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The Social Cost of Motor Vehicle Use

By MARK DELUCCHI

ABSTRACT: We have classified and estimated the social cost of motor vehicle use in the United States on the basis of 1990-91 data. The analysis provides a conceptual framework for viewing social costs, develops analytical methods and data sources, and presents some detailed estimates of some of the costs. The data, methods, functions, and estimates of this analysis can help analysts and policymakers evaluate the costs of transportation projects, establish efficient prices for transportation services, and prioritize research and funding. This analysis cannot, however, tell us precisely what we should do to improve our transportation system. Not only are many of the estimates too generic and uncertain, but, more important, society cares at least as much about equity, opportunity, and justice as it does about economic efficiency. At the end of the day, a total social-cost analysis contributes only modestly to but one of several societal objectives for transportation.

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EVERY year, American drivers spend hundreds of billions of dollars on highway transportation. They pay for vehicles, maintenance, repair, fuel, lubricants, tires, parts, insurance, parking, tolls, registration, fees, and other items. These expenditures buy Americans considerable personal mobility and economic productivity.

But the use of motor vehicles costs society more than the hundreds of billions of dollars spent on explicitly priced transportation goods and services. There also are bundled costs: those goods and services that are not explicitly priced but are bundled in the prices of nontransportation goods and services. For example, free parking at a shopping mall is unpriced, but it is not costless: its cost is included—bundled—in the price of the goods and services sold at the mall.

In addition to these priced or bundled private sector costs, there are public sector costs, of tens of billions of dollars per year, to build and maintain roads and to provide a wide range of services that partly support motor vehicle use. These services include police protection, the judicial and legal system, corrections, fire protection, environmental regulation, energy research and regulation, military protection of oil supplies, and more.

Finally, beyond these monetary public and private sector costs are the nonmonetary costs of motor vehicle use, which by definition are not valued in dollars in normal market transactions. There are a wide variety of nonmonetary costs, including the health effects of air pollution, pain and suffering due to accidents, and travel time. Some of these nonmonetary costs, such as air pollution, are what economists call externalities, while others, such as travel time in uncongested conditions, are what I will call personal nonmonetary costs.

The social cost of motor vehicle use—the all-inclusive economic cost to society of using motor vehicles—is the sum of all of the costs mentioned previously: explicitly priced private sector costs, bundled private sector costs, public sector costs, external costs, and personal nonmonetary costs. These costs are listed in complete detail, and classified more rigorously, in Table 1.

Over the past three years, my colleagues and I at the University of California have been doing a detailed and comprehensive analysis of the social cost of motor vehicle use. In this article, I explain the purpose of estimating the total social cost of motor vehicle use, explain my conceptual framework and cost classification, and present and discuss our preliminary cost estimates.[1]

WHY AN ANALYSIS OF THE SOCIAL COST OF MOTOR VEHICLE USE?

Researchers have performed social-cost analyses for a variety of reasons, and have used them in a variety of ways, to support a wide range of pol-

1. This article summarizes a series of 20 reports published as *The Annualized Social Cost of Motor-Vehicle Use in the United States, Based on 1990-1991 Data*, UCD-ITS-RR-96-3 (Davis: University of California, Institute of Transportation Studies, 1997). A list of the reports in the series is available from the institute.

