RISK

Regulating cellular phone use: too little benefit for too much cost

Should You Be Allowed To Use Your Cellular Phone While Driving?

By Robert W. Hahn, Paul C. Tetlock, and Jason K. Burnett

During the past few years, consumers, politicians, academics, and interest groups have expressed growing concern about the safety of using cellular phones in cars and trucks. The increasing use of cellular phones in vehicles is part of a larger trend related to the introduction of technologies that could divert attention from driving. A recently published National Highway Traffic Safety Administration (NHTSA) survey reports that 44 percent of drivers have a phone with them when they drive, 7 percent have e-mail access, and 3 percent have facsimile capabilities. Those numbers are likely to increase. Other technologies that increase possible distractions will also be added to new vehicles, such as easily accessing the Internet, getting directions electronically, and receiving real-time information on traffic patterns.

With mounting concern among the public about such distracting devices in vehicles, we think it is appropriate to undertake a careful analysis of their advantages and disadvantages. This paper focuses on cellular phone use in vehicles because it is currently the most common of the new technologies. We believe, however, that the methodology developed in this paper could be helpful in assessing how best to address the use of other distracting technologies in vehicles.

Cellular phone subscribership in the United States has grown dramatically in recent years, from 92,000 people in 1985 to more than 77,000,000 in 1999. Cellular phones in cars provide important conveniences, including the ability to check on children, get help in an emergency, and coordinate schedules. In addition, drivers sometimes use cellular phones to report accidents and alert police and firefighters to problems that need to be addressed.

Unfortunately, cellular phones can also impose costs on society. One of the potentially significant costs of cellular phone usage while driving is the increased risk of vehicle accidents, some leading to serious injury or death. We estimate that several hundred people die each year in the United States as a consequence of collisions related to cellular phone use. While small in comparison to the 41,000 people who die in all vehicle accidents each year in the United States, municipalities, states, and even some countries have proposed a large array of restrictions on the use of cellular phones. Although only a few American municipalities have implemented a ban on people's use of hand-held cellular phones while driving, several foreign countries have enacted laws, including limited and total bans.

In this article we provide an economic evaluation of cellular phone regulatory options. Our primary conclusion is that banning cellular phone usage by drivers is a bad idea. A ban in the United States is estimated to result in annual economic welfare losses of about $20 billion. (All numbers are adjusted to 1999 dollars by using the consumer price index. Calculations are generally rounded to two significant digits.)

Less intrusive regulation, such as requiring the use of a hands-free device that would allow a driver to use both

Robert W. Hahn is director of the AEI-Brookings Joint Center for Regulatory Studies, a resident scholar at the American Enterprise Institute, and a research associate at Harvard University. **Paul C. Tetlock** was a researcher at the AEI-Brookings Joint Center for Regulatory Studies and is a graduate student at Harvard University. **Jason K. Burnett** is a researcher at the AEI-Brookings Joint Center for Regulatory Studies.

hands for steering is probably not economically justified. Instead of direct regulation, we argue that the government should focus on gathering additional information to determine the extent of the problem and also consider providing information to the public on the relative risk of cellular phone use in vehicles.

CELLULAR PHONE REGULATION IN VEHICLES

ON MARCH 22, 1999, BROOKLYN, OHIO, BECAME THE FIRST city in the United States to ban hand-held cellular phone use in vehicles. Brooklyn's ordinance bans the use of cellular phones while driving unless drivers keep both hands on the steering wheel. While the city has been enforcing that ordinance aggressively, offenses are punishable only by a $3 fine. Because Brooklyn was also the first city to mandate the use of seatbelts, media speculation surrounding the Brooklyn ordinance has focused on its potential national repercussions. Following Brooklyn's lead, other cities have implemented similar laws. For example, Conshohocken, Hilltown Township, and Lebanon in Pennsylvania and Marlboro Township, New Jersey, have hands-free mandates similar to Brooklyn's ordinance, while New York City bans taxi and limo drivers from using cellular phones.

No state has taken as aggressive a position as those cities. As Table 1 shows, even the strictest state laws simply provide guidelines for the use of cellular phones in vehicles. This table also shows, however, that several states have legislative proposals that would ban some or all uses of cellular phones while driving. These proposals, like the existing city ordinances, allow drivers to place emergency calls. States did not begin to address specific concerns about cellular phones until 1987, and most state legislative proposals have been introduced in the past two years. The table shows that a total of 88 proposals have been introduced at the state level in the past year. Great variation exists across states in terms both of laws and proposed legislation.

States have enacted either very modest measures aimed at regulating cellular phones or no measures at all. Most existing state legislation focuses on gathering data and educating drivers who use cellular phones. Massachusetts has the most stringent law of all the states, requiring drivers to keep at least one hand on the wheel while talking on their cellular phones. California's law orders rental car dealers to provide customers with instructions for the safe use of a cellular phone in all rental cars with installed phones. Florida prohibits the use of certain headset devices in conjunction with a cellular phone because such devices impair a driver's ability to hear surrounding sounds of the road.

All states have laws designed to prevent inattentive driving. These laws aim to curtail a driver's irresponsible habits, but the laws are often vague, open to legal interpretation, and poorly enforced. The concerns about cellular phone use while driving may lead many states to adopt stricter inattentive-driving laws. Five states—Delaware, Idaho, New Mexico, Ohio, and Wisconsin—recently specified unacceptable practices. It is unclear whether additional efforts to strengthen these laws will affect driving habits.

BENEFIT-COST ANALYSIS

OUR BASIC FINDING IS THAT THE ECONOMIC COSTS OF A ban on cellular phone use in vehicles far outweigh the benefits. Therefore, we argue against a ban. The reason is simple—cellular phone use in vehicles provides substantial benefits to users but does not appear to contribute to a large number of serious accidents. Next, we make calculations addressing a more difficult issue—whether particular regulations mandating cellular phone innovations would represent a relatively low-cost way of reducing accidents. As an example, we consider the case of mandating a hands-free device that is similar to a phone headset used in office environments. While the results are not as clear-cut as a ban, they suggest that such regulation is probably not warranted on benefit-cost grounds. Next, we develop a calculation that shows a break-even incremental cost for the regulation of cellular phones, which could be useful to regulators who are thinking about necessary conditions for intervening in this technologically dynamic market. Finally, we review some important limitations of our benefit-cost analysis and we highlight key insights.

