

EVIDENCE AND EVALUATION: THE NATIONAL MINIMUM DRINKING AGE ACT OF
1984¹

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Abstract: When considering federal legislation to encourage states to raise the drinking age to twenty-one, public officials faced a common problem: assessing the efficacy of a proposed policy change from diverse evidence that is deficient in quality and quantity. This paper shows how the political system yielded an assessment that was substantially more optimistic than merited by the evidence available at the time. This outcome was shaped less by political inadequacies than by the failure of academia to provide the requisite intellectual background and institutional failures within the federal agency that oversees traffic safety.

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ACRONYMS USED IN THE PAPER

AAA: American Automobile Association

BAC: Blood Alcohol Concentration

CPSC: Consumer Product Safety Commission

DWI: Driving While Intoxicated (drunk driving)

GAO: General Accounting Office, a federal government “watchdog” agency

IIHS: The Insurance Institute for Highway Safety, an industry research and lobbying group

MADD: Mothers Against Drunk Driving, a group that lobbies for the enactment of various drunk driving countermeasures

MLDA: Minimum Legal Drinking Age

NHTSA: The National Highway Traffic Safety Administration, the federal agency with primary responsibility for traffic safety

NIAAA: National Institute on Alcohol Abuse and Alcoholism

NMDAA: National Minimum Drinking Age Act, which strongly encouraged states to raise the drinking age to 21

NSC: National Safety Council

NTSB: National Transportation Safety Board, a federal agency that investigates vehicle accidents, plane crashes, etc., and makes safety recommendations

TSCS: Time-series cross-section, data that contains variation over time across a number of cross-sectional units, such as states

In general the influence of the public, whether directly or through political institutions, has been pernicious to traffic safety. It comes and goes, filling in the troughs between peaks of more exciting events; it seizes on issues without concern for the relevance or tractability of the problems; it proposes “solutions” which are at best naïve and at worst absurd, and above all it demands action even where action may be only a waste of money (Haight, 1985).

Although it is hard to challenge Haight’s characterization of...the political process in the area of traffic safety, his proposed solution of entrusting the issue to low-profile agencies...seems wishful and unrealistic. His viewpoint neglects the fact that the recognition of any condition as a social problem is a political matter. It is not helpful for underdogs in the political game to pick up their chips, denounce the rules...and look elsewhere, when the political game is the only game in town. Even the experts are forced to play it, often as mere adjutants to parties with less sophistication but greater involvement and determination (Ross, 1992, p. 174).

The primary reason to undertake policy analysis is to inform public policy. Economists’ penchant for highlighting their results’ policy implications is so widespread that one respected economist has warned against its overuse.¹ The federalist system in the U.S., in which the states, “laboratories of democracy,” experiment with alternative solutions to social problems, is predicated on accurate assessments of these experiments, so that the most promising solutions thrive.

While policy analysts provide evidence on the effectiveness of these experiments, in the form of published and unpublished research, assessing the collective evidence and forming a summary judgment is often a political matter. Policy is generally governed by political actors instead of technical experts because it is necessary to trade off competing interests, “recognize a condition as a social problem,” or consider non-technical factors such as the social acceptance of a new law. In assessing the state of knowledge, these actors frequently face a daunting task. The merits of any given policy are generally uncertain, because of differences across studies in design,

¹ See slide 16 of Daniel Hamermesh’s slide presentation, “How to Publish in a Top Journal: I Wish I Knew!” at <https://www.wiwi.hu-berlin.de/professuren/vwl/wtm2/hamermeshslides>.

data, and interpretation, while the compressed time scales of policymaking heighten deficiencies in the quality and quantity of the evidence available at the point of decision (Jewell and Bero, 2008).

Unfortunately, the pages of academia offer limited insight into how these political actors negotiate these formidable impediments in assessing the evidence. The subject appears to fall in a no-man's-land between the topical research itself, on the one hand, and general theories of the policy process, on the other. This latter literature acknowledges the difficulties getting policymakers to care about policy analysis (Shulock, 1999), the frequent dissonance between the technocratic merit of a proposed policy and its political feasibility (Majone, 1989; Stone, 2001), and the role of learning in policy formation and diffusion (Keikkila and Gerlak, 2013; Meseguer, 2005), but does not examine the evaluative process in detail.² A better understanding of how these assessments are formed could improve their accuracy and help dispel a certain fatalism that hovers over the existing literature, which treats these impediments as intractable rather than as a consequence of intellectual, institutional, and political arrangements that can be ameliorated.

Such an inquiry, however, faces impediments of its own. Many relevant factors, such as political forces or institutional characteristics, are not quantifiable, but contextual (Contandriopoulos et al., 2010; Hahn, 2000). This invalidates an approach built around statistical analysis or a priori theorizing in favor of a qualitative, multifaceted case-study that induces general principles from specific situations. Using this approach, this paper investigates how evidence on the effects of raising the minimum legal drinking age (MLDA), “one of the most thoroughly

² The closest work we could find touches on other aspects of the analysis-policy nexus: techniques employed directly by policymakers, such as cost-benefit analysis (e.g., Boardman, Wining, and Waters, 1993), policies governed by technical experts (e.g., Blinder, 1997; Chalkidou et al., 2009), or those developed collaboratively between academics and other stakeholders (Greenhalgh et al., 2016).

evaluated social interventions of our time,” (Ross, 1992) was evaluated in the prologue to the 1984 passage of the National Minimum Drinking Age Act (NMDAA), which provided strong and ultimately successful incentives for all states to raise their MLDA to 21. We examine how well the federal government assessed the extant evidence on the effects of the raised MLDA, how well it assessed the limitations of that evidence, and how underlying intellectual and institutional factors influenced these assessments. We then generalize our conclusions, showing that the NMDAA is representative of a broad class of related policy issues, that our findings explain events related to subsequent drunk driving laws quite well, and that most behavior can be explained using universal principles, comparative advantage and self-interest especially.

In the prelude to the NMDAA, we find that the evidence on the MLDA’s effects was assessed far too optimistically. Perhaps this is not surprising. What is surprising is the cause of this outcome: not the failings of the political system per se, but those of its supporting cast, academia and the federal agency overseeing traffic safety, the National Highway Traffic Safety Administration (NHTSA). These problems can be ameliorated with the proposed reforms with which we close this paper.

Section I. The Setting.

A Brief History of the National Minimum Drinking Age Act. Legislation to curtail drunk driving and youth drinking began in the late 1970s, a reversal of the increased permissiveness earlier in the decade. From 1976-1980, thirteen states raised their drinking ages; in the subsequent three years, twelve more followed suit. Activity crested between 1984 and 1986 with the passage of hundreds of state laws, as documented in Table 1.

This activity was associated with three concomitant social changes, each also documented in Table 1. The first was increased social awareness of the dangers of drunk driving. Media coverage of the issue, almost wholly absent during the 1970s, grew rapidly after 1981. During the next quadrennium, hundreds of stories appeared in major newspapers and dozens of stories in magazines. Radio and television coverage also increased:

I can see it from my experiences of ten, twelve years ago as Secretary [of Transportation], when if I could get one TV camera to come to a hearing or a meeting about drunk driving, I thought we were very fortunate. They might stay as long as ten minutes. Our first hearing [of the Presidential Commission on Drunk Driving] we had four television cameras, twelve radio stations, and eight or nine newspaper people there. Two of the cameras stayed half a day and two stayed all day long. (John Volpe, Chair of the Presidential Commission on Drunk Driving, H1, 1983, p. 273.)³

This awareness translated into action—the second social change. Hundreds of organizations were formed whose purpose was to curtail drunk driving. The best known of these, Mothers Against Drunk Driving (MADD), played a key role in lobbying for the NMDAA and subsequent legislation and is still active today.

These two changes contributed to the third, in attitudes. The public became much less accepting of driving after drinking:

For...decades, the enormous toll of death and injury that occurred in the United States was regarded as accidental in almost a cosmic sense. The statistical toll of road accidents was collected and reported with an air of fatalism similar to attitudes toward earthquakes, tornadoes, or other natural disasters. At the same time, the...paradigm of responsibility began and ended with the personal fault of the parties to the accident. The public perception now in the United States...is that the manner in which...laws are drafted and enforced can have important effects on highway deaths and injuries (Zimring, 1988).

The American public is far less tolerant of drunk driving that they were ten years ago. It's no longer funny for Johnny Carson to joke about the issue. (Judith Stone, Director, Federal Affairs, National Safety Council, H5, June 1988, p. 24.)

³ This quote, like many others to follow, comes from the transcript of a Congressional hearing or Congressional debate. These events are each listed in the chronology in the Appendix, labeled H0-H6, and cited within the text using that appellation.

The popularity of a raised drinking age was established by a Gallup Poll in 1983.

Lawmakers responded to these social changes. While most legislative activity occurred at the state level, the issue also received federal attention, partly due to concern about youth (under 21) driving across state lines to take advantage of a lower MLDA. Federal transportation bills offered financial incentives to the states to adopt various drunk driving countermeasures (including higher drinking ages). President Reagan appointed a Presidential Commission on Drunk Driving, which held nationwide hearings and issued dozens of recommendations on the issue. Both NHTSA and the National Transportation Safety Board (NTSB) weighed in with written reports and testimony before Congressional subcommittees, which held several hearings on drunk driving and teenage drinking. The Appendix contains an extensive chronology of the activity surrounding the passage of the NMDAA.

In 1983 and 1984, these forces built to a fever pitch and provided the impetus for strong federal action. In November 1983, the Presidential Commission on Drunk Driving, following in the footsteps of MADD, the National Safety Council (NSC), the Insurance Institute for Highway Safety (IIHS), and the NTSB, formally recommended establishing a national drinking age of twenty-one in order to improve traffic safety. President Reagan signaled his support in June, 1984; the NMDAA was law one month later. Challenges to the law's constitutionality were exhausted by 1987; the last two states raised their MLDA's to 21 the next year.