TABLE 1

CLASSIFICATION OF THE COSTS OF MOTOR VEHICLE USE

Personal Costs	Private Sector Costs		Public Sector Costs	External Costs (except 6b)	
Nonmonetary	Monetary costs				Nonmonetary costs
(1) Personal nonmonetary costs of MV use	(2) MV goods and services produced and priced in the private sector (estimated net of producer surplus and taxes and fees)	(3) MV goods bundled in the private sector	(4) MV goods and services provided by government	(5) Monetary externalities of MV use	(6a) Nonmonetary externalities of MV use
• Travel time, excluding travel delay imposed by others, that displaces unpaid activities	*Usually included in GNP-type accounts*	• Annualized cost of nonresidential off-street parking included in the price of goods and services or offered as an employee benefit	• Annualized cost of public highways, excluding private investment in roads but including on-street parking	• Monetary costs of travel delay imposed by others: extra consumption of fuel, and forgone paid work	• Accidental pain, suffering, death, and lost nonmarket productivity not accounted for by the economically responsible party
• Accidental pain, suffering, death, and lost nonmarket productivity inflicted on oneself	• Annualized cost of the fleet, excluding external costs of accidents	• Annualized cost of off-street residential parking included in the price of housing	• Annualized cost of municipal and institutional off-street parking	• Accident costs not accounted for by economically responsible party: productivity, medical, legal, administrative, and property damage costs	• Travel delay, imposed by other drivers, that displaces unpaid activities
• Personal time spent working on MVs and garages, refueling MVs, and buying *and disposing* of MVs and parts	• Motor fuel and lubricating oil, excluding cost of fuel use attributable to delay	• Annualized cost of roads provided or paid for	• Highway patrol and safety	• Expected loss of GNP due to sudden changes in oil prices	• Air pollution: effects on human health, crops, materials, and visibility[†]
	• Parts, supplies, maintenance, repair, cleaning, storage, renting, towing, and so on, except external costs of accidents and travel delay		• Regulation and control of air pollution, water pollution, and solid waste	• Price effect of using petroleum fuels for motor vehicles: increased payments to foreign countries for oil used in other sectors (not an external cost internationally)	• Global warming due to fuel-cycle emissions of greenhouse gases (U.S. damages only)
	• Automobile insurance: administrative and management costs and profit				• Noise from MVs

Included with external costs in column 6

- MV noise and air pollution inflicted on oneself

- Accident costs (except property damage) paid by automobile insurance of economically responsible party

- Priced private commercial and residential parking, excluding parking tax

Usually not included in GNP-type accounts

- Travel time, excluding travel delay imposed by others, that displaces paid work

- Overhead expenses of business, commercial, and government fleets

- Accident costs (except property damage) paid by economically responsible party but not through automobile insurance

by the private sector and recovered in the price of structures, goods, or services

- Energy and technology R&D

- Nongovernmental, monetary costs of motor-vehicle related fires and net crimes*

- Police protection (excluding highway patrol), court and corrections system (net of cost of substitute crimes)

- Fire protection

- Motor-vehicle-related costs of other agencies

- Military expenditures related to the use of Persian Gulf oil by motor vehicles

- Annualized cost of the Strategic Petroleum Reserve: investment, operation and management, and oil-holding cost

- Water pollution: effects of leaking storage tanks, oil spills, urban runoff, and highway deicing

- Nonmonetary costs of motor-vehicle-related fires and net crimes*

- *Not estimated here:* cost of leaking waste sites, vibration damages, and fear of MVs and MV crime

(6b) Nonmonetary impacts of MV infrastructure (not estimated)

- Land-use damage: habitat and species loss due to highways, MV infrastructure

- The socially divisive effect of roads as physical barriers in communities

- Aesthetics of highways, vehicles, and service establishments

SOURCE: Updated from M. A. Delucchi, "The Annualized Social Cost of Motor-Vehicle Use in the U.S., Based on 1990-1991 Data: Summary of Theory, Data, Methods, and Results," in *Full Costs and Benefits of Transportation*, ed. D. L. Greene, D. Jones, and M. A. Delucchi (Berlin: Springer-Verlag, 1997), tab. 1.1; ibid., in *Social Costs and Sustainability, Valuation and Implementation in the Energy and Transport Sector*, ed. O. Hohmeyer, R. L. Ottinger, and K. Rennings (1996), tab. 1. Updated with permission of Springer-Verlag.

NOTE: MV = motor vehicle; GNP = gross national product; R&D = research and development.

*These really should be classified not as external costs, within an economic framework, but as costs of illegal or immoral behavior, within a framework that encompasses more than just economic criteria. I have classified these as external costs because it is simpler to do that than to create yet another column, for only a handful of costs. Also, note that regardless of how these are classified, they in fact are costs of motor vehicle use.