Costs of a Ban The benefit-cost analysis of a ban requires estimating the cost to cellular phone users, the cost to producers, and the monetized benefits associated with a reduction in accidents. If cellular phone service is produced at constant marginal costs, the costs of a ban to cellular phone users is the welfare loss to consumers. Industrywide demand functions for cellular phone service allow economists to approximate the economic loss to consumers from a general ban. We estimate the amount of money that would be necessary to compensate cellular phone users so they would be indifferent to a ban.

Our analysis begins with an estimate by Hausman of industrywide demand for cellular phone services and then uses that measure to approximate the loss to consumers from a ban on using cellular phones in vehicles. Hausman finds that the price elasticity of cellular phone demand is –0.51, meaning that a 10 percent reduction in cellular service pricing would increase demand by 5.1 percent. This result is consistent with our own unpublished analysis using 1999 data. Based on Hausman's calculations that use 1994 data, we estimate that consumers in the United States would need to receive at least $27 billion a year to be indifferent to a ban. Using a linear approximation, we find that this number would now exceed $41 billion, employing 1999 price and subscribership figures.

The proportion of total cellular phone revenues arising from calls occurring in vehicles multiplied by the total amount that consumers would have to be compensated yields an estimate of the cost to consumers of prohibiting cellular phone use by drivers. This estimate assumes that cellular phone demand by drivers resembles the total cellular demand analyzed by Hausman. Using an industry market-

Table 1

Finalized and Recently Proposed Cellular Phone Legislation[a]

State	Mandated Data Collection	Guidelines for Cell Phone Use	Heightened User Penalties in Contributing to an Accident	Ban on All Hand-Held Devices	Total Ban on All Cell Phone Use[b]	Total Number of Proposals since 1999
Arizona	P				P	1
California		F[c] (1987)				0
Colorado				P		1
Connecticut		P		P		4
Delaware	P					1
Florida		F[d] (1992)				0
Georgia		P	P	P	P	7
Hawaii	P			P		3
Illinois				P		2
Indiana					P	1
Iowa		P				2
Kansas				P		1
Kentucky					P	2
Louisiana	P	P				2
Maine				P		1
Maryland				P	P	2
Massachusetts		F[e] (1990), P			P[f]	2
Michigan		P	P	P		3
Minnesota	F[g] (1991)					0
Missouri					P	1
Nebraska			P			1
Nevada					P	1
New Hampshire		P			P	2
New Jersey	P	P			P	6
New York	P	P		P	P	19
Ohio	P				P	1
Oklahoma	F[h] (1992)					0
Oregon	P			P	P	3
Pennsylvania	P	P		P	P	8
Rhode Island	P			P		4
South Carolina				P		1
Texas					P	1
Virginia					P[i]	1
Washington	P		P			2
West Virginia			P			1
Wyoming				P		1

Note: P = Proposed Legislation F = Finalized Legislation

[a]Proposed state legislation in this table dates back to January 1, 1999. Finalized legislation, however, spans the entire history of this legislative issue.
[b]Most proposed legislation banning the use of cellular phones permits emergency calls and allows a one- or two-minute grace period for pulling off to the side of the road.
[c]In California, rental cars with cellular telephone equipment must include written operating instructions concerning its safe use.
[d]Cellular phone use in Florida is permitted as long as the device provides sound through one ear and allows surrounding sound to be heard with the other ear.
[e]Cellular phone use in Massachusetts is permitted as long as it does not interfere with the operation of the vehicle and one hand remains on the steering wheel at all times.
[f]This piece of legislation only applies to school bus drivers.
[g]This statute requires police officers to indicate on motor vehicle accident reports whether or not cellular phone use played a part in the accident.
[h]This statute requires police officers to indicate on motor vehicle accident reports whether or not cellular phone use played a part in the accident.
[i]This piece of legislation only applies to school bus drivers.

Sources:"Cell Phones and Driving: 1999 State Legislative Update." NCSL, 1999. Environment, Energy, and Transportation Program. <http://www.ncsl.org/programs/esnr/celphone.htm>.

Legislative Tracking Database provided by the National Highway and Transportation Safety Board in conjunction with the National Conference of State Legislatures. <http://www.nhtsa.dot.gov/ncsl> (Legislative year: 2000. View Available Records: Cell Phone Issue).

National Highway Traffic Safety Administration, 1997, State Net search through Lexis Nexis.

Personal communication with ComCARE Alliance (1999).

"Spring 2000, Telecommunications Report." StateScape. June 30, 2000: 59.

Allyson Vaughn. "Missouri: Jail Time for Car-Phone Use?" Wireless Week, February 7, 2000. <http://www.wirelessweek.com/news/feb00/ftwo27.htm>.

Allyson Vaughn. "Driving, Talking Targeted Again." Wireless Week, April 3, 2000. <http://www.wirelessweek.com/News/safety/in43.htm>.

ing survey conducted by the Yankee Group, we estimate that consumers spend 60 percent of their cellular phone time while driving. This estimate would imply that, for consumers to remain indifferent between a ban and no ban, they would need to be paid about $25 billion if they were not allowed to use their cellular phones while driving.

Benefits of a Ban Economists can measure the costs of cellular phone use by drivers in terms of the *lost* lives, property damage, and injury costs of accidents associated with driver use. Collisions are caused by several contributing factors, so it is difficult to attribute all the costs to a single factor, such as the use of a cellular phone. In our cost estimates, we assumed that drivers using cellular phones did not take into account any of the accident risks. If drivers did take account of some or all of these risks, the demand curve would reflect that. Counting them again would bias our benefit-cost analysis in favor of a ban.