Evidence on the Effects of the Minimum Legal Drinking Age: Then and Now. The country's eagerness for a raised MLDA was echoed by its supporters' optimism about its effects:

Nearly every state that has raised the drinking age to twenty-one has produced a significant drop in the (sic) teenage driving fatalities. In the state of New Jersey...the rate dropped by twenty-six percent; Illinois, it has fallen twenty-three

percent; in Michigan, thirty-one percent. (President Ronald Reagan, Remarks on Signing HR 4616 into Law, July 17, 1984.)

This degree of optimism, however, was not supported by the evidence that was available at the time, which was limited both in amount and enthusiasm.

This can be seen in Figure 1, taken from Grant (2013), which displays the academic literature through 2009.⁴ On this “bubble plot,” the horizontal axis represents the publication date, which is generally a couple of years after the data terminate, and the vertical axis represents the estimated percentage effect on fatalities involving affected drivers, with insignificant estimates set to zero. The volume of each bubble represents the number of academic citations in Google Scholar as of June 2009, while bubbles ringed in black circles are supported by external funding, generally from the National Institute on Alcohol Abuse and Alcoholism (NIAAA).

While the evidence available in 1984—especially for raised MLDAs—was quite limited, an outpouring of evidence occurred in subsequent years. While this evidence is quite varied, it nonetheless follows a distinct progression, both in result and method. The former can be tracked using the trendline, while the latter can be tracked using the color of the bubbles. Red represents cross-section regression and blue quasi-experimental designs, which generally compare the change in fatalities in one, or a few, law-adopting states with the change in control states that do not adopt the law. The spatial and temporal dimensions are combined in pooled time-series cross-section (TSCS) regressions, in purple, which do not incorporate state and year fixed effects, and superior panel regressions, in white, which do.

Overall, Figure 1 documents the following evolutionary process. Early studies, dominated

⁴ This includes all studies published in an academic book or refereed journal that estimate the effect of the raised MLDA on the affected population (generally 18-20 year olds), omitting regression discontinuity analyses that cover only one edge of this age range and a few panel analyses that go far beyond this range.

by quasi-experimental methods, yield highly variable yet relatively favorable conclusions. As the number of law-adopting states and post-law years grow, these are supplanted by pooled TSCS and, eventually, panel regressions, which are less variable and less favorable. This can be seen for studies of lowered drinking ages and, more strikingly, studies of raised drinking ages, where the number of law-adopting states and post law-adoption years becomes large, permitting extensive use of panel methods.⁵ Overall, the raised-MLDA findings average about 15% at the beginning of the literature and about 10% at the end.

One important study that does not meet the selection criteria for Figure 1, Dobkin and Carpenter (2009), finds a 14% difference in traffic fatalities just before, and after, a person's 21st birthday. Because alcohol use (when legal) grew considerably with age during late adolescence, this number probably overestimates the effect of a raised MLDA across the full 18-20 age range. Thus, even after accounting for this study, there is still some moderation in the findings of this literature over time.

While the evolution in methods partly explains this trend in findings, there is something else going on as well. As documented by Grant (2013) for three Congressionally-incentivized drunk driving laws and by Miron and Tetelbaum (2009) for the MLDA specifically, fatality changes associated with new laws are consistently larger in those states that adopt them earliest, without being spurred to do so by Congress, even when the estimation method is kept the same. This too causes estimates of these laws' effects to trend toward zero over time.

Figure 2 summarizes Miron and Tetelbaum's results. The top pane estimates the

⁵ One might expect the long term effect of raising the drinking age from 18 to 21 to be equal and opposite that of moving in the reverse direction. Nevertheless, evidence on the effects of lowered MLDA was mostly ignored during the runup to the NMDAA, though the best of this evidence (Cook and Tauchen, 1984) spanned more states and years than any raised MLDA study could then muster. It is unclear why this was the case.

percentage change in youth traffic fatalities generated by raising each state's MLDA to twenty-one, taken from a sequence of individual state time-series regressions, and plotted against the year that state raised its MLDA. (These regressions each cover the same span of years and include the same control variables. States maintaining an MLDA of 21 since 1975 are excluded.) The bottom pane contains a cumulative estimate, from all states adopting this MLDA up to that point in time. Over the time period in the figure, this falls from 10% to less than 5%.

Overall, the literature converges to reasonable extent. This is a natural consequence of the ethos of academia, which is organized as an “independent, collective, cumulative, open-ended enterprise of knowledge creation and testing” (Henig, 2008, p. 232). Over the decades, one could observe the slow resolution of conflicts in the MLDA literature over measurement (Williams et al., 1983 vs. Males, 1986; Hammond, 1973 vs. Zylman, 1974), specification (Garber, 1988), and execution (General Accounting Office, or GAO, 1987). But policymakers contemplating action in 1984 did not have the luxury of waiting decades. And the evidence available at that time was highly disparate in method, sample, and result.

Section II. The Evaluation of the Evidence in Four Congressional Hearings.

We examine how the political theatre evaluated the evidence on this issue through the lens of four Congressional subcommittee hearings surrounding the passage of the NMDAA, which were held by various House and Senate committees and subcommittees in 1983, 1984, and 1986. These hearings (labeled H1-H4), other peripheral hearings, and the relevant Congressional debate are all described in the chronology in the Appendix. No other hearing focused on the MLDA as did these four.

Each hearing featured a wide range of witnesses, who each delivered a prepared statement and then answered questions about the effects of a raised MLDA. Far more studies are discussed here than on the floors of the House and Senate, while the positions argued by the same individual or organization varied little across time. Collectively, therefore, these hearings comprehensively record the various perspectives on the evidence, the way these perspectives were presented and examined, and the participants' political and technical skills.

Most witnesses had an interest in the hearing's outcome. Along with NHTSA and the NTSB, the higher drinking age was favored by the insurer-funded IIHS, safety organizations such as the NSC, and grassroots advocates such as MADD. All have extensive experience with policymaking; most also have some analytical skill. Then, as now, NHTSA managed the data used in many traffic safety analyses, the NSC edited the well-regarded *Journal of Safety Research*, and the IIHS regularly published analyses of traffic safety laws in academic journals. The opposition consisted mostly of groups representing students, bars, and restaurants, such as the United States Students Association and the National Restaurant Association. These groups possessed less policymaking experience and little analytical skill. Thus, in contrast to academia, the evidence on MLDA's effects was assessed in an adversarial political environment under significant time pressure between two sides with unequal political and technical expertise.

Any hope that this competition would result in median-voter-style moderation is quickly dispelled by a review of the evidence cited, which was cherry-picked on both sides. Consider, for example, the work of one influential researcher, Alexander Wagenaar. Wagenaar (1981) found that in 1979, the year after Michigan raised its drinking age from 18 to 21, crashes involving 18-20 year old drivers whom police reported had been drinking fell by 31%. Because police-reported drinking can be unreliable, a common "three-factor surrogate" was also analyzed; it fell by 18%.

There was little change in control groups. Later Wagenaar (1983) found that after Maine's 1977 increase in the MLDA, crashes by affected drivers with police-reported drinking rose slightly, while the three-factor surrogate fell by 19%. Witnesses supporting a raised MLDA repeatedly cited only the largest number, a 31% reduction, while their opponents only cited the increase in police-reported drinking crashes after the MLDA rose in Maine. (The mean finding of each study was used in forming Figure 1.)

This selectivity is confirmed in a review of all the evidence cited in these hearings, which is presented in Figure 3. As before, each bubble represents a study, but its color now indicates the authors' affiliation, while its area is proportional to the number of entities citing it; studies ultimately published in refereed journals are circumscribed in black. (All studies are identified in the note to the figure.) The top plot in the figure depicts the evidence cited by three prominent raised-MLDA advocates—MADD, the IIHS, and the AAA—across the three hearings held prior to July, 1984. The weighted or unweighted means or medians of this evidence all indicate a fatality reduction of at least 20%. In contrast, raised-MLDA opponents, having few supportive studies to cite, instead referred to the experiences of states where MLDA increases were not associated with fatality changes at all.

These excesses were not temporized by testimony from government agencies. In fact, these agencies, unreservedly supportive of the raised MLDA's effects, cited evidence that was even more favorable than that cited by advocates. This evidence is displayed in the middle plot in Figure 3 for five government entities, identified in the note to the table, in these same three hearings. This time, the weighted or unweighted means or medians always exceed 25%. These numbers resemble those quoted in President Reagan's signing statement, but vastly exceed the best estimate that could have been obtained at the time.

That estimate comes from the GAO, which conducted a systematic literature review and evaluation that was the subject of the last of these four hearings in 1986. The evidence cited therein, fourteen mostly quasi-experimental studies of fatal or injury crashes meeting reasonable methodological standards, is presented in the bottom plot in Figure 3. With three (not unusual) exceptions, identified in the plot, each study was produced by 1984. The mean and median effect of a raised MLDA across these fourteen studies is a more modest 13%.

The wide-ranging, relatively philosophical Congressional debate on the NMDAA did not focus on the empirical evidence. Nonetheless, the 20-25% figure put forward by raised-MLDA advocates was more or less accepted as fact. Most claims of the NMDAA's effects devolved to an influential IIHS study of nine MLDA-raising states (Williams et al., 1983, well-represented in Figure 3), which found an average fatality reduction of 28%. These claims were rarely disputed.

Citations of this figure collapsed shortly afterwards, however, when five new studies, each analyzing several law-changing states, supplanted the single-state studies that had predominated. Saffer and Grossman (1987), Hoxie and Skinner (1987), DuMouchel, Williams, and Zador (1987), Arnold (1985), and Hoskin, Yalung-Mathews, and Carraro (1986) found that raised MLDAs reduced fatalities by 8%, 11%, 13%, 13%, and 15%, respectively. Twenty years later, the general estimate in the literature was even smaller, as Figure 1 shows.