†The cost of crop damage and some of the components of other costs of air pollution actually are monetary externalities.

icy positions. Some researchers have used social-cost analyses to argue that motor vehicles and gasoline are terrifically underpriced, while others have used them to downplay the need for drastic policy intervention in the transportation sector. In any case, social-cost analyses usually excite considerable interest, if only because nearly all of us use motor vehicles.

By itself, however, a social-cost analysis does not determine whether motor vehicle use on balance is good or bad, or better or worse than some alternative, or whether it is wise to tax gasoline or restrict automobile use or encourage travel in trains. Rather, a social-cost analysis is but one of many pieces of information that might be useful to transportation analysts and policymakers.

A social-cost analysis can provide cost data, cost functions, and cost estimates, which can help analysts and policymakers evaluate the costs of transportation policies, establish efficient prices for transportation services and commodities, and prioritize research and funding. Let us examine these uses more closely.

One use is to evaluate the costs of transportation projects, policies, and long-range plans. In cost-benefit analyses, policy evaluations, and scenario analyses, analysts must quantify changes to and impacts of transportation systems. The extent to which a generic national social-cost analysis can be of use in the evaluation of a specific transportation policy or system depends, of course, on the detail and quality of the social-cost analysis. At a minimum, a detailed, original social-cost analysis can be mined as a source of data and methods for cost evaluations of specific projects. Beyond this, if costs are a linear function of quantity, and invariant with respect to location, then estimates of national total or average cost, which any social-cost analysis will produce, may be used to estimate the incremental costs for specific projects, policies, or scenarios. Otherwise, analysts must estimate the actual nonlinear cost functions for the project, policy, or scenario at hand. Our own social-cost analysis does develop total-cost models for noise, air pollution, and a few other cost components.

Another use is to establish efficient prices for and ensure efficient use of those transportation resources or impacts that at present either are not priced but in principle should be (for example, emissions from motor vehicles) or are priced but not efficiently (for example, roads). Again, at a minimum, the data and methods of a detailed social-cost analysis might be useful in analyses of marginal-cost prices. Beyond this, the average-cost results of a social-cost analysis might give analysts some idea of the magnitude of the gap between current prices (which might be zero, as in the case of pollution) and theoretically optimal prices, and inform discussions of the types of policies that might narrow the gap and induce people to use transportation resources more efficiently. To the extent that total-cost functions for the pricing problem at hand are thought to be similar to the assumed linear national cost functions of a social-cost analysis, the average-cost results of the national social-cost analysis may be used to approximate prices for the

problem at hand. Of course, any marginal-cost models in a social-cost analysis may be employed to estimate marginal-cost prices.

A third use is to prioritize efforts to reduce the costs or increase the benefits of transportation. The total-cost or average-cost results of a social-cost analysis can help analysts and policymakers rank costs (Is road dust more damaging than ozone?), track costs over time (Is the cost of air pollution going down?), and compare the costs of pollution control with the benefits of control (Are expenditures on motor vehicle pollution control devices greater or less than the value of the pollution eliminated?). This information can help people decide how to fund research and development to improve the performance and reduce the costs of transportation. For example, if one is considering funding research into the sources, effects, and mitigation of pollution, it might be useful to know that road-dust particulate matter might be more costly than ozone attributable to motor vehicles.

I present our analysis and estimates with these relatively modest purposes in mind, not to promote a particular policy agenda regarding the use of motor vehicles and certainly not to forward any particular position about what, for example, gasoline taxes should be or whether the nation should invest more or less in motor vehicle use than it does now.

THE CONCEPTUAL FRAMEWORK

When I speak of the social cost of motor vehicle use, I mean the annualized social cost of motor vehicle use in the United States based on 1990-91 cost levels. The annualized cost of motor vehicle use, based on 1990-91 data, is equal to the sum of

- — 1990-91 periodic, or operating, costs, such as fuel, vehicle maintenance, highway maintenance, salaries of police officers, travel time, noise, injuries from accidents, and disease from air pollution, plus
- — the 1990-91 value of all capital, such as highways, parking lots, and residential garages (items that provide a stream of services), converted into an equivalent stream of annual costs (annualized) over the life of the capital, on the basis of real discount rates.