The best estimate of accidents and fatalities was based primarily on the available data from actual accident reports and narratives at the state and national level. We also used an influential epidemiological study by Redelmeier and Tibshirani. We chose to construct our best estimate based on a careful, subjective weighting of these two data sources.

We relied more on the actual data because we felt that they were likely to yield a more reliable measure of the impact of cellular phones on vehicle accidents and fatalities. Our upper bound is generated by using an estimate of risk of driving from the epidemiological study.

We used state and national accident data to generate four different estimates of the number of accidents associated with cellular phones. For the purposes of this analysis, we will assume that those accidents are actually caused by drivers' use of cellular phones. The lowest estimate is that fewer than 3 in every 10,000 accidents were related to driver cellular phone use in 1999. The highest estimate from state data is that cellular phones were associated with 1 in every 1,000 vehicle accidents. Weighting the four estimates equally–two from state data and two from national data–yields an estimate that 2 out of every 1,000 accidents were associated with driver cellular phone use. The state and national data imply that about 80 fatalities out of 41,000 national fatalities each year are associated with cellular phone use in cars. If only 3 in every 10,000 accidents are related to driver cellular phone use, then only 10 fatalities a year are associated with cellular phone use in cars. We will use that estimate as our lower bound.

Redelmeier and Tibshirani estimated the relative risk of talking on a cellular phone while driving was 4.3 for accidents not involving injuries. It is not clear that the same risk factor holds for more serious accidents. Assuming that it does, the probability of having an accident while using a cellular phone is 4.3 times the probability of having an accident when not using a cellular phone.

It may not be appropriate to use that risk factor to extrapolate to an estimate of cellular phone accidents nationally. Cellular phone users may not be representative of the general driving population and may not use their phones for the same proportion of time during all driving conditions. If cellular phone users are safer than average drivers or if they use their phones during relatively safe periods, then a direct extrapolation using the risk factor of 4.3 would overestimate the number of accidents. In addition, drivers may be willing to take small risks of getting in minor accidents as Redelmeier and Tibshirani have shown. This finding does not necessarily imply that these same drivers would take a comparable risk if the consequences were death. We also believe that those who use cellular phones while driving are likely to be better educated and have higher incomes, on average, than other drivers. Such characteristics may make them more careful than average drivers to avoid fatal accidents. Because of these potential biases, we treat the risk factor of 4.3 as an upper bound.

Using that risk factor, we developed an upper bound estimate of fatalities related to cellular phone use. Using survey data, we estimate that 0.7 percent of driving time is spent on a cellular phone. Assuming drivers using cellular phones are as safe as average drivers and drive under similar conditions, we estimate that 3 percent (0.7 times 4.3) of accidents occur while a driver is talking on a phone. Subtracting the general risks from traveling in a vehicle implies that about 2.3 percent of accidents are attributable to the use of a cellular phone while driving. This percentage implies that about 1,000 out of 41,000 driving-related fatalities annually are caused by cellular phones.

If we assume that cellular phones increase the risk of minor accidents, injury accidents, and fatal accidents equally, our estimates suggest between 10 and 1,000 fatalities are associated with or caused by cellular phones. After considering the concerns about the two estimates, we decided to calculate our best estimate by taking a weighted average of our estimates from crash data and the epidemiological study. We used 300 as our best estimate of the number of fatalities caused by cellular phones. We used the estimate based on the relative risk as our upper bound. In summary, we estimated cellular phone use in vehicles causes 300 fatalities per year, with a range of 10 to 1,000 fatalities. Assuming the same percentage of accidents as fatalities yields a best estimate of 38,000 accidents involving injuries, with a range of 1,300 to 130,000.

We then placed a dollar value on those estimates of accidents. Our analysis draws heavily on a study by NHTSA (1994), which monetizes the economic costs of motor vehicle accidents. The study found that traffic accidents result in annual losses of about \$170 billion. By chance, the total numbers of crashes and fatalities in 1994 were almost exactly the same as projections for 1999. Thus, the 1994 data offer a reasonable approximation of economic costs of accidents in 1999. The \$170 billion figure represents the present value of lifetime economic costs for 41,000 fatalities, 5.2 million nonfatal injuries, 3.7 million uninjured occupants, and 27 million damaged vehicles. These accidents include both police-reported and unreported accidents. Most of the \$170 billion in NHTSA's calculation stems from lost productivity in the workplace and direct medical expenses.

NHTSA's measures of costs take account of only direct costs but do not consider what an individual would be willing to pay to reduce mortality and morbidity risks. If we use Viscusi's 1993 willingness-to-pay estimate of \$5 million per statistical life, adjusted to \$6.6 million to account for inflation, NHTSA's estimate would increase from \$170 billion to \$410 billion. If willingness to pay to prevent injuries (morbidity) were taken into account, NHTSA's estimate would increase to \$630 billion. That amount is our best estimate of the total annual cost of motor vehicle accidents.

Estimating that cellular phone use contributes to just under 0.74 percent of total accidents, we calculated the costs of drivers' cellular phone use to be \$4.6 billion per year (0.0074 times \$630 billion). About half of this \$4.6 billion is attributable to the 300 estimated fatalities associated with driver use of cellular phones, while the other half represents the costs associated with more minor accidents in which cellular phones were a contributing factor.

Net Benefits of a Ban On the basis of the preceding cost and benefit estimates, national legislation banning cellular phone use by drivers would impose annual net costs of about $20 billion ($25 billion in costs minus $4.6 billion in benefits). Indeed, the costs of a ban are more than five times greater than the benefits. These results are summarized in the first part of Table 2 as our best estimate.

A great deal of uncertainty exists in many of the parameter values used in our model. To account for key uncertainties, we considered a wide range of parameter values for the number of lives saved, the amount of time drivers spend using a cellular phone, and the price elasticity of demand. A range of 10 to 1,000 is used for lives saved, based on a lower bound from NHTSA's study of North Carolina crash narratives and an upper bound from an extrapolation from Redelmeier and Tibshirani's estimate of relative risk. Hausman's estimate for price elasticity applies to all cellular phones, not only phones in vehicles. To account for that additional source of uncertainty, we used a range of –0.17 to –0.84 for price elasticity, based on two of Hausman's standard error estimates. A range of 40 percent to 70 percent was used for the percentage of time cellular phones are used by drivers. The lower-bound estimate assumes passengers use cellular phones proportionally to drivers while our best estimate assumes that passengers rarely use phones.