Evaluating the Evidence's Limitations. In addition to summarizing the evidence, evaluators should identify the sign and magnitude of any bias contained therein. This was vital for the early MLDA literature, because the quasi-experimental studies dominating it had two acknowledged design problems: an absence of control variables and a brief, five-to-seven-year sample period, which made it hard to adequately account for temporal factors.

The results to date of studies increasing (sic) the drinking age have generally been favorable. However, these laws have been in place for only a short time. During that time, other factors which could produce a reduction in accidents have been present...the question of whether increasing the legal age of purchase will reduce accidents remains to be proven when longer experience with these higher age laws generates sufficient data for a more definitive analysis of impact, from which the effect of transient economic factors can be eliminated. (*Alcohol and Highway Safety: A Review of the State of Knowledge*, 1984, p. 49.)

Any bias thereby engendered is likely to be favorable. A longstanding theme in social science, a product of the law and economics literature, emphasizes that estimates of a law's effect on social outcomes are influenced by the circumstances of its adoption (see Andenaes, 1975, and Siegelman, 2002). They will be favorably biased for laws inspired by changes in social attitudes, adopted as part of a package of broader reforms, or passed because of a temporary flare-up in undesirable behavior. As the social changes documented above coincided with the adoption of early laws raising the drinking age, this theme is potentially significant, as some contemporaneous observers recognized:

Most research published to date is based on faulty premises such as assuming a direct cause and effect relationship between drinking age and crashes without taking into account other variables...[such as] changes in DWI enforcement and increased public education...and covering only short time periods which are inadequate for determining whether changes occurring after a lowering or raising of the drinking age are indicative of long-term effects. (Ronald Sarasin, Director of Government Relations, National Restaurant Association, H2, 1984, pp. 44-46.)

A corollary to this theme emphasizes that public support increases the effectiveness of laws:

I have read over most of the papers I have written on this general subject during the past thirty years. In nearly every one of them, I state that the weakest link in attacking this problem has been public support. What we perceive as low-level action against the drunken driver is probably a direct result of lack of public support. We can inform and we can enforce and as a result change behavior through fear for a while. But when we fail to change attitudes, regression is bound to occur (Borkenstein, 1985).

Thus, a law will be more effective in voluntarily-adopting states than in states "forced" to adopt it

via threatened financial penalties like those in the NMDAA:

[Lack of enforcement] points up some of the concern that I have... Particularly in the South and the West—there is a resentment of federally imposed standards of that type, and therefore it tends to be discounted at the enforcement level and in the courts. (Jim Burnett, NTSB Chairman, H1, 1983, p. 236.)

Retrospectively, this theme and its corollary imply that early-MLDA-raising states will yield more favorable estimates than late-adopting states do, fostering the trends found in Figures 1 and 2. Prospectively—from the perspective of a policymaker in 1984—they imply that the early evidence under consideration would overstate the effect of laws “imposed” on states by the NMDAA.

In the field of alcohol control, there have been many examples of programs and control strategies which ultimately have proved ineffective, even when first advocated and employed they seemed to show great promise. (American Automobile Association, or AAA, H0, 1982, pp. 671-672.)

This theme was acknowledged in two ways in the testimony we reviewed: explicitly, as in some of the quotes above, and implicitly, through a tempered assessment of the evidence’s implied effects.

It seems...clear that establishing a 21-year minimum nationwide drinking age would have a salutary impact on drunk driving statistics, although the extent of the prospective improvement is far from certain. (Sen. Charles Mathias, R-MD, Senate Debate on the NMDAA, 1984, p. S8226.)

I suspect that you have had some testimony about the overwhelming evidence statistically about this, and I suspect that I am hindered by my 35 years as a researcher when I say that the research is not as overwhelming as we would like it to be. (Morris Chafetz, former director of the NIAAA and member, Presidential Commission on Drunk Driving, H2, 1984, p. 71.)

Such judiciousness, however, was rare. Acknowledgement of potential biases or the social science theme articulated above was nearly absent from government agencies and raised-MLDA advocates, while their opponents criticized the evidence so broadly that their valid criticisms were more easily overlooked. In the end, these criticisms could not overcome the general legitimacy of

the techniques utilized and the absence of an academic consensus on this issue (see below). In Congressional debate, the validity of the evidence supporting the raised MLDA was not questioned.

Thus, in the end, optimism prevailed both in amalgamating the estimates of the MLDA's effect and in determining the confidence that could be placed in those estimates. Though not central to the theme of this paper, this optimism could have affected the passage of the NMDAA, by influencing President Reagan's decision to switch from opposition to support.⁶ While the only roll call vote on the NMDAA had a veto-proof majority (81-16 in the Senate), legislative progress on the NMDAA did not proceed until immediately after Reagan's change of heart.

Section III. Intellectual and Institutional Underpinnings.

It would be facile but wrong to ascribe the outcomes in Section II merely to an adversarial system headed by political actors. Such an explanation neglects the powerful intellectual and institutional underpinnings that undermine the effectiveness of this system. To maximize the generality of the ensuing discussion, these underpinnings are developed from first principles, applied to the NMDAA, and then extended beyond it.

⁶ Though the decision to adopt the NMDAA did not center around economic efficiency, the cost-benefit calculus could have been affected by this optimism as well.

The study most cited in Congressional debate, Williams et al. (1983), estimated that a national MLDA of 21 would have saved 1,250 lives annually during the late 1970s. The benefit of those lives saved varies dramatically, depending on the Value of Statistical Life utilized and whether the fatalities of drinking drivers and their passengers represent internal or external costs. In current dollars, it could range (roughly) from \$100 to \$1000 per affected 18-20 year-old. Calculating these benefits using a more realistic estimate of the MLDA's effect would lower them by more than half, possibly making them lower than the "cost" to those individuals of being legally unable to drink. Further details are available from the author.

Intellectual Underpinnings. Imagine a new policy that is intended to address a widespread social problem, which is initially implemented in a small number of jurisdictions. Soon, interest naturally arises as to this policy's effectiveness, though the outcomes data available for analysis is limited. Because the amount of post-law outcomes data increases over time, analyses of the policy's effect occur earlier than is socially optimal, as in Barzel's (1968) theory of patents, where technological progress reduces the cost of making a given discovery over time. But, as in Barzel (1968), studies appear as soon as they yield positive net benefits to the parties conducting them. In a world of policy advocacy, this could be quite early.

With little post-policy data available, these studies may need to use crude analytical methods; in general, both limitations inhibit these studies' accuracy. If the policy seems sufficiently promising, however, it will diffuse across the country, increasing the breadth and span of post-policy data available for analysis and facilitating the use of improved methods. Generally the accuracy of these later studies improves, and this continues going forward, probably at a diminishing rate. Ideally, the literature eventually reaches a reasonable degree of convergence in method and result.

This process adequately describes the evolution of the raised-MLDA literature in Figure 1. But it is incomplete, because it omits the essential fact that evaluation of studies in any scientific field is conducted within a body of assumptions, techniques, etc., that are generally accepted by the experts working in that field—namely, a paradigm. But there need not be only one. Where the convergence of academia is slow, and answers are needed quickly, specialization according to comparative advantage suggests the emergence of two paradigms, one geared to the urgent needs of policy, the other to the patient demands of “pure knowledge.” This appears to be the case in several policy-related areas (Dror, 1971; Henig, 2008, Ch. 8).

Certainly it is true in traffic safety, where two paradigms use different research designs suited to these disparate objectives. Early studies of new state laws typically employ the quasi-experimental methods described above. Conducted mostly by (for lack of a more precise term) “program evaluators” with strong links to policymaking, these are often found in well-regarded safety journals such as the *Journal of Safety Research* or *Accident Analysis and Prevention*. In contrast, later studies, typically large-scale, retrospective panel regressions of laws’ long-run effects, are conducted by academic social scientists (particularly economists) and published in the *Journal of Health Economics*, among others. This second group of analysts is less closely linked to policymaking; their primary audience is other academics, and their focus accuracy in estimation rather than immediate policy influence. These generalizations adequately describe the MLDA literature in Figure 1 and explain a subtle divide between policymaking and academia that is depicted in that figure and in Figure 3, namely that the most influential studies in the policy process are rarely cited by academics—and, in some cases, were never published.

Being geared to different purposes, these paradigms are segmented, to a reasonable degree, and coexist more than they compete. Studies of drunk driving laws in safety journals rarely highlight the potential biases in their estimates, while those in economics journals rarely acknowledge that their panel estimators work best only when the policy in question has long been settled. This segmentation is perpetuated by cultural and philosophical differences between the two fields, which “seem to be too many...to permit cooperation” (Dror, 1971, Chapter 6 and p. 34; see also Bogenschneider and Corbett, 2010, and Onder and Tervio, 2015), and by a substantial temporal divide in their studies of any given issue, clearly visible in Figure 1.

There has thus been little comparison within traffic safety of these techniques’ relative efficacy. The closest paper we could find, Garber’s (1988) theoretical, multi-technique critique,

has been largely ignored. Some literature reviews (Shults et al., 2001; Wagenaar and Toomey 2002) do identify higher-quality and lower-quality studies, but this is based primarily on the execution of a given study design. The relative merits of these designs are not compared in these reviews, in NHTSA's occasional compendium *Alcohol and Highway Safety*, or in GAO reports. Thus, in practice, these two techniques tend to be used in different spheres for different purposes, and accepted within that sphere as valid for the purpose for which it is used.