In essence, the yearly social cost of motor vehicle use, as we estimate it, is the yearly cost stream of the whole motor vehicle system, analyzed as if it were one large transportation alternative among several.

What counts as a cost of motor vehicle use or infrastructure?

In economic analysis, "cost" means opportunity cost. The opportunity cost of action A is the opportunity you forgo—what you give up, or use, or consume as a result of doing A. For some resource R to count as a cost of motor vehicle use, it must be true that a change in motor vehicle use will result in a change in the use of R. Thus gasoline is a cost of motor vehicle use because a change in motor vehicle use will result in a change

in gasoline use, all else being equal. But general spending on health and education is not a cost of motor vehicle use because a change in motor vehicle use will not result in a change in the resources devoted to health and education.

For the purposes of planning, evaluating, or pricing, we care not only whether something is a cost of motor vehicle use but also, if it is a cost, exactly how it is related to motor vehicle use. For example, pollution is a direct, immediate cost of motor vehicle use: if you change motor vehicle use a little, you immediately change pollution a little. But defense expenditures in the Persian Gulf, if they are a cost of motor vehicle use at all, are an indirect, long-term, and tenuous one. This sort of distinction is important because the more tenuously linked costs are harder to estimate, often lagged considerably with respect to the causal changes in motor vehicle use, and often highly dependent on the specific characteristics and amount of the change in motor vehicle use.

How to interpret "the cost of all motor vehicle use in the United States"

If one wishes to apply the estimates of the total cost of all motor vehicle use, or to understand the basis for deciding what is included in Table 1, then one might ask what is meant by the cost of all motor vehicle use: all motor vehicle use compared to what?

In normal cost-benefit analysis of transportation projects, one estimates costs and benefits relative to a well-defined no-project alternative, or base case. For example, one might compare a highway-expansion project with a light-rail project relative to a base case of business-as-usual improvement in the management of the existing infrastructure. But if the project is all motor vehicle use, what is the base case—the world without motor vehicle use?

In this analysis, the world without motor vehicle use is presumed to be the same as the world with motor vehicle use except that in the former, people do not use motor vehicles. This means that the benefits of motor vehicle use—the access provided—are presumed to be the same in both worlds. Put another way, the total social cost of motor vehicle use is the welfare difference between the present (circa 1991) motor vehicle system and a system that provides exactly the same services (that is, moves people and goods to and from the same places as do motor vehicles) but without time, manpower, materials, or energy—in short, without cost.

This costless transportation baseline is just a frame of reference, a conceptual baseline with respect to which total-cost trends can be estimated, or the total costs of one system (say, passenger vehicles) compared with the costs of another (say, passenger trains). It is relevant only to understanding the meaning of the total cost estimates themselves; it is not relevant if one is interested specifically in the data, methods, and marginal-cost models of the social-cost analysis, for the purpose of estimating efficient prices (say, for motor

vehicle emissions) or doing cost-benefit analysis of specific projects.

Costs versus benefits

In this project, we estimate the dollar social cost but not the dollar social benefit of motor vehicle use. Of course, we have not forgotten that there are benefits of motor vehicle use—a charge occasionally leveled against social-cost analysts—and certainly have not presumed that the benefits somehow are less important than the costs of motor vehicle use. Rather, I know of no credible way to estimate all of the benefits of motor vehicle use, so I do not attempt to do so. I emphasize, however, that not only does motor vehicle use provide enormous social benefit but in my view this benefit, if it could be expressed in dollars, would greatly exceed the full social cost.

Nevertheless, because ours is a cost analysis only, I am unable to say much about net dollar benefits or cost-benefit ratios or whether a particular transportation system is worthwhile or better or worse than another system. For example, our analysis indicates that motor vehicle use might cost us more than we realize, that is, that the total social cost appreciably exceeds the commonly recognized private cost. But even if this is so, it does not mean that motor vehicle use costs more than it is worth or that we should prefer any transportation option that might have near-zero external costs or even any transportation option that might have lower total social costs. To make such choices, one must estimate the dollar value of all the benefits as well as the dollar value of all the costs.