The qualitative nature of our ranges does not allow us to provide precise confidence intervals. To present this uncertainty, we first calculated the minimum and maximum costs, benefits, and net benefits by choosing the most extreme values for all parameters simultaneously. The results are presented in the last column of Table 2. For example, the benefits of a ban range from at least zero to $21 billion, which primarily reflects the large uncertainty in the number of fatalities associated with cellular phone use. This approach creates the largest plausible ranges, although it is unlikely that the costs, benefits, or net benefits are near the ends of those ranges. Such a result would require unlikely values for all our estimates simultaneously. For that reason, the ranges presented in Table 2 overstate the uncertainty in our results.

Another approach to illustrating the sensitivity of the results is shown in Figure 1, which shows the effect of varying one parameter at a time. By varying each parameter, we are able to determine the most important uncertainties. We use a plausible range for each key variable and calculate the corresponding range of net benefits. Varying the price elasticity of demand yields net cost estimates ranging from $14 billion to $73 billion. Varying fatality and injury estimates also generates a large range for net costs, but even if cellular phones cause 1,000 fatalities a year, a ban would still result in net costs of $9 billion annually. Only when extremely conservative estimates are used for both the number of fatalities and the price elasticity of demand do we calculate positive net benefits. Because that result requires extreme assumptions for two variables simultaneously, we feel that it is extremely unlikely for the benefits of a ban to exceed the costs. We found that for most plausible ranges for parameter values, a ban on cellular phones while driving cannot be justified for the United States on narrow grounds of economic efficiency.

Table 2

Benefits and Costs of Policies Regulating Cellular Phones in Vehicles (in millions of dollars)

Ban on the Use of Cellular Phones While Driving		
	Best Estimate	Range [a]
Benefits	$4,600	$110 to $21,000
Costs	$25,000	$10,000 to $87,000
Net Benefits [b,c]	($20,000)	($87,000) to $6,800 [d]
Mandate for Hands-Free Devices		
	Plausible Estimate	Range [a]
Benefits	$690	$0 to $6,300
Costs	$1400	$100 to $7600
Net Benefits	($710)	($7600) to $6,200

Sources: Hausman (1997), NHTSA (1996, 1997, 1998, 1999).

[a] Ranges are determined by taking maximum and minimum values of key parameters.

[b] Numbers in parentheses are negative.

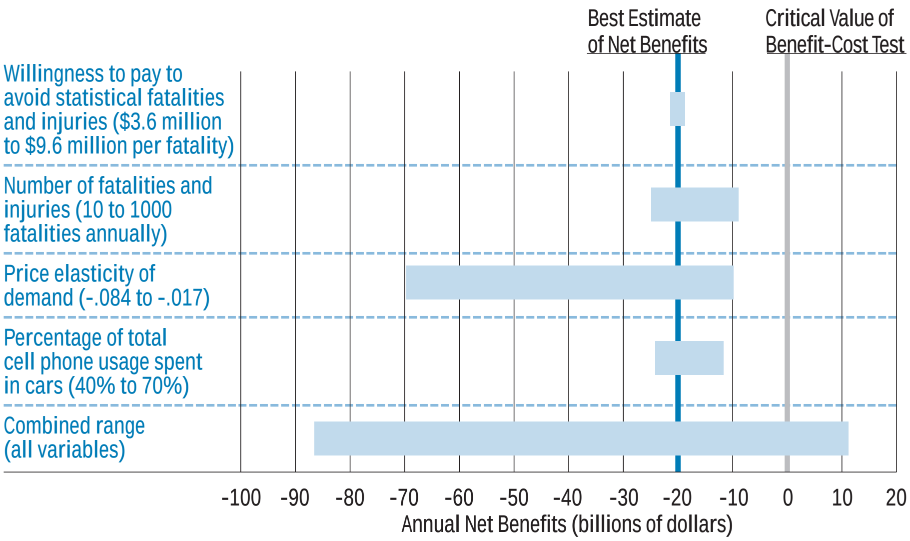
[d] The upper bound on benefits and the lower bound on costs cannot occur at the same time because they assume different levels of penetration. The $6,800 figure represents the maximum net benefits when the penetration rate in the cost and benefit calculation is the same.

Hands-Free Mandate Despite that strong evidence that a ban would not pass a benefit-cost test, less draconian policies could still be justified. For example, a policy that mandates the use of a hands-free device in conjunction with a conventional cellular phone would allow consumers to reap many of the benefits of using phones while driving, albeit at some additional cost. At the same time, such a mandate could reduce the number of accidents by freeing a driver's hands. Other approaches, such as a policy requiring voice-activated dialing or one restricting who may use a phone or under what conditions, may also be justified but we did not make those calculations because of a dearth of data.

We analyze the economics of a hands-free mandate and assume that drivers using cellular phones would purchase the least expensive hands-free technology. We define the least expensive device as the one that provides the lowest net cost to consumers after they have already taken into account the convenience of the device and the time it takes to shop for it. The least expensive hands-free device, ignoring convenience benefits and shopping costs, has a price of $20 to $60, depending on the model of phone. A hands-free mandate would force people who currently own a phone to make an extra trip to purchase the hands-free device. After a hands-free mandate is in place, people would presumably purchase the hands-free device concurrently with their new phone purchase and thereby save time, but in this example we include the additional search costs. We assume that the opportunity cost of time for cellular phone users is $20 per hour. Each person who uses a hand-held phone in a vehicle is assumed to spend 30 minutes shopping for a hands-free device; thus, the search cost is $10. Adding the search cost to the price of the phones produces a range of $30 to $70 for the full cost of the device with an average price of $50. If we assume that consumers do not incur losses in

Figure 1

Sensitivity of Best Estimate to Key Variables



Sources: Hausman (1997), NHTSA (1997), Viscusi (1993), and author's calculations.

convenience for having that device in their car, we can place an upper bound of the net costs of such a device at $50. Those users have not purchased that device on their own, so their revealed preference suggests that the lower bound on the net costs is slightly more than zero. We take the average of those two extremes as our best estimate of the net costs of obtaining such a device. Assuming the device lasts for three years, we calculate an amortized cost of purchasing the device to be $9 annually.