Because the scientific competence of a study is determined within a given paradigm, this segmentation complicates the already-challenging task facing political actors assessing the evidence, who now must weigh paradigms in addition to assessing the studies themselves. This is not much facilitated by the presence of experts, who tend to hail from one paradigm or the other, but not both. This was certainly true for the NMDAA. NHTSA, the NSC, and the GAO all utilized the quasi-experimental paradigm and never acknowledged that a judicious assessment of the evidence might be merited—even when asked (H4, 1986, p. 13-14):

Rep. Nancy Johnson (R-CT): How do you take into account whether or not, for example, there has been a strong movement within a state among high school students to focus on this problem?

GAO Official: That is the beauty of the control group.

Rep. Johnson: In your control group, you have states that have not changed their policy...but do you have all of those same groups that are springing up throughout the Nation, the teenage groups, the MADD parents and so forth?

GAO Official: [Without directly answering the question, simply notes that some control groups are age-based, such as 21-25 year olds, while others are geographical, such as a neighboring state.]

In consequence, the assessment criteria used by the political system shifts away from scientific *competence* toward something very different: *credibility*.

Factual conclusions are not easily separable from considerations having to do with the plausibility of [the researcher's] assumptions and his selection of the evidence

or choice of methodology. And because there seems to be no objective way of checking the conclusions of analysis, the credibility of the expert becomes as important as his competence (Majone, 1989, p. 4).

This shift reinforces the bifurcation between these two paradigms, as one is more directly linked to policymaking than the other. Its practitioners are more familiar with this adversarial process and more likely to have alternate sources of credibility (Innvaer et al., 2002).

Increasingly, public debates about regulatory decisions [and other modern policy issues] resemble adversary proceedings in a court of law, but with an important difference—the lack of generally accepted rules of evidence. Some participants are able to take advantage of the relative informality of the process, but to scientists even codified adversary procedures seem inappropriate and alien to their tradition. In science the issue is not a witness’s credibility but his specific competence...and this is not reliably established by an adversary debate (Majone, 1989, p. 4).

This was also true for the NMDAA. Several supporters of a raised drinking age, including NHTSA, the NTSB, and the NSC, have institutional credibility before Congress, as does the IIHS, which interacts with policymakers on a wide range of traffic safety issues. Technical prowess only reinforces this other source of credibility. Thus, there was no imperative for NHTSA to publish (academically) three in-house MLDA studies from the early 1980s, discussed below, or for the NTSB’s support of a raised MLDA to be based on a formal evidence review. (In fact, its widely-repeated calculations of lives saved were erroneous: Males, 1986.) This contrasted with academic witnesses, who possessed competence but no alternate source of credibility, and raised MLDA opponents, who generally lacked both. This imbalance further limited the self-correcting properties of an adversarial system.

In studies of drunk driving legislation, this intellectual segmentation persists unabated. Grant (2013) shows that more recent literatures on two subsequent laws, “.08 laws” and “zero tolerance laws,” both recipients of the kinds of incentives employed by the NMDAA, follow patterns in study design and result that closely resemble Figure 1. The zero tolerance literature

played out relatively recently, with key panel analyses appearing around 2010.

Institutional Underpinnings. The political actors who must ultimately assess the evidence often possess limited technical knowledge. One possible remedy is to locate this knowledge in an agency that is overseen by those political actors. Here that agency would be NHTSA, founded in 1966 to address both “vehicle factors” and “behavioral factors.”

The existence of such agencies ameliorates this knowledge problem, but introduces a principal-agent problem in its place. In the early 1980s, interest in the effects of higher drinking ages heightened NHTSA’s roles as arbiter and facilitator of research. In both roles it is intended to act as an agent for the public, and Congress by extension, discerning as accurately as possible how laws such as a raised MLDA would affect traffic safety. But its behavior may deviate from this ideal, either because the agency has private objectives that deviate from those of the public, as emphasized by public choice theory, or because it faces constraints that prevent it from pursuing the public interest as intended, as emphasized by theories of public administration (Wilson, 1989).

On the vehicle factors side, these constraints and their consequences have been effectively documented by Mashaw and Harfst (1990). Caught between the industry and consumer groups, hemmed in by procedural and legal limitations, and stymied by informational inadequacies, the agency became a poster child for regulatory ineffectiveness among academics and politicians alike.⁷ In response, it retreated to less effective but more defensible regulatory ground, which emphasizes recalls rather than standard setting.

⁷ Academics include Breyer (1982), Wilson (1989), Mashaw and Harfst (1990), Pecht et al. (2005), and Cavazos (2007). Politicians include the Subcommittee on Commerce, Trade, and Consumer Protection, House Committee on Energy and Commerce (“NHTSA Oversight: The Road Ahead,” March 11, 2010); also see Stout, Ivory, and Ruiz (2014).

The essence of the problem is that NHTSA “[has] a political job without a political mandate” (Mashaw and Harfst, p. 226). This was no different on the behavioral factors side. At the time of the NMDAA, this part of the agency had already been stung twice, in attempting to mandate motorcycle helmet use and the installation of “detachable passive restraints,” moves that were ultimately undermined by a lack of popular support and perceived rationality (Mashaw and Harfst, Ch. 10 and 11).

By the early 1980s, then, the beleaguered agency desperately needed to be seen as effective and in tune with the public and to avoid initiatives that could be legally or procedurally undermined or that perturbed stakeholders, such as advocacy groups or the alcohol industry. Aggressive support of laws to deter underage drinking (the NMDAA), drunk driving (such as .08 laws), or both (zero tolerance laws) fit these requirements well. These laws were in tune with the spirit of the times, a “hardening of public attitudes about the dangers of driving after drinking...due in part to scientific demonstrations linking elevated blood alcohol with automobile crashes” (Zimring, 1988, pp. 379, 381). They were also immune from procedural or judicial challenge and were supported by advocacy groups such as MADD (Ross, 1992).

The alternative approach, which views drunk driving less as the result of individual choice than as the “understandable, predictable product of social institutions” (Ross, 1992, p. 170), was, for NHTSA, less tenable. It conflicted with the conservative emphasis on individual responsibility that characterized the 1980s (Reinarman, 1988), generated political controversy (Ross, 1992, p. 182-3), and antagonized the alcohol industry (which preferred to emphasize the drinker rather than the alcohol being drunk). Thus deterrence-based countermeasures were well-represented in NHTSA’s 1984 publication *Alcohol and Highway Safety* and dominated its plans for reducing drunk driving in the 1990s and beyond (NHTSA, 1990).

All this did not occur in an intellectual vacuum, however. It could not, given NHTSA's need for its initiatives to be perceived as rational. In the words of Majone (1989, p. 102), "policy actors have incentives to invest resources in restructuring the channels through which information is collected, evaluated, and disseminated." Such restructuring had, indeed, already occurred on the vehicle-factors side during the 1970s (Mashaw and Harfst, 1990, pp. 177-9). Here, then, the intellectual expression of the aforementioned principal-agent problem would be for NHTSA's research strategy to be shaped to stress this type of deterrence. Such a strategy would emphasize the quasi-experimental studies that yielded the most favorable findings and would deemphasize the cautionary social science theme articulated above.

This was the case in NHTSA's three studies of raised MLDA's (Maxwell, 1981; Klein, 1981; Arnold, 1985, later updated by Womble, 1989). Each of these used sound quasi-experimental designs to estimate short run effects in early-adopting states, and each obtained findings that were typical of the time (a 9-15% reduction in fatalities). None addressed any potential problems with the estimates.

After the mid-1980s, however, NHTSA performed very few subsequent studies in this area, instead relying almost exclusively on contractors. Of NHTSA's 21 analogous alcohol impaired-driving Behavioral Safety Research Reports, 18 have been produced under contract. This is puzzling because a grant would be the most suitable and most typical mechanism for procuring this type of research: analyzing publicly available data with straightforward statistical methods to study a topic of general interest.⁸ But there is an answer to the puzzle.

⁸ This conclusion comes from interviews with five knowledge-producing federal agencies with health or safety-related orientations: the Consumer Product Safety Commission (CPSC), the Environmental Protection Agency (EPA), the Department of Housing and Urban Development (HUD), the Federal Trade Commission (FTC), and the Agency for Healthcare Research and Quality (AHRQ). In each interview, which typically lasted half an hour, a medium-to-high level

This is that contracting institutionalizes NHTSA’s research strategy, by allowing the sponsoring agency to shape the project’s scope and design (see Henig, 2008, p. 234). Thus, NHTSA’s contracted research in this area uses quasi-experimental designs almost exclusively, unlike analogous studies funded by NIAAA grants (see Figure 1). Its most recent (2001, 2006) versions of *Alcohol and Highway Safety*—both produced by contractors—deemphasize regression-based evaluations of drunk driving legislation, ignore potential biases with any estimation method, and omit regression from discussions of research design.

Furthermore, contracting makes NHTSA more susceptible to political influences, by limiting the in-house human capital available to evaluate the evidence.

Where management decisions are based substantially on technical judgments...there must be sufficient technical competence within the Government so that outside technical advice does not become technical decisionmaking (sic). (Report to the President on Government Contracting for Research and Development, Bureau of the Budget, May 1962, pp. 9-10.)

In interviews we conducted with an independent traffic safety policy advocate and a former high-level NHTSA administrator, both bemoaned the “lack of an independent research capability within the agency,” particularly on the behavioral factors side, and described its origins and consequences as mostly or wholly political, noting that its absence benefits stakeholders that gain from deterrence-oriented policies. Overall, then, the production of knowledge via contracting perfectly suits NHTSA’s objectives in this area of policy.

The evidence suggests that this state of affairs has achieved stasis. Political oversight is unlikely to change the status quo. Our discussions with staff on two oversight committees confirm

research administrator (or their representative) articulated that agency’s “strategy” for producing knowledge and gave a basic rationale for using that strategy. In contrast, we were unable to speak or correspond with the administrator in charge of NHTSA’s behavioral factors research or a member of the agency’s communication office, after multiple attempts.

their indifference with the technical issues raised here, as do recent Congressional hearings.⁹ When Congress needs a more objective evaluation of the evidence, it must turn to the GAO. It had done so prior to the events described here, and, as we will see, did for subsequent drunk driving legislation as well.