Classification of components of the total social cost

Individual cost components, or cost items, should be classified in consonance with how the cost estimates will be used. As discussed previously, estimates of the total social cost of motor vehicle use legitimately can be applied toward three ends: to evaluate the costs of transportation projects, policies, and long-range scenarios; to establish efficient prices for and ensure efficient use of transportation services and commodities; and to prioritize research and funding. Of these uses, only the second one, efficiency of use, comes with a set of principles and conditions—namely, the conditions of efficient resource use—that can be used to categorize costs. Consequently, if one is estimating costs in order to help policymakers improve the efficiency of the use of the transportation system, then one should categorize and analyze cost items with respect to the economic efficiency of their production or consumption (for example, not priced but efficiently allocated, unpriced and inefficiently allocated, priced improperly, and so forth). I have done so here.

In Table 1, I also use another organizing criterion, such as whether or not a cost is valued in dollars—and end up with six categories of costs. Of course, one could come up with other classifications, even using the same

general organizing principles; for example, one could merge or split some of my categories.

COMPONENTS OF THE SOCIAL COST OF MOTOR VEHICLE USE (TABLE 1)

Column 1: Personal nonmonetary costs

Personal nonmonetary costs are those unpriced costs of motor vehicle use that a person imposes on him- or herself as a result of the decision to travel. The largest personal costs of motor vehicle use are personal travel time in uncongested conditions and the risk of getting into an accident that involves nobody else.

With respect to economic efficiency, what matters in this cost category is whether drivers fully recognize the personal nonmarket costs that they face. If a person does not correctly assess these costs, then he will drive more or less than he would if he were fully informed and rational. For example, people who, on account of ignorance or poor judgment, underestimate their risk of falling asleep at the wheel will once in a while make trips for which the real but underestimated risk cost exceeds the value and which consequently should not be made.

Column 2: Priced private sector motor vehicle goods and services, net of producer surplus and taxes and fees

The economic cost of motor vehicle goods and services supplied in private markets is the area under the private supply curve: the dollar value of the resources that a private market allocates to supplying vehicles, fuel, parts, insurance, and so on. To estimate this area, one must subtract producer surplus and taxes and fees from total price-times-quantity revenues. One must deduct producer surplus because it is defined as revenue ("profit," in lay terms) in excess of economic cost and hence is a noncost wealth transfer from consumers to producers. One must deduct taxes and fees assessed on producers and consumers because they either are transfers from producers and consumers to government or are economically inefficient government charges for government services.

Note that the prices and quantities that obtain even in well-functioning private markets rarely if ever are optimal, not only because of distortionary taxes and fees but also because of imperfect competition (for example, monopoly), standards and regulations that affect production and consumption, externalities, and poor information.

Column 3: Bundled private sector costs

Some very large costs of motor vehicle use are not explicitly priced as separate costs of motor vehicle use. Foremost among these are the cost of free nonresidential parking, the cost of home garages, and the cost of local roads provided by private developers. Although the goods themselves are not explicitly priced, their costs are included in the price of packages, such as houses and goods, that are explicitly priced. This is called bundling. In principle, a producer will

bundle a cost, and not price it separately, if the administrative, operational, and customer (or employee) cost of collecting a separate price exceed the benefits. If the relevant market—say, for parking—is not distorted by taxes, or regulations (such as parking-space requirements), and if there are no external benefits of pricing, then the decision to bundle is economically efficient. To the extent that taxes and standards do distort the market, the ideal remedy is to eliminate the inefficient taxes and standards, not to force the costs to be unbundled.

Column 4: Government goods and services charged partly to motor vehicle users

Government provides a wide range of infrastructure and services in support of motor vehicle use. The most costly item is the capital of the highway infrastructure. I categorize government costs separately because generally they either are not priced or are priced but not at marginal cost.

Column 5: Monetary externalities

An external cost of motor vehicle use is a cost of motor vehicle use that is imposed on person A by person B but not accounted for by person B. A monetary external cost is one that happens to be valued monetarily by markets, in spite of being unpriced from the perspective of the responsible motor vehicle user. The clearest example, shown in column 5 of Table 1, is accident costs that are paid for by those not responsible for the accident. These repair costs, inflicted by uninsured motorists, clearly are unpriced in the first instance—that is, unpriced from the perspective of the uninsured motorist responsible for the accident—but nevertheless are valued explicitly in dollars in private markets. With respect to economic efficiency, the concern here, of course, is that the costs in this category are not priced at all, and hence are larger than is socially optimal.

The largest monetary externalities are those resulting from accidents and travel delay.

Column 6: Nonmonetary externalities

As mentioned previously, an externality is a cost or benefit imposed on person A by person B but not accounted for by person B. Environmental pollution, traffic delay, and uncompensated pain and suffering due to accidents all are common examples of nonmonetary externalities.

Environmental costs include those related to air pollution, global warming, water pollution, and noise due to motor vehicles. To estimate these costs, one must model complex physical processes and biological responses, and then estimate the dollar value of the responses. Our analysis indicates that the largest environmental externality, by far, is the cost of air pollution by particulate matter. Interestingly, a typically overlooked and completely unregulated emission source, particulate matter kicked up from the roadbed by passing vehicles, is one of the larger sources of pollution damages—larger even than damage from ozone, which

TABLE 2
SUMMARY OF THE COSTS OF MOTOR VEHICLE USE

	Total Cost (billions of dollars)		Percentage of Total		Cost per Registered Vehicle*	
	Low	High	Low	High	Low	High
(1) Personal nonmonetary costs of motor vehicle use	$544	$954	33%	29%	$2,885	$5,056
(2) Motor vehicle goods and services produced and priced in the private sector (estimated net of producer surplus, taxes, fees)	$807	$919	49%	28%	$4,279	$4,874
(3) Motor vehicle goods and services bundled in the private sector	$76	$279	4%	9%	$402	$1,482
(4) Motor vehicle infrastructure and services provided by the public sector†	$132	$241	8%	7%	$698	$1,277
(5) Monetary externalities of motor vehicle use	$30	$124	2%	4%	$160	$660
(6) Nonmonetary externalities of motor vehicle use	$69	$755	4%	23%	$363	$4,002
Grand total social cost of highway transportation	$1,658	$3,273	100%	100%	$8,791	$17,352
Subtotal: monetary cost only (2 + 3 + 4 + 5)	$1,045	$1,564	63%	48%	$5,538	$8,294
Payments by motor vehicle users for public highway infrastructure and services	$112	$197	n.a.	n.a.	$593	$1,046

SOURCE: Updated from M. A. Delucchi, "The Annualized Social Cost of Motor-Vehicle Use in the U.S., Based on 1990-1991 Data: Summary of Theory, Data, Methods, and Results," in *Full Costs and Benefits of Transportation*, ed. D. L. Greene, D. Jones, and M. A. Delucchi (Berlin: Springer-Verlag, 1997), tab. 1.5; ibid., in *Social Costs and Sustainability, Valuation and Implementation in the Energy and Transport Sector*, ed. O. Hohmeyer, R. L. Ottinger, and K. Rennings (1996), tab. 3. Updated with permission of Springer-Verlag.

*These figures are equal simply to total costs divided by 188.6 million registered vehicles (cars and trucks) in 1991. I show the cost per vehicle only to give a sense of the magnitude. One definitely should not infer from this presentation that all costs are proportional to the number of vehicles, that all costs are the same for different vehicle classes, or that the proper way to correct deficiencies in transportation markets is to raise the price of vehicles. For illustrative purposes, one also could present cost per vehicle mile of travel, by dividing the total cost by total vehicle miles of travel.

†Includes items in Table 1 that straddle columns 4 and 5.

is the most intensely regulated ambient air pollutant.

THE RESULTS OF THE ANALYSIS

The results of this analysis are summarized by aggregate cost category in Table 2. I show the aggregated totals here in order to provide a sense of magnitudes, not because such aggregated totals are themselves useful. Indeed, as discussed next, one must be careful to avoid misusing estimates of the total social cost of motor vehicle use.

How the results should not be used

Earlier, I discussed the legitimate uses of such estimates. Here, I caution against several common misuses of the estimates shown in Table 2.

First, one should resist the temptation to add up all of the unpriced costs and express the total per gallon of gasoline, as if the optimal strategy to remedy every economic inefficiency were simply to raise the gasoline tax. It turns out that there is not a single external cost, with the possible exception of carbon dioxide emissions from vehicles, that in principle is properly addressed by a gasoline tax. For example, some sources of inefficiency, such as imperfect competition and distortionary income tax policy, are not externalities and hence should be addressed not by adding taxes to market prices but by ensuring that the markets are competitive and only minimally distorted by taxation. Moreover, even where economic theory says that a tax is called for, a tax on gasoline is not the proper corrective. For example, an optimal air pollution tax would be a function of the amount and kind of emissions, the ambient conditions, and the size of the exposed population; it would not be simply proportional to gasoline consumption.

Second, I caution that it might be misleading to compare the total social cost of motor vehicle use with the gross national product (GNP) of the United States, because the GNP accounting is quite different from and generally more restricted than our social-cost accounting. For example, the GNP does not include any nonmarket items, which constitute a substantial portion of the social cost estimated here.

Third, one should properly represent and interpret the considerable uncertainty in any estimate of social cost. Uncertainty can be represented by low-high ranges, scenario analyses, probability distributions, and other techniques. Our analysis presents low and high estimates of cost. Yet, strictly speaking, these estimates are not lower and upper bounds, even where the high is much higher than the low, because we did not estimate every conceivable component or effect of every cost and we did not always accommodate the entire span of data or opinions in the literature. Moreover, one certainly should not assume that omitted costs in column 6 of Table 1—fear and avoidance of motor vehicles, habitat and species loss due to highways and motor vehicle infrastructure, the socially divisive effect of roads as physical barriers in communities, vibration damages, and the aesthetics of highways, vehicles, and service establishments—are trivial.

Fourth, it is not economically meaningful to compare estimates of user tax and fee payments for public motor vehicle goods and services with our estimates of government expenditures for same. Most emphatically, it simply is not true that, in order to have the economically optimal amount and use of public motor vehicle goods and services, we must increase current user charges until revenues collected from users equal government expenditures. It is not true because current taxes and fees do not have the structure or incidence of economically optimal charges and

because, in any case, it is not a necessary or sufficient condition of economic efficiency that the government collect from users revenues sufficient to cover cost. Comparisons between payments and costs are of use only in analyses of equity.

Finally, given that ours is an analysis of the total social cost of motor vehicle use, whereas any particular policy or investment decision will involve costs incremental or decremental to the total, one generally should not use our average-cost estimates in the analyses of specific projects and policies. Certainly, our results will become less and less applicable as one considers times and places increasingly different from the United States in 1990 and 1991. On the other hand, I note that, even if our results per se are irrelevant, our data, methods, and concepts might be useful in an analysis of specific pricing policies or investments.

CONCLUSION

We have classified and estimated the social costs of motor vehicle use in the United States on the basis of 1990-91 data. Our analysis is meant to inform general decisions about pricing, investment, and research. It provides a conceptual framework for analyzing social costs, develops analytical methods and data sources, and presents some detailed first-cut estimates of some of the costs.

By now it should be clear that a social-cost analysis cannot tell us precisely what we should do to improve our transportation system. There are several kinds of inefficiencies in the motor vehicle system and hence several kinds of economically optimal measures. Many of our estimates are simply too generic or uncertain to be of much use—as estimates—to policymakers and analysts faced with specific problems. Moreover, society cares at least as much about equity, opportunity, and justice as it does about economic efficiency. At the end of the day, a total social-cost analysis contributes only modestly to but one of several societal objectives for transportation.