After individuals purchase their devices, the hands-free mandate would also require them to use the device for every phone call that they make while driving. Drivers had the option to do so without that requirement, however. Such a requirement therefore will not make drivers better off and may be inconvenient. It is difficult to calculate the costs of that possible inconvenience but we offer the following example of how it might be done. If one assumes that the average person drives two times a day, prepares the cellular phone for use in the vehicle, and that it takes 15 seconds to plug the device into the phone and install the earpiece, the user would spend 3 hours a year connecting and disconnecting the device. At $20 per hour, this example suggests that the annual inconvenience costs could be on the order of $60. We do not believe that the inconvenience would necessarily be close to $60 annually for the average user, due to offsetting utility gains from using the device. For purposes of this calculation, we use $15 annually as our best estimate of the inconvenience cost.

Adding the $9 purchase cost and the $15 inconvenience cost produces a plausible estimate of $24 for those individuals using cellular phone in cars who do not currently own a hands-free device. We call this a plausible estimate to reflect the large uncertainty in our calculation.

This estimate ignores some other potentially important costs. For example, people may simply dislike using the hands-free device. Moreover, attaching the device while driving could actually increase risks. Unfortunately, we do not have any data or reasonable ways of bounding such costs.

Net Benefits of a Hands-Free Mandate
Multiplying the 60 million affected cellular phone users (23 percent of the 77 million cellular phone users do not operate hand-held phones while driving) by the net cost of about $24 per user yields our plausible estimate that a hands-free mandate would cost $1.4 billion. Using this estimate and our best estimates for all risk variables, we find that hands-free regulation would fail a benefit-cost test unless it resulted in roughly a 25 percent reduction in accidents related to cellular phone use.

According to evidence from accident data in Japan and North Carolina, about 15 percent of cellular-related collisions could have been avoided if the drivers had been using hands-free devices. This estimate is very uncertain because the studies on which they are based suffered from a lack of data and did not focus particular attention on the safety of hands-free devices.

A 25 percent reduction in accidents from hands-free regulation seems unlikely, so proposals to ban hand-held phones fail our benefit-cost test unless consumers receive larger convenience and safety benefits from hands-free devices than we assume in our example. The conclusion is dependent on the number of fatalities attributable to cellular phones. If evidence reveals that cellular phones cause significantly more fatalities than our best estimate of 300, a hands-free mandate would pass our benefit-cost test.

The second part of Table 2 presents best estimates and ranges for the benefits and costs of a hands-free device mandate in the United States. The benefit of this mandate is equal to the benefit of a ban times the percentage of accidents reduced. Our illustrative estimate is that a hands-free mandate would cost users $23 per year, which implies a total cost of $1.4 billion annually. If we assume a 15 percent accident reduction, the benefits would be roughly $700 million, suggesting net costs of $700 million. Our estimated net benefits range between $6.2 billion and negative $7.6 billion. The range of net benefits is very large because of the large uncertainty in the number of fatalities and injuries reduced by a hands-free mandate.

While it is possible future information will reveal that a hands-free mandate is cost-effective, we would be reluctant to recommend a mandate at this point. We believe a mandate would not be warranted because the data on the effectiveness of these devices are very uncertain and our analysis suggests that a mandate would not pass a benefit-cost test. Moreover, the introduction of other technologies, such as voice activation, could reduce the need for hands-free devices. The key policy point is that we should be wary about mandating a technology whose efficacy is questionable and which may be superseded or complemented by new technologies that are safer.

A FRAMEWORK FOR POLICY EVALUATION

GIVEN THE LIMITED DATA, WE HAVE BEEN ABLE TO EVALUate quantitatively only two options for regulating cellular phones while driving—a ban and a mandate of hands-free devices. Because the cellular phone industry is so dynamic, a framework for analyzing future technological developments could assist regulators in making informed decisions. Figure 2 provides such a framework. It presents a graph of the tradeoff between accident reduction and the cost of regulation to cellular phone subscribers which was obtained from our model. The positive slope of the line illustrates that as a technology or policy increases in cost, it needs to be more effective in reducing risks for it to pass a benefit-cost test or a cost-effectiveness test. A proposal lying above the line in the graph is not cost effective in the sense that it fails to reduce accidents sufficiently to justify its expense. For the case of mandating hands-free devices, analyzed earlier, the figure shows that the area corresponding to the plausible range of accident reduction and cost per subscriber falls almost entirely outside the cost-effective region. This result suggests that a hands-free mandate is not likely to be economically justified.

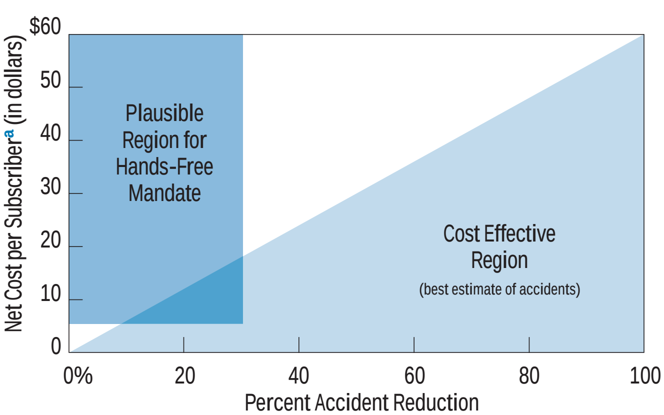
To illustrate the power of this framework, consider the following example. Assume that built-in, voice-activated technology on cellular phones prevents half of all accidents related to cellular phone use and that consumers derive no utility from the technology. From Figure 2, we see that a technology that reduces accidents by 50 percent would pass a benefit-cost test if it costs no more than about $30 per subscriber annually.