Section IV. Generalization and Extension.

The argument developed in the previous section was built on general facts and principles, not details specific to the NMDAA. To complete it we must confirm its generality empirically, by showing that it also explains subsequent events, and then extend it theoretically, by showing that it contains a system of mutually-reinforcing behaviors. Only then can we consider how to alter this system's mechanics and improve the evaluation of the evidence used in policymaking.

Empirical Generalization. We generalize empirically by analyzing the postlude to the NMDAA and the prelude and postlude to the adoption of .08 laws, the only other drunk driving initiative to get a comparable level of attention.

In the two decades following the NMDAA, many panel studies were introduced to the literature on the raised MLDA, increasing the methodological divergence between the two intellectual paradigms discussed above. Our arguments imply that NHTSA should continue to emphasize quasi-experimental findings, while academia should continue to avoid inter-paradigm

⁹ The evaluation of behavioral safety initiatives was mentioned only once in one recent hearing ("Assessing the Effectiveness of the NHTSA's Highway Traffic Safety Programs," House Subcommittee on Highways and Transit, July 16, 2008, p. 35) and not at all in another ("NHTSA Oversight: The Road Ahead," House Subcommittee on Commerce, Trade, and Consumer Protection, March 11, 2010).

competition.

This is exactly what happened. NHTSA's most recent direct statement on the effect of the raised MLDA, found in its March 2005 Traffic Safety Facts Research Note, relies on a single source: Arnold (1985), an early, unpublished, in-house quasi-experimental study. The estimated effect on fatalities was 13%. Academics, on the other hand, have produced only one comprehensive review of the literature (Wagenaar and Toomey, 2002, extended in 2005). This review drew mild methodological distinctions, eliminating studies with very poor execution or cross-sectional designs, and showed only that the remaining estimates were roughly split between insignificance and significance in the expected direction. This supported the effectiveness of a raised MLDA but left the effect size ambiguous and fostered no methodological comparisons.

Next, consider .08 laws, which establish a per se illegal BAC threshold of .08 g/dl, down from (generally) .10. In 2000, these laws received Congressional incentives like those in the NMDAA. The prelude to these incentives did indeed resemble that to the NMDAA. NHTSA first advocated the enactment of .08 laws in 1992, when there was virtually no evidence on their effectiveness. Though only 3% of traffic fatalities involve drivers with BACs of .08 or .09, who would be affected by such a law, double-digit fatality reductions are claimed in most of the evidence cited in NHTSA's "Setting Limits, Saving Lives" (1997) and "Presidential Initiative for Making .08 BAC the National Legal Limit" (1998). These publications, along with *Alcohol and Highway Safety* (2001), omitted the more conservative results of economists' two regression analyses of this law (Chaloupka, Saffer, and Grossman, 1993; Dee, 2000). After identifying numerous methodological problems with several studies of this law, including some sponsored or produced by NHTSA, a 1999 GAO report determined that "the evidence does not conclusively establish that .08 BAC laws, by themselves, result in reductions in the number and severity of

alcohol-related crashes” and that “NHTSA’s position—that this evidence was conclusive—was overstated.” Despite this ambiguity, “Setting Limits, Saving Lives” lists dozens of organizations in support, including MADD and the IIHS.

The postlude was similar as well. By the time .08 laws had been adopted nationwide, in 2005, they had been repeatedly analyzed using a variety of methods, creating a literature whose evolution closely followed that of the MLDA, as noted above. Nonetheless, to date academics still have neither provided an effective summary of the evidence nor bridged the intellectual segmentation dividing paradigms. The most detailed review of the literature on .08 laws, Shults et al. (2001), was produced not by academics, but by the Centers for Disease Control and Prevention. Even today, there are assertions that the evidence strongly supports these laws’ effectiveness, and others to the contrary.

Empirically, the behavior of each actor in our narrative is consistent throughout, as implied by the generality of the arguments in Section III.

Theoretical Extension. To consummate the analysis we must extend it, by more closely examining the influences on the behavior of our four major actors: academia, policy advocates, NHTSA, and Congress.

Throughout, we have argued that this behavior accords with each actor’s self-interest. Advocacy groups maximized their credibility through political and technical skill, deployed in the support of research designs that yield relatively favorable findings. NHTSA maximized its political support and minimized its political risk by aligning itself with these advocacy groups and orienting itself to support similar research designs. Two distinct groups of academics each maximized their internal reputations by operating securely within two distinct research paradigms

that were geared toward different purposes, maintaining intellectual segmentation. Given these circumstances, Congress assessed the evidence as best it could, evaluating competing claims on the basis of credibility, which it can reasonably discern, instead of scientific competence, which it cannot.

But there are independencies as well. Altogether, these behaviors form a perverse set of complements, each reinforcing the others. Adversarial Congressional hearings support intellectual segmentation. Such segmentation, in turn, lets policy advocates and NHTSA stress the research paradigm that better suits their political objectives. This stress, and NHTSA's limited in-house human capital, further weakens the evaluative process, de-emphasizing competence in favor of credibility. The emphasis on credibility, in turn, supports adversarial hearings (which better discern credibility) and minimizes the role of academics (who are oriented towards competence instead). In consequence, academics have less incentive to bridge paradigms and eliminate this intellectual segmentation. In other words, everything works together. Given this fact, it is best to consider this set of actors as a unit—that is, a system.

Clearly, the outcomes produced by this system are sub-optimal. It promotes neither an accurate assessment of the evidence at hand nor feedback that could be used to improve future studies. Unfortunately, the strong complementarities in this system imply that it will not be self-correcting or easily disrupted from outside. As a result, we should expect it to behave similarly over time—a prediction upheld in the previous subsection.

Because of this hyper-stability, the prospects for changing this system are seemingly dim. If any one actor's behavior is reinforced by the other actors in the system, why should they do anything differently? Our solution to this problem is to identify the linchpin that holds this system together and remove it.

Section V. Prescriptions.

That linchpin is not political. The futile lament that policy analysis is destined to be underappreciated by a recalcitrant political system has been consistently undermined throughout this narrative. In the short term, federal and state governments produced more studies of .08 laws and raised MLDA's than did academia. (See Figure 3 and the two aforementioned GAO reports.) Via the GAO, Congress assessed the evidence more satisfactorily than NHTSA and academia have done, then or since; via the hearings discussed above, it also gave a more complete expression—however limited—of its weaknesses. All this was achieved despite having less technical knowledge than academia and greater political and time constraints. Thus, last section's discussion of self-interest could assert that Congress acted in the public interest too, assessing the evidence as best it could under the circumstances.

Neither is the linchpin policy advocacy by NHTSA or by groups such as MADD. Safety advocates are unlikely to promote policies they believe are not effective, though they may overstate the impact of those that are. As noted above, the IIHS was a credible source of research on the MLDA's effects, as was NHTSA. And Figure 3 showed that, on the whole, safety advocates were more cautious and realistic in their assessment of the evidence than were government agencies.

While credibility is not equivalent to scientific competence, it is enhanced by such competence and destroyed by its opposite. NHTSA and the IIHS had license to alter their approach to the production of knowledge to suit their political objectives; they did not have license to simply abjure scientific competence. The presence of political objectives does not run counter to the production of knowledge or its evaluation; it merely complicates it.

Rather than be surprised that these actors utilize the methodological flexibility they are

afforded, we should ask why there is so much flexibility to begin with. The answer, of course, lies in the coexistence of clashing paradigms: intellectual segmentation. In addition to broadening the acceptable range of methods, this segmentation transforms the evaluation of competence into a contest of credibility and prevents the long-term feedback that would ensure a judicious evaluation of the limitations of short-run, quasi-experimental approaches. Intellectual segmentation—the province of academia—is the essential ingredient that ties this system together. Meaningful reform must begin here.

Reform. To delineate reforms, we must first ask just what function academia should serve in evaluating the effects of policy. Given the presence of other policy actors, the answer should accord with the principle of comparative advantage. For traffic safety, at least, academics clearly are not needed to conduct straightforward implementations of established methods—and are ill-equipped to do so quickly. Neither are academics needed to summarize the evidence, applying a mild methodological screen for good practices—the GAO and others are fully adequate for that. Instead, academia’s comparative advantage lies in developing analytic techniques and determining their adequacy for the task at hand: the creation and clash of paradigms.

In one sense, academia has executed this task almost too well, generating two paradigms, each geared toward a somewhat different purpose. But, in a more practical sense, it has not executed this task well enough. The existence of broad, general, traditional research paradigms offers limited comfort to policymakers who must evaluate a limited amount of conflicting, imperfect evidence within a compressed time frame. Except for randomized, controlled experiments, which clearly are not feasible here, every evaluation method has pitfalls and potential biases and is subject to the vagaries of implementation. Viewed in this light, intellectual

segmentation was a reflection of the broader problem that neither paradigm was, *for the purposes of traffic safety policy*, sufficiently developed.

To clarify this remark it is useful to distinguish between a paradigm in the usual sense of the word, a traditional research paradigm, and what we will call a “working paradigm” that has been adapted to the needs of a more narrowly defined policy area such as traffic safety or drunk driving. The latter requires, in addition to the theoretical structure and empirical techniques of the traditional research paradigm, practical knowledge as to how these techniques are best applied to the issue at hand and how they can go awry (large errors, biases, unanticipated consequences, etc.). To the degree that experience permits, a working paradigm systematizes the implementation of methods from the broader paradigm to a particular class of practical policy issues and characterizes the limits of the evidence thereby produced. In doing so, it reduces methodological flexibility that could be adapted for political ends and de-emphasizes credibility in favor of competence in applying the working paradigm.

Some of this methodological flexibility is of the crudest sort. Consider, for example, the issue of which states to analyze or use as control groups in quasi-experimental studies. At the time the NMDAA was passed, the distribution of states across all such MLDA studies was quite skewed. Of nineteen MLDA-raising states, three (IL, MI, and ME) were studied thrice each, while eight others (MD, NJ, RI, GA, OH, TX, CT, and NE) were untouched. Larger estimates were obtained from single-state studies, suggesting that these states were not randomly chosen for analysis. Yet the selection criteria used in this literature is usually quite informal and defended casually, if at all (e.g., Williams et al., 1975, 1983; Wagenaar, 1983).

Equally pedestrian is the issue of how a given study should amalgamate a variety of estimates in order to best summarize its findings. This issue arises in numerous quasi-experimental

studies in the MLDA literature, including several mentioned in Congressional hearings (e.g., Williams et al., 1975; Klein, 1981; Hingson et al, 1983; Wagenaar, 1983). Generally, these studies offer no “best estimate,” just a collection of results waiting to be cherry-picked by both sides, as Wagenaar’s work was in Section II. This issue arises in the .08 law literature too. For example, Dee’s (2000) regression analysis concludes that .08 laws work on the basis of a coefficient estimate that differs significantly from the omitted category, which is no per se BAC limit at all. This estimate, however, does not differ significantly from that on the dominant policy at the time, a .10 BAC limit. Yet the latter finding is disregarded in favor of the former, with no justification offered for doing so. In the presence of such rudimentary methodological confusion, is it really surprising that assessments of the evidence varied widely?

In the broader, traditional sense, the program evaluation and social science regression paradigms are well established and have vigorously competed, for example in highly visible literatures on job training programs and the employment effects of the minimum wage (Card and Krueger, 1997; Heckman, LaLonde, and Smith, 1999; and many others). But in the narrower sense, working versions of each paradigm, for the purposes of drunk driving policy, are relatively undeveloped even now, thirty-five years after the NMDAA. These would identify best practices for estimating laws’ short run effects in early-adopting states and indicate the likely long-run biases that would accompany those estimates. Accomplishing this would require comparing various estimators’ short run and long run effect sizes; examining the variability of quasi-experimental estimates obtained with various control groups (based on geography, age, or alcohol involvement); and determining the suitability of various regression specifications for forming early estimates of laws’ effects. Except for the studies generating Figures 1 and 2, these issues have received little attention in literature reviews, *Alcohol and Highway Safety*, or the academic literature. There

simply is no working paradigm.

Addressing these issues would not only improve the evaluation of evidence, but also bridge the divide between the social science and program evaluation paradigms, forcing program evaluators to attend more to reducing bias and social scientists to attend more to achieving immediacy. Potentially, a single, unified working paradigm would emerge that integrated the benefits of each approach, improving the quality of evidence as well as its evaluation.

How can working paradigms be created? Various arrangements are possible, though the involvement of academia is likely to be essential. Academics have studied some issues, such as the minimum wage, sufficiently that a working paradigm can be said to have resulted. But academia's reward structure, which emphasizes internal rather than external relevance, and the potential for intellectual segmentation makes this far from axiomatic. Thus, it may be necessary to create specific institutional arrangements within academia, the policy sciences especially, or government that promote and reward the creation of working paradigms. These arrangements could include grant programs, special issues of journals, or the creation of subfields within economics, policy sciences, or meta-analysis that were devoted to this end. Such an endeavor would also be the natural province of NHTSA, were it—or some part of it—freed from its current political constraints.

Had such a working paradigm been available at the time of the NMDAA, a much more satisfactory evaluation of the evidence would surely have resulted. In its continued absence, the history documented in this paper is likely to be repeated.

Section VI. Conclusion.

Early evidence on the effects of newly-adopted policies is often too scarce and scattershot to be easily and conclusively evaluated. To conduct such an evaluation in an adversarial, politicized environment is a daunting task, especially for political actors who lack the necessary technical expertise. It would be ingenuous to expect the political system to do so effectively, and this paper confirms that, for the NMDAA at least, it did not. Raised MLDA opponents were, in this theatre, outmatched by advocates, fostering an overly optimistic assessment of the evidence that was available at the time.

On the other hand, it is equally ingenuous to assume that other mechanisms will be superior. They certainly were not for the NMDAA. Academia, segmented into distinct paradigms, had no effective means of meshing and reconciling their conclusions, particularly on the time scales required by policymakers. Neither did the bureaucracy, NHTSA. Overly wedded to deterrence, it lacked the necessary quantity and diversity of in-house human capital. Given these facts, it is surprising that the political system evaluated the evidence as well as it did.

The lessons learned here are not unique to this case. Certainly the adversarial nature of policymaking generalizes broadly, as does evidence of segmentation in academic fields (see the citations above). Meanwhile, the independence of federal agencies varies broadly. Some, such as the Consumer Product Safety Commission, resemble NHTSA quite closely, while others, such as the FAA or FDA (Carpenter, 2010), are far more independent. It depends on the circumstances.

Policy analysis does not emerge from our narrative as an art that is destined to be underappreciated by a political system that cannot assimilate it into policy formation. Rather, policy analysts should accommodate the imperatives of policymakers. It need not be government's responsibility to systematize the implementation of basic research designs, draw distinctions between these designs, assess likely biases, and develop methods to mitigate these biases on the

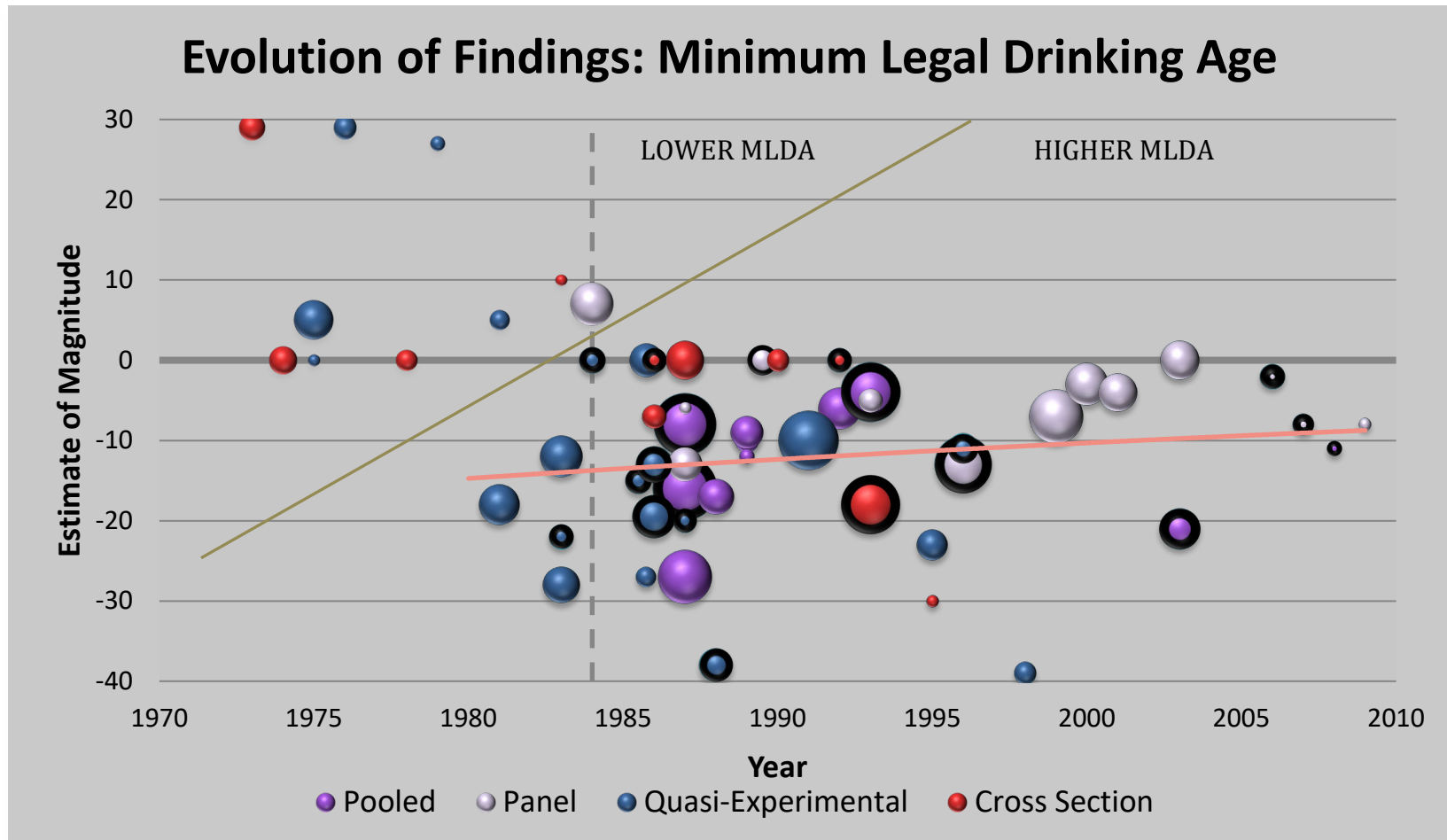
time scales required by policymakers. The development of such working paradigms can, and generally should, be the responsibility of academics who desire policy impact. Unfortunately, it has here been shirked in the name of intellectual segmentation. We have met the enemy, and he is us.

Table 1. Social Activity Aimed at Reducing Drunk Driving (constructed from Howland, 1988), and Drunk Driving Attitudes (from Greenfield and Room, 1997).

Year	COUNTS				PERCENTAGE IN AGREEMENT	
	Number of Drunk Driving Groups Founded	Volume of Newspaper Coverage of Drunk Driving	Volume of Periodical Coverage of Drunk Driving	“Legislative Changes to Reduce Drunk Driving”	It is OK to drink before driving.	It is OK to drink a lot before driving. (Asked of heavy drinkers.)
1978-1981	36	37	22		32%	8%
1981		17	13	44		
1982	109	81	35	47		
1983	117	169	50	129		
1984	103	162	42	108	18%	5%
1985	89	76	36	223		
1986		45	9	178		

Note: Newspapers include the *New York Times*, the *Washington Post*, the *Los Angeles Times*, and *The Wall Street Journal*. Periodical volume comes from the Magazine Index. The attitudinal questions were phrased: “A person should feel free to drink one or two drinks, or more, when going to drive a car,” and “A person should feel free to drink enough to feel the effects, or more, when going to drive a car.”

Figure 1. Bubble Plot of Academic Studies of the MLDA (from Grant, 2013).



Note: Black-ringed bubbles are supported by external funding. The year is the year of publication. The estimate of magnitude is the percentage change in the fatality or crash-involvement measure. The volume of the bubble is proportional to the number of citations it received in Google Scholar as of June 2009, with a minimum bubble size so that uncited studies are not eliminated.

Figure 2. MLDA Effects vs. Time of Adoption (based on the findings of Miron and Tetelbaum, 2009). The top graph contains individual state estimates; the bottom graph cumulative estimates.

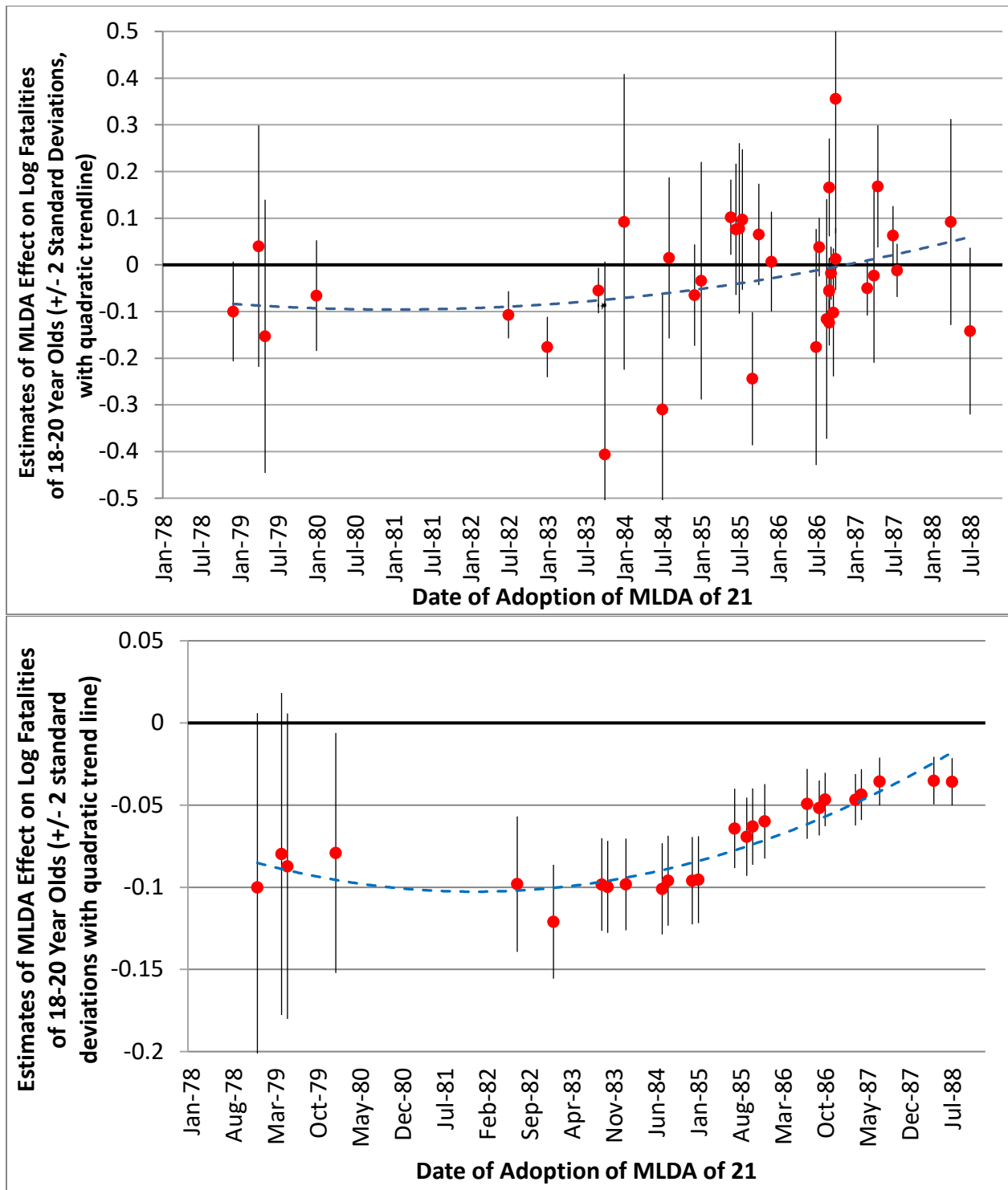
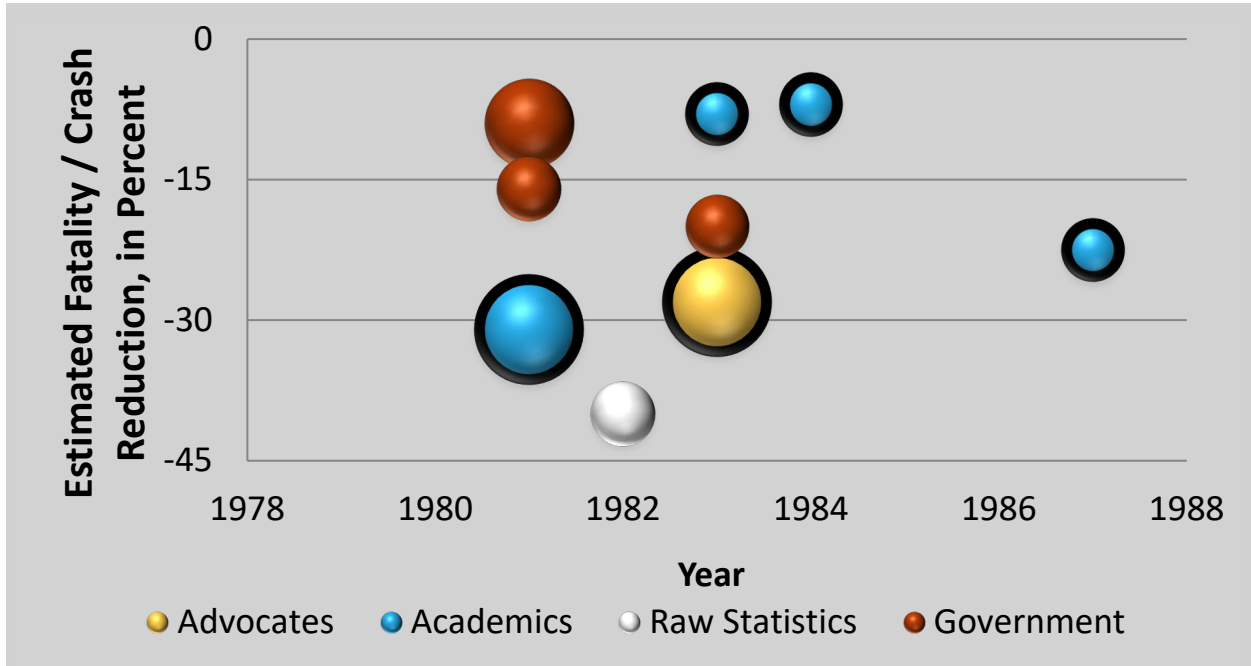
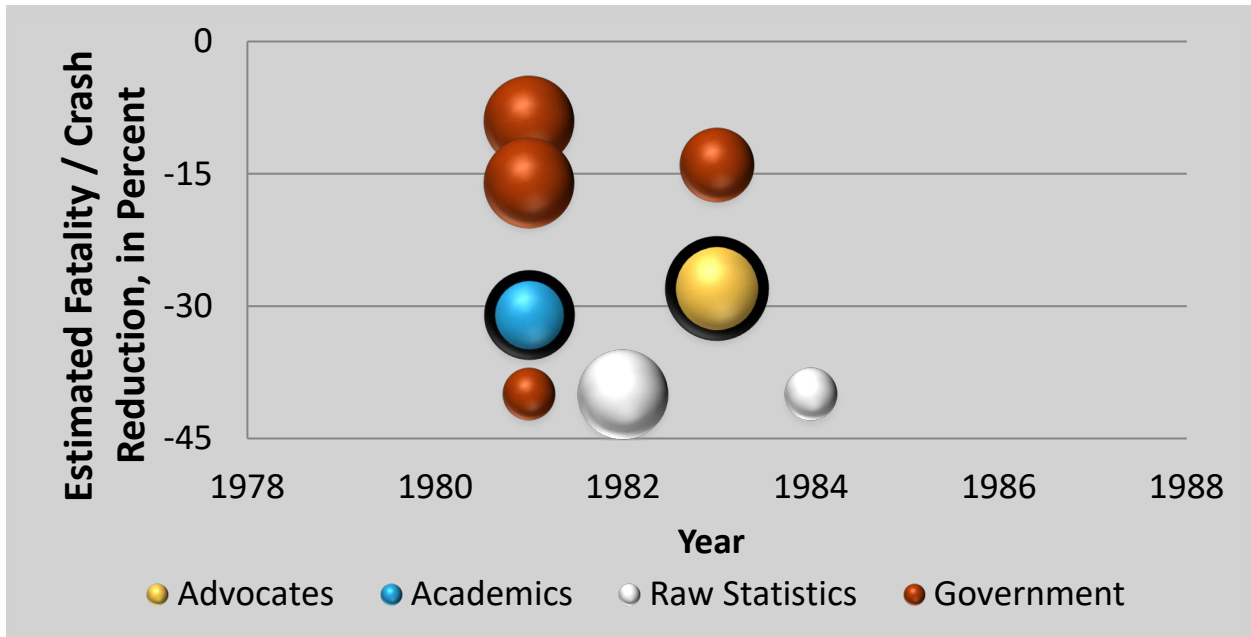


Figure 3. Evidence Cited across Four Hearings on the Effect of a Raised MLDA on Crashes.

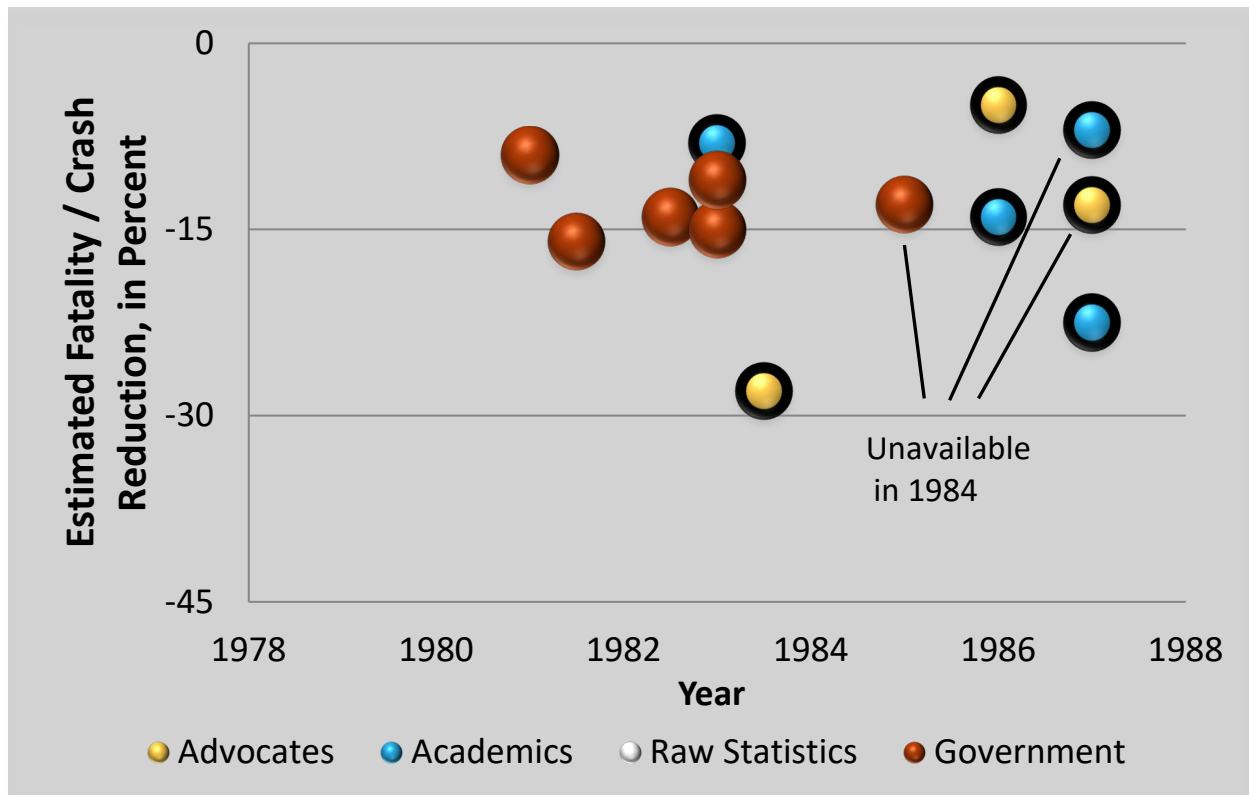
Top: Evidence Cited by Three Raised-MLDA Advocates, 1983-1984.



Middle: Evidence Cited by Five Government Organizations, 1983-1984.



Bottom: Evidence Cited by the GAO, 1986-7.



Note: The advocates are MADD, the American Automobile Association, and the IIHS. The government organizations are NHTSA, the NTSB, the NSC, the National Association of Governor’s Highway Safety Representatives, and the Presidential Commission on Drunk Driving. The area of each bubble is proportional to the number of organizations citing that study in the hearings indicated. Bubble colors indicate the affiliation of the authors of each study; “raw statistics” indicates the organization simply cited the change in crashes or fatalities after the adoption of a law, without referring to any formal study. Bubbles ringed in black indicate studies published in a refereed journal. For such studies, the horizontal axis indicates the publication year; for the others it is the year the study was completed. When a study contains multiple estimates, the estimate that is cited by the relevant entity is utilized.

Studies cited in all three graphs: Williams et al. (1983), Klein (1981), Maxwell (1981), and Wagenaar (1981). Additional studies cited in the top graph: Hingson et al. (1986), Cook and Tauchen (1984), Lillis et al. (1987), and Dunham and Detmer (1983). Additional studies cited in the middle graph: Schroeder and Meyer (1983) and Lynn (1981). Additional studies cited in the bottom graph: Schroeder and Meyer (1983), Saffer and Grossman (1987), Lillis et al. (1987), Florida Department of Community Affairs (1983), Emery (1983), Hingson et al. (1983), Hoskin et al. (1986), Wagenaar (1983), Arnold (1985), and DuMouchel et al. (1986).

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Appendix: A Chronology of the Minimum Drinking-Age Issue
(excerpted almost verbatim from Appendix IV of GAO, 1987, with minor edits and additions;
hearings or Congressional debate referenced in the text of this paper are italicized)

Jan. 5, 1933. Ratification of the 21st amendment repealed prohibition and granted the states substantial power to regulate the purchase and possession of liquor within a state.

Sept. 9, 1966. Enactment of the Highway Safety Act of 1966 (Public Law 89-564) provided the first major impetus for federal involvement in drinking and driving by requiring the Department of Transportation (DOT) to establish uniform safety standards for state highway safety programs and to provide funds to carry out such programs.

June 1967. The DOT issued its "Alcohol in Relation to Highway Safety Standard," to broaden the scope and number of activities directed at reducing alcohol-related accidents.

1970. NHTSA established a special office of alcohol countermeasures and the alcohol safety action program in 1970-71.

July 1971. Ratification of the 26th amendment, extending the right to vote to 18-year-olds, helped prompt 29 states to lower their minimum drinking ages in the early 1970's.

1973. NHTSA agreed by contract with the University of Michigan Highway Safety Research Institute to scientifically analyze the effects of lowering the legal drinking age from 21 to 18 on youths involved in crashes. The report showed a 10%-26% increase in crash involvement between 1968 and 1971.

Jan. 2, 1974. Enactment of the Emergency Highway Energy Conservation Act (Public Law 93-239) temporarily established a nationwide speed limit of 55 miles per hour. The law relied on crossover sanctions to encourage the states to conform to the act. One year later the Federal-Aid Highway Amendments Act of 1974 made this speed limit permanent.

1976. From this year forward, no state lowered its drinking age, partly because of empirical evidence that suggested a link between lowering the drinking age and increased traffic fatalities. Between 1976 and 1980, thirteen states raised their drinking ages by at least one year.

April 14, 1982. The president appointed a 32-member commission to study the problem of drunk driving.

April 27, 1982. H.R. 6170 was introduced by members of the Congress from New Jersey and Maryland and others to encourage the states to strengthen programs to control drunk driving.

April 29, 1982. [H0] The House Subcommittee on Surface Transportation held hearings on H.R. 6170; the legislation was generally supported by both the beverage and insurance industries.

May 12, 1982. H.R. 6170 was incorporated into H.R. 6211, which became the Surface Transportation Assistance Act of 1982.

July 22, 1982. The National Transportation Safety Board recommended a national minimum drinking age of 21.

Sept. 29, 1982. The House of Representatives unanimously approved H.R. 6170.

Oct. 1, 1982. The Senate unanimously approved its counterpart bill to H.R. 6170, and the bill was sent to the president.

Oct. 25, 1982. Enactment of H.R. 6170 as Public Law 97-364 provided for a two-tier incentive grant program to improve traffic safety. The Congress mandated that the Department of Transportation would consider a state minimum drinking age of 21 as one criterion to be met for supplemental grants.

Nov. 30, 1982. House and Senate resolutions were introduced on the legal minimum age for drinking and the purchase of alcohol.

Dec. 13, 1982. The Presidential Commission on Drunk Driving recommended a uniform minimum drinking age of 21 in an interim report intended to allow state legislatures time to consider this recommendation early in their 1983 sessions.

Jan. 6, 1983. The Surface Transportation Assistance Act of 1982 contained a small section strongly encouraging the states to raise the minimum drinking age to 21. On the day the law was enacted, House Concurrent Resolution 23 was introduced, expressing the sense of the Congress that all states should establish a minimum drinking age of 21.

Jan. 27, 1983. A Gallup poll showed that 77 percent of Americans supported a uniform drinking age of 21 for all states.

April 7, 1983. H.R. 2441 was introduced by a member of the Congress from Illinois to prohibit the use of federal highway funds by states whose minimum drinking age was lower than 21.

April 20-21, 1983. Senators from Missouri, Oregon, and Rhode Island introduced S. 1108, the Highway Safety Act of 1983, which provided more incentive grants to states for efforts to deter drunk driving. The bill was never voted out of committee. A member of the Congress from California introduced H.R. 2693, a counterpart bill to S. 1108.

May 6, 1983. A Senator from Pennsylvania introduced Concurrent Resolution 32 to express the sentiment of the Congress that all states should establish a minimum drinking age of 21.

Sept. 13, 1983. Members of the Congress introduced H.R. 3870, a bill to prohibit the sale of alcoholic beