficiency savings in a number of cases. See Richard D. Morgenstern, "Reflections on the Conduct and Use of Regulatory Impact Analysis at the U.S. Environmental Protection Agency," Resources for the Future Discussion paper, Apr. 7, 2011.

In sum, two economic ideas — centralized economic analysis and the so-called "market-based regulation" — took root in the early years of the Reagan Administration. Because of experience showing that these might benefit environmental interests a consensus was formed around the economic approach, and economics came to the forefront of environmental policy-making.

2. A. C. Pigou, The Economics of Welfare (1920; 2nd Ed. 1924; 3rd Ed. 1929; 4th Ed. 1932). Pigou's First Edition (1920) was essentially a reworking of his prior book, Wealth and Welfare (Macmillan and Co, London, 1912); one infers from the change in title Pigou's intent to put a greater distance between his work and the classical economics of Adam Smith. Pigou broke with classical economics by noting that private markets don't always generate the greatest productivity; in his terms they "diverge" from optimality. He then identified and discussed specific "divergences," among them those that would later be labeled "externalities." It is to be noted that Pigou did not originate the line of thinking that produced the theory of externalities (indeed, he never used the term "externalities."). His work simply advanced concepts previously put forward by Henry Sidgwick in The Principles of Political Economy (London, Macmillan, 1st Ed. 1883, 2nd Ed. 1887, 3rd Ed. 1901), and by Alfred Marshall in The Principles of Economics (1890). Marshall repeatedly made a distinction between internal and external factors and used the term "external economies" regarding positive spillover effects. Pigou spoke of "divergences between marginal social net product and marginal private net product." Pigou, supra, (1st Ed., 1920), at 149. On occasion Pigou also used Marshall's term "external economies" but not as an expression of the idea that would later become the theory of externalities. Nor did Pigou actually develop a complete statement of externality theory; that was worked out later. Thus, while the modern economics literature attributes the notion of externalities to Pigou, its consolidation into its modern form actually occurred afterward. Indeed, according to Coase (1960), supra, much of the doctrine of externality theory emerged not in the pages of the literature but through an oral tradition he called "The Pigovian Tradition." Coase (1960), supra. It should also be noted that those such as Bator who later assembled the pieces of the market-failure/externalities model did not leave Pigou intact; Bator (1958) reconceptualized the Pigouvian model. Just as in Pigou's own multiple editions the theory remained a work in progress.

So what was Pigou's contribution? His role is described herein as "developing" rather than originating the model because he relied on the prior work of Sidgwick and Marshall. Thus, Pigou's true contribution was to elaborate the doctrines of Sidgwick and Marshall and apply them to pollution issues. In this regard the concept of the social benefit as distinct from the private benefit is the legacy Pigou set in place. "The two key analytical constructs here were marginal social net product and marginal private net product." Steven G. Medema, The Hesitant Hand: Taming Self-Interest in The History of Economic Ideas (Princeton Univ. Press, Princeton, 2009), at 61.

3. As much as the externalities theory relies upon the existence of incentives, its explanation of how they relate to causality is its

weakest part. The difficulty comes from defining the causal mechanism as the lack of incentive to control emissions, a sort of double negative. Being based on the absence, rather than the presence, of something, it has been difficult for economists to point to anything specific as the thing referred to. The classical statement of the theory by Pigou sidestepped this issue by being heavy on characterization and light on causality, following its origins in the work of Sidgwick, which was as much moral philosophy as economics. See Sidgwick, supra. "In fact, the most accurate characterization of Pigou's work here would be to say that he put Sidgwick's ideas into a Marshallian theoretical framework." Medema (2009), supra, at 60. It was natural, coming from that approach, to focus on classifying things by definitional categories and think much less about what caused them to come into existence. Thus, while Pigou defined what divergences are and illustrated them by setting out examples, he made no attempt to describe the incentives that cause them to occur. The argument was framed in nouns, not in verbs.

This left the question of causality to be filled in by others, resulting in a variety of accounts in the standard literature, for example, this modern textbook account of the results from Tietenberg:

> ... [W]e can draw a number of conclusions about market allocations of commodities causing pollution externalities:
> 1. The output of the commodity is too large.
> 2. Too much pollution is caused.
> 3. The prices of products responsible for pollution are too low.
> 4. As long as the costs are external, no incentives to search for ways to yield less pollution per unit of output are introduced by the market.
> 5. Recycling and reuse of the polluting substances are discouraged since release into the environment is so inefficiently cheap.
> The effects of a market imperfection for one commodity end up affecting the demands for raw materials, labor, and so on. The ultimate effects are felt through the entire economy.

Tom Tietenberg, Environmental and Natural Resource Economics, 6th Ed. (Boston, Addison Wesley, 2003), at 67. The gist of the theory is that the opportunity to externalize, i.e., to pollute without negative consequences to oneself, creates an incentive to pollute that people, being profit-maximizing, will inevitably follow. But that is about as detailed as it gets. Because Pigou left it to be filled in later and did not go through that exercise, the theory never got to the point of translating incentives into motives. Thus, the theory remains long on conclusions and short on specifics, providing few concrete assertions about incentive to test. It is ultimately an unsatisfying account of the cause of pollution.

4. If the postulated goal of economics is to achieve efficiency, and efficiency is considered the optimum allocation of resources, then there has to be a test for determining when optimality has been achieved. Though statements of the model vary in specifics, a broad notion of the principles is as follows: (a) Generally speaking, optimality in a market occurs where marginal willingness to pay equals marginal cost of supplying that item. In theory the economic optimum is when MC = MB, that is, where the cost curve and the demand curve intersect. At any other point, whether the number of units is increased or decreased, the total value will be less, hence sub-optimal. (b) In the case of externalities, however, private costs and benefits do not reflect the external effects, so that the private optimum diverges from the social optimum. To correct for this sub-optimization, which because it produces an outcome that diverges from the true optimum constitutes a market failure, one must correct the prices so that the market functions based on the all-inclusive social cost and benefits. If correctly calculated, the social optimum occurs when MSC = MSB, that is, where the marginal social cost curve and marginal social demand curve intersect.

5. One notes that the Pigouvian set of remedies includes subsidies as well as fees.

6. Coase (1960), supra. As noted by Coase the Pigovian Tradition did not prevent economists from reaching unanimity in agreement, but it did prevent them from reaching clarity regarding its principles, which posed a problem for critique. "Not being clear, it was never clearly wrong." Coase (1960), supra. Coase thus sought to reanalyze the doctrine set in motion by Pigou. Coase was awarded the Nobel Memorial Prize in economics in 1991

7. Coase stated,

> The traditional approach has tended to obscure the nature of the choice that has to be made. The question is commonly thought of as one in which A inflicts harm on B and what has to be decided is: how should we restrain A? But this is wrong. We are dealing with a problem of a reciprocal nature. To avoid the harm to B would inflict harm on A. The real question that has to be decided is: should A be allowed to harm B or should B be allowed to harm A? The problem is to avoid the more serious harm.

Coase (1960), supra.

8. George Stigler, Memoirs of an Unregulated Economist (New York: Basic Books, 1988), at 77.

9. Coase made this clear right from the start of his article, stating in only the second sentence, "The standard example is that of a factory the smoke from which has harmful effects on those occupying neighbouring properties." Coase (1960), supra. Though Coase found that this was "a problem which arises in many different guises," Id., and went on to list and analyze a variety of scenarios, all of his examples had the same essential nature. That is, in every case the impacts at issue were nuisances having identifiable economic consequences.

10. Thus, within this logical zone one can determine, for example, if the amount of pollution results in a social cost that exceeds the social benefit, or to plot the point where the marginal abatement cost equals the marginal damage function.

11. Because the intercept of the *x* and *y* axes is zero, the economic construct incorporates the assertion that some quantity of incentive (i.e., greater than zero) leads to some quantity of pollution (i.e., greater than zero), as postulated by theory. While we see the field within which economic analysis takes place being derived from the logic of the Table, economists do not work backwards from the analytical field to the logic. They think if it only as the place where incentives and pollution are plotted, but this is so deeply absorbed in the assumptions that it is never stated, though it is foundational for the exercise conducted there.

12. The basic premise is that abating pollution involves a trade-off. Reducing emissions may have benefits (for example, reducing exposure of people and natural systems to these damaging materials, which is beneficial), but reducing emissions comes at the cost of resources that might have been put to use elsewhere, which is an opportunity cost. The economists frame this as inherently negative. As stated in one conventional text, "On the one hand, reducing emissions reduces the damages that people suffer from environmental pollution; on the other hand, reducing emissions takes resources that could have been used in some other way." Field, B. C., *Environmental Economics: An Introduction* (McGraw Hill, New York, 2001) at 84.

13. Indeed, in the famous case of gasoline lead additive the marginal abatement cost was negative — that is, the first unit of abatement achieved had a negative cost (i.e., it represented a cost savings) — and the marginal abatement cost curve never crossed the marginal damage function, which is to say there was no economically efficient quantity of lead additive greater than zero. Lead in gasoline was nothing more than a diseconomy that would have continued indefinitely as a multi-billion-dollar drag on both the consumer economy and the public health were it not for the Clean Air Act. It may be that the private marginal abatement cost was in Quadrant 1, but the social marginal abatement cost was deep in Quadrant 4.

Also, suppose instead a situation in which a substance is harmful at high exposure but harmless or even beneficial at low exposure, for example a substance or compound that provides nutritional or medical benefits at low levels but becomes toxic at higher doses. This is known as "hormesis." An example would be salt, which is essential to life but very damaging to human health when consumed in excess. For hormetic materials one could not only not use a linear approach, since the relationship of quantity to damage is J-shaped, one would have to represent the marginal damage function for part of the relationship in Quadrant 4.

14. Loeb, A.P., "Birth of the Kettering Doctrine: Fordism, Sloanism and Tetraethyl Lead," *Business and Economic History*, Vol. 24, No. 2, Fall 1995.

15.

> [I]f it can be shown ... that an actual danger to the public is had as a result of the treatment of the gasoline with lead, the distribution of gasoline with lead in it will be discontinued from that moment. ... [B]ut ... when a material is found to be of this importance for the conservation of fuel and for increasing the efficiency of the automobile it is not a thing which may be thrown into the discard on the basis of opinions. It is a thing which should be treated solely on the basis of facts.

Dr. Robert Kehoe, testimony before the U.S. Public Health Service, May 20, 1925, as reprinted in Proceedings of a Conference to Determine Whether or Not There is a Public Health Question in the Manufacture, Distribution, or Use of Tetraethyl Lead in Gasoline, Public Health Bulletin 158 (August, 1925), at 70. See *Automotive Industries*, May 21, 1925, at 914.

16. See Loeb, A.P., "Birth of the Kehoe Rule: Implications of the Surgeon General's Review of Tetraethyl Lead, 1925-26," unpublished conference presentation, March 7, 1997.

17. See "A Bill of Health for Looney Gas," *Literary Digest*, Feb. 6, 1926, at 14. The full phrase, "clean bill of health," was used by others such as GM chemist T.A. Boyd. See, e.g., Thomas A. Boyd, The Early History of Ethyl Gasoline, GM Research Laboratories Division Report OC-83, Project No. 11-3, (unpublished manuscript) (June 8, 1943), at 209.

18. Seee "Interim Report of the Departmental Committee on Ethyl Petrol," Presented by the Minister of Health to Parliament by Command of His Majesty July 1928," and Great Britain, Ministry of Health, Final Report of the Departmental Committee on Ethyl Petrol (Feb. 10, 1930).

19. See Loeb, A.P., "Paradigms Lost: A Case Study Analysis of Models of Corporate Responsibility for the Environment," *Business and Economic History*, Vol. 28, No. 2, Winter 1999, at 95.

20. The appearance of a product whose impacts from ordinary use were both toxicological and ambient challenged the imagination, for neither the public nor the health authorities had any experience in resolving such a scenario. There were of course precursors. It was long understood that some substances were toxic, but it was also believed that such hazards were only found within enclosures where they could concentrate, for once they escaped beyond an enclosure they would disperse harmlessly into the environment. The idea that something might be so potently toxic or be emitted in such quantity that it might reach a toxic level of concentration defied experience, and it defied common sense. One instance where toxic exposure was not limited to an enclosure arose during World War I regarding the war gases. These, however, were not intended for daily and ordinary use by civilians, as was tetraethyl lead, so they didn't force the public or its agencies to consider widespread exposure over long periods. Overall, none of the various toxic or dangerous products that had emerged (such as such as radium-painted watch dials) involved exposure of entire populations, and they were addressed narrowly.

21. By 1960 the Surgeon General's review of lead, the first modern environmental health controversy, had been forgotten by just about everyone except those participating in the revision of the PHS lead regulations in the second half of the 1950s. But even if that scenario had become virtually invisible there were new pollution scenarios that had arisen, such as the post-war appearance of urban ozone, that had the same four attributes as the lead controversy. So while the lead case itself was mostly forgotten, the modern environmental health phenomenon was actually quite current.

It should be recognized that after Coase's article other economists have come to at least recognize the existence of the modern pollution scenario, and this has entered the economics literature. For example, one text recognizes "neglect of future consequences of present actions" as a reason for market failure Lipsey, Steiner and Purvis, Economics (Harper & Row, New York, 8th Ed., 1987), at 414. The text also uses as an example "taking action without finding out whether there are as-yet-unknown adverse externalities," discussing DDT as an example. Id., at 414. Such accounts purport to take account of the modern scenario, but once they have acknowledged such factors they go back to the standard analysis that applies a framework which ignores the very same factors. Thus, they now recognize that it's there, but it hasn't been allowed to change accepted doctrine.

22. The economists made their case for overturning the lower court's ruling by arguing the following:

> As economists, we believe that the D.C. Circuit's ruling not allowing the EPA to consider important information relating to the consequences of its regulatory actions is economically unsound. Without delving into the legal aspects of the case, we present below why we think the Court should allow the EPA to consider costs in setting standards. In particular, we believe that, as a general principle, regulators should be allowed to consider explicitly the full consequences of their regulatory decisions. These consequences include the regulation's benefits, costs, and any other relevant factors.

Brief Amici Curiae of AEI-Brookings Joint Center for Regulatory Studies, filed in *American Trucking Associations, Inc., et al., v. Carol M. Browner, Administrator of the Environmental Protection Agency, et al.*, No. 99-1426, Jul. 21, 2000, at 7. Thus, while ATA wanted to knock down EPA's new standards, and in pursuit of that goal argued principle, economists went straight for the principle. They wanted the Section 109 process invalidated so it could be replaced by methods conforming to economic doctrine. Thus, the case came to represent issues well beyond standards for PM and ozone or the obligations of an industry to meet them; it came to represent a test of principle. What was not recognized (because the history underlying the policies preexisting the Clean Air Act and rejected by it was by then largely forgotten) is that both the diagnosis and the remedies adopted by the Act in 1970 represented a specific rejection of policies adopted decades earlier by the Surgeon General, which the authors of the Act considered to have failed, though they didn't know the those policies' origins.

23. Though unknown to the parties, the case actually turns on one of the policies that was established in the Surgeon General's proceedings and reversed by the 1970 Amendments. Under the Kehoe Rule, the decision to allow a pollutant should be made by balancing its health detriments against its economic benefits. The economic benefits won every time because the uncertainties applied to the health considerations caused that side of the ledger to be highly discounted, and to be always outweighed by the more quantifiable economic benefits, which were accepted without question. This result was then misinterpreted as giving gasoline lead additive a clean bill of health. Thus, even though the Kehoe Rule was an implicit cost-benefit analysis, it could generate catastrophically inefficient outcomes, as shown in the case of lead. By 1970 lead had become ubiquitous in the environment.

Although the designers of the Act did not know the origins of the Kehoe Rule, it was entirely rational for them to replace it with a new decision rule that corrected its flaws. Experience had shown the Kehoe Rule to have produced inadequate controls because in the process of formulating a decision it commingled the economic factors with the health considerations, leading directly to the problem Congress wished to solve. In this context it was not unreasonable for Congress to insulate health considerations from other factors in the first instance. Indeed, it would have been unreasonable for Congress to have attempted to reduce pollution leaving the Kehoe Rule in place.

The argument that should have been made in *American Trucking* is that Congress passed the 1970 Amendments to change, among other things, the decision rule which had been used to determine the need for regulatory control of ambient

pollutants, and that the policy to protect health considerations from contamination by economic factors was entirely rational in that context. The remedy adopted in Section 109 has been so completely successful in solving the problem for which it was designed that the institutional failure that was long ago designed into the Kehoe Rule has itself been buried and is now forgotten.

Though the amicus argument does not stand up historically the idea that cost/benefit analysis might be useful is supported by the experience in the lead phasedown in the 1980s, when an analysis of the costs of leaded for public health purposes revealed that leaded gasoline had enormous social costs unrelated to its health effects. See Endnote 1, supra. A regulatory reform initiative built on that experience would be quite useful, though it does not appear in the present political climate that the use of cost/benefit analysis would gain much political traction if its results justified more stringent regulation.

24. "The causes of environmental problems are fundamentally economic, and the consequences have important economic dimensions. That's why anyone who wishes to play an effective role in the environmental policy process will benefit from having a real understanding of environmental economics." Professor Robert Stavins, Faculty Chair, Economics and the Environment, John F. Kennedy School of Government, Harvard University, quoted in www.free-eco.org.

25. It has been noted previously that economics, like other sciences, sets up methodologies that ultimately become limitations that have the potential for doing harm. Whitehead listed economics as 'Exhibit A' in deploring the tendency of modern science to fixate on a single set of ideas, to the exclusion of others:

> It is very arguable that the science of political economy, as studied in its first period after the death of Adam Smith (1790), did more harm than good. It destroyed many economic fallacies, and taught how to think about the economic revolution then in progress. But it riveted on men a certain set of abstractions which were disastrous in their influence on modern mentality. ... This is only one example of a general danger inherent in modern science. ... It fixes attention on a definite group of abstractions, neglects everything else, and elicits every scrap of information and theory which is relevant to what it has retained. ... But, however triumphant, the triumph is within limits. The neglect of these limits leads to disastrous oversights. ... [201] A self-satisfied rationalism is in effect a form of anti-rationalism. It means an arbitrary halt at a particular set of abstractions. This was the case with science.

Alfred North Whitehead, Science and the Modern World (Macmillan, Toronto, 1925), at 200-201.