The framework underlying Figure 2 can also accommodate changes in a variety of key assumptions. For example, a critical concern is how accidents could be affected by increases in drivers' cellular phone use in vehicles. Some would argue that the risks will increase more than proportionally if the number of drivers using cellular phones increases. Current data do not support that view, however. Predictions of fatalities from driver cellular phone use that are based on linear extrapolations from previous years overestimate today's observed fatalities. The important point for analysis is that both views can easily be accommodated in Figure 2 by simply adjusting the slope of the line to reflect particular cases of interest.

We emphasize that this framework provides a useful tool for examining different policy options. However, we think that it is not definitive because there are many uncertainties and biases not addressed in our analysis and because other factors may be important in the design of policy. For example, if society values accident reductions to average citizens at a premium relative to its valuation of the welfare gains that drivers using cellular phones receive, then the slope of the line in Figure 2 would increase.

Figure 2

Framework for Identifying Cost-Effective Policies



Sources: Hausman (1997), NHTSA (1996, 1997, 1998).
[a]Net cost is the cost in excess of offsetting utility gains

POSSIBLE CRITIQUES OF OUR ANALYSIS

THE PRECEDING ANALYSIS LEAVES OUT AT LEAST THREE important factors that could alter our policy conclusions: our demand elasticity estimates; the possibility of substitution to other risky behavior; and how policies are actually enforced.

Demand Elasticity The demand curve used in our analysis describes the cellular service industry as a whole. It does not explicitly consider the ease with which consumers can switch between using cellular phones in vehicles and cellular phones in other places, such as at the office or on the street. Our demand curve considers only the ease of switching cellular phone calls with other types of communication methods like pager calls and traditional landline calls. This demand curve is not valid if replacing in-vehicle calls from cellular phones with out-of-vehicle cellular phone calls (i.e., if the driver pulls to the side of the road before calling) is easier for consumers than replacing in-vehicle calls from cellular phones with landline calls (the demand curve for cellular phones while driving would be more elastic than the one Hausman estimates for the entire industry). In that case, our estimate of the cost of a policy intervention limiting cellular phone use while driving is likely to be overstated.

It is unlikely, however that the price elasticity will be sufficiently high to change our ultimate conclusions with respect to a ban. For a ban to pass a benefit-cost test, the absolute value of the price elasticity required is at least three. Thus, if a 3 percent reduction in cellular calls made while driving results from a 1 percent increase in the price of calls from vehicles, then a ban might increase economic welfare. Because many businesspeople place a high value on their time, however, calls made while commuting to work are unlikely to be dramatically affected by a 1-percent increase in this price.

The bias is also not very likely to affect the qualitative conclusion on net benefits for a hands-free technology mandate. The decision to implement hands-free technology is insensitive to elasticity changes unless a substantial number of consumers would choose to forgo vehicle calls altogether when confronted with hands-free regulation, a situation we consider unlikely.

Substitution Effects A second potential source of bias in our results lies in the driver response to hands-free regulation or an outright ban. The analysis implicitly assumes that the driver will not engage in other risky driving behaviors as a result of that policy intervention. If drivers instead respond to regulation by performing other distracting tasks in place of using the phone, the gross accident figures from NHTSA data systematically overstate the extent to which a ban would help. In fact, we do not know whether a driver would be likely to engage in more or less risky behavior. It is highly unlikely, however, that the intervention would result in changes in driving behavior that are riskless.

In an extreme scenario, one could imagine a driver's performing a task more distracting than talking on a phone under a ban. More than half of all cellular phone users have used their phones to call for directions according to a 1995 Cellular Telecommunications Industry Association survey. Drivers who value their time may need directions to a destination. With access to phones, they may elect to call from their vehicle for directions. Without access to phones, they may attempt to read a map while they are driving. According to the Transportation Research Institute, reading a map is actually more distracting than talking on a phone. In this example, a ban would increase the risk a driver imposes on others.

While we are not arguing that overall risks would increase, we are arguing that the gross number of accidents and fatalities associated with cellular phones is likely to overstate the actual risk that is reduced from a policy intervention perhaps by a large amount. Drivers, especially those who are as time-conscious as the drivers using cellular phones, will increase the amount of time they spend on other distracting tasks if they are not permitted to use their cellular phones while driving. If cellular phone use in vehicles were banned, we would not be surprised to see additional fatalities resulting from such tasks as eating, tuning a radio, talking to a passenger, or surfing the Web . Indeed, NHTSA estimates that fatalities associated with accidents from such inattentive driving activities number 4,000 annually, compared with a best estimate of 300 resulting from cellular phones.

Another important factor that could lead to overestimation of net fatalities is the impact a ban would have on reporting potential problems to authorities. Although most of the proposed regulations would exempt cellular phone use in an emergency, a ban on nonemergency use would tend to decrease the instances of people's carrying phones in their cars. The safety-enhancing effect of ubiquitous cellular phones is a byproduct of having the phones available for other uses. Thus, some of the positive social impacts of cellular phones, like the quicker reporting of accidents, for example, would be reduced.

The effect of overestimating accidents and fatalities on our results would be to make the proposed ban and the mandate to use hands-free devices look less attractive from an economic point of view. Because they already are unlikely to pass a benefit-cost test, that effect is unlikely to change our qualitative results.

Enforcement A final key issue that needs to be addressed is how a policy is actually enforced. Our calculations have assumed that policies are perfectly enforced. We know that in many countries these policies are either not enforced or that enforcement is far from perfect. Moreover, some of the policies may be quite costly and difficult to enforce. Imagine, for example, trying to enforce a total ban in the United States. Drivers who use cellular phones could respond by putting tinted glass in their vehicles, which would make phone use harder to detect. Many cab drivers in New York City use hands-free devices, possibly, in part, to avoid detection.

Less than perfect enforcement is likely to reduce both the costs and the benefits of the two policies considered here. A plausible assumption is that the costs and the benefits will be reduced proportionally. If benefits and costs are reduced proportionally when a policy is imperfectly enforced, then the qualitative relationship between benefits and costs is not likely to change.

The proportionality assumption may not be realistic, however. Suppose, for example, that those users who benefit most from cellular service would be the ones willing to risk getting caught. Under such circumstances, the cost of regulation would decrease dramatically if the law were poorly enforced. The people getting the most surplus from cellular service would be the people who break the law. But if the citizens receiving the greatest surplus from cellular phones are also the citizens who are most likely to abide by the law, a ban would have relatively greater costs. Without more detailed information, it is difficult to know how imperfect enforcement will affect costs and benefits.

Another important issue related to enforcement arises if the police have a fixed amount of resources. If some resources were devoted to enforcing driver cellular phone regulations, then some benefits would presumably be forgone elsewhere because other policies would be enforced with less vigilance. Without more information, it is difficult to know whether that issue is important empirically.

Our basic conclusion is that the enforcement considerations could be important determinants of the total level of net benefits achieved from the policies considered here. At the same time, they are not very likely to change the qualitative results.

POLICY RECOMMENDATIONS AND CONCLUSIONS

REGULATION OF THE USE OF CELLULAR PHONES BY DRIVERS is now commonplace outside the United States and has been proposed in a number of jurisdictions in the United States. On benefit-cost grounds alone, a proposed ban and a mandate to use hands-free devices are not likely to be justified in the United States. We are less sure whether such policies are justified elsewhere because of an absence of data, nor does our analysis consider the effect of a ban or hands-free mandate on particularly accident-prone subpopulations.

We doubt that the net benefits from a ban on drivers' use of cellular phones would be significant for three reasons. First, the results of our quantitative benefit-cost analysis suggest that costs are likely to exceed benefits under a range of assumptions. Second, our best estimates of accident and fatality reductions do not take into account how drivers would alter their behavior in response to regulation. If regulations were enforced, drivers might simply switch to other risky behaviors. Thus, the net reductions in accidents and fatalities are likely to be overstated, which means that the benefits of regulatory interventions could be quite small. Third, the technology is already moving in the direction of voice-activated cellular calls, which could reduce risks.

The economic analysis of mandating drivers' use of hands-free devices is less conclusive. Our benefit-cost analysis suggests that such devices may be justified, but the uncertainties on both the benefits and costs are large. Without stronger data supporting the view that such devices actually reduce accidents and fatalities, we would be reluctant to recommend requiring their introduction.

It is likely that the market will more effectively address risks associated with cellular phone usage than would highly regulatory government intervention. As an example, several cellular phone makers and service providers have recently introduced voice-recognition technology.

If the problem with using cellular phones while driving becomes severe enough, vehicle insurance companies may begin to classify drivers who use cellular phones in higher-risk groups and charge those drivers commensurately higher insurance premiums. Because an insurance company bears the burden of reimbursing injured parties for their losses, a rational company would consider charging drivers who use cellular phones higher premiums to compensate for any increased risk that cellular phone use forces the company to assume. Insurance companies are not likely to introduce such pricing schemes if the transaction costs of doing so exceed the private benefits to the company.

Instead of regulating now, the government should carefully monitor the problem and improve the information base for making regulatory decisions. It is possible that fatalities are significantly underestimated now. Moreover, an argument can be made that accidents will increase more than linearly as more drivers use cellular phones. Finally, technologies could emerge that the government should encourage. To address those issues, the federal government and the states should collect more systematic information on the possible relationship between cellular phone use while driving and accidents.

The government should also assess the benefits and costs of mandating the use of promising new technologies, such as voice activation, as well as older ones, such as hands-free devices. More research on the effectiveness of hands-free devices in countries and municipalities that have required their use could help determine whether these devices should be encouraged. There is also a need for research on the extent to which cellular phones increase net accidents and fatalities, while taking into account the potential positive impacts that cellular phones could have on the reporting of hazards and accidents.

Simple improvements in information collection could help reduce uncertainty. If all states included a statistic in their accident reports describing whether the driver was using a cellular phone at the time of a collision, the resulting national data would be much more reliable. Similar additions to the Fatality Analysis Reporting System, endorsed by NHTSA, could substantially improve the federal database.

Government may also have a role in providing easily accessible information to consumers on the risks of different kinds of cellular phone usage. A number of parties currently supply such information, including newspapers, companies, and interest groups, so the government needs to be careful not to duplicate their efforts.

A useful role the government could play is to help sort out high risks from low risks. For example, some gas stations have banned the use of cellular phones while refueling. We think the risks of serious accidents in this situation are likely to be minimal, and the government could play a useful role here by providing information that could reduce "cell-phone phobia" in areas where it is not justified.

The general lesson we take from this analysis is that the mere existence of a problem does not, by itself, warrant government intervention. Our review of the available data suggests that drivers' cellular phone usage does lead to an increase in accidents and fatalities. It is not obvious, however, that feasible government policies would significantly reduce the size of the problem. Moreover, for government intervention to be warranted, a strong case needs to be made that the likely economic benefits exceed the costs by a significant amount. Our analysis suggests that the case has yet to be made for regulating drivers who use cellular phones; however, a more tempered response, in which government continues to assess the size of the problem, provide useful information, and fund research, is warranted.

The problem of regulating potentially risky technologies in vehicles is not likely to go away. Many technologies other than cellular phones have the potential to distract drivers and increase the risk of our roads. The U.S. government has chosen not to regulate some of these technologies; car radios are an example. Others, such as e-mail, Web browsing, fax machines, or cellular phones, may be regulated. We strongly encourage governments to consider the economics of such choices before implementing a potentially costly regulation.

readings

- Battelle. *Lexington Area Travel Data Collection Test*. Final Report to Federal Highway Administration, 1997 (available at *www.fhwa.dot.gov/ohim/lextrav.pdf*).
- William J. Baumol and Wallace E. Oates. *The Theory of Environmental Policy*. Cambridge, Mass.: Cambridge University Press, 1975.
- Cellular Telecommunications Industry Association (CTIA). *CTIA Survey*. Washington, D.C.: World of Wireless Communications, 1996 (available at *www.wow-com.com*).
- CTIA. *Semi-Annual Wireless Survey*. World of Wireless Communications, 1999 (available at *www.wow-com.com*).
- Council of Economic Advisers. *Economic Report of the President 1999*. Washington, D.C.: U.S. Government Printing Office, 1999.
- S. H. Fairclough. "Voice Communication in Vehicles," In *Driving Future Vehicles*, edited by S. Franzer and A. Parkes. London: Taylor and Francis, 1993.
- John D. Graham and Jonathan B. Wiener. *Risk Versus Risk: Tradeoffs in Protecting Health and the Environment*. Cambridge and London: Harvard University Press, 1995.
- Scott E. Harrington. *Insurance Deregulation and the Public Interest*. Washington, D.C.: AEI-Brookings Joint Center for Regulatory Studies, January 2000.
- Jerry A. Hausman. "Valuing the Effect of Regulation on New Services in Telecommunications." *Brookings Papers on Economic Activity, Microeconomics*, 1997: 1.
- M.S. Horswill and F.P. McKenna. "The Effect of Interference on Dynamic Risk-taking Judgements. *British Journal of Psychology* 90 (1999): 189.
- Japanese National Police Agency. "Study of Inquiry Producing Crashes during June 1996." *Daily Automobile Newspaper*, August 17, 1996.
- Lester B. Lave. The Strategy of Social Regulation: *Decision Frameworks for Policy*. Washington, D.C.: Brookings Institution, 1981.
- Randall Lutter, John F. Morrall III, and W. Kip Viscusi. "The Cost per Life Saved Cutoff for Safety-Enhancing Regulations." *Economic Inquiry* (forthcoming).
- James McKnight and A. Scott McKnight. "The Effect of Cellular Phone Use upon Driver Attention." *Accident Analysis and Prevention* 25 (1993): 259.
- Minnesota Department of Public Safety, Office of Traffic Safety. *Minnesota Motor Vehicle Crash Facts*, 1998. St. Paul, Minn.: Department of Public Safety, 1998.
- Steven A. Morrison, Tara Watson, and Clifford Winston. "Fundamental Flaws of Social Regulation: The Case of Airline Noise." *Journal of Law and Economics* 42 (1999): 723.
- National Highway Transportation Safety Administration, Federal Highway Administration (NHTSA/FHA). "Motor Vehicle Accident Costs—Technical Advisory." Washington, D.C.: National Highway Transportation Safety Administration, 1994.
- NHTSA/FHA. 1996 *Traffic Safety Facts*. Washington, D.C.: National Highway Transportation Safety Administration, 1996.
- NHTSA/FHA. *An Investigation of the Safety Implications of Wireless Communications in Vehicles*. Washington, D.C.: National Highway Transportation Safety Administration, 1997.
- NHTSA/FHA. *1998 Traffic Safety Facts*. Washington, D.C.: National Highway Transportation Safety Administration, 1998.
- NHTSA/FHA. *Early Assessment of 1998 Crashes, Injuries, and Fatalities*. NHTSA/NCSA. Washington, D.C.: National Highway Transportation Safety Administration, 1999 (available at *www.nhtsa.dot.gov/people/ncsa/Reports.html*).
- L. Nilsson. "Behavioral Research in an Advanced Driving Simulator: Experiences of the VTI System," *In Proceedings of the Human Factors and Ergonomics Society 37th Annual Meeting*, 1993:612.
- Oklahoma Department of Public Safety, Highway Safety Office. 1997 *Oklahoma Traffic Crash Facts*. Oklahoma City: Department of Public Safety, 1997.
- Philip M. Parker and Lars-Hendrik Röller. "Collusive Conduct in Duopolies: Multimarket Contact and Cross-Ownership in the Mobile Telephone Industry." *RAND Journal of Economics* 28 (1997): 304.
- A. M. Parkes "Drivers' Business Decision-Making Ability Whilst Using Carphones." In *Contemporary Ergonomics, Proceedings of the Ergonomic Society Annual Conference*, edited by E. Lovessey. London: Taylor and Francis, 1991.
- Sam Peltzman. "The Effects of Automobile Safety Regulation." *Journal of Political Economy* 83 (1975): 677.
- Personal Communications Industry Association (PCIA). *Wireless Users and Safety: A Survey of Usage and Attitudes Towards Safety and Regulation*. Washington, D.C.: Personal Communications Industry Association, 1999.
- PCIA. *Market Demand Forecast for Terrestrial 3rd Generation (IMT-2000) Services for the PCIA*, 1998 (available at *www.pcia.com/wireres/3gstudy.htm*).
- Donald A. Redelmeier. "Car Phones and Car Crashes: an Ecologic Analysis." *Canadian Journal of Public Health* 89 (1998): 157.
- Donald A. Redelmeier and R.J. Tibshirani. "Association Between Cellular Telephone Calls and Motor Vehicle Collisions." *New England Journal of Medicine* 336 (1997): 453.
- Donald A. Redelmeier and Milton Weinstein. "Cost-Effectiveness of Regulations Against Using a Cellular Telephone While Driving." *Medical Decision Making* 19 (1999): 1.
- J.M. Violanti and J.R. Marshall. "Cellular Phones and Traffic Accidents: An Epidemiological Approach." *Accident Analysis and Prevention* 28 (1996): 265.
- W. Kip Viscusi. "The Value of Risks to Life and Health." *Journal of Economic Literature* 31 (1993): 1912.
- Clifford Winston and Chad Shirley. *Alternative Route: Toward Efficient Urban Transportation*. Washington, D.C.: Brookings Institution Press, 1998.
- Yankee Group. *1999 Mobile Users Survey*. Boston, Mass.: Yankee Group, 1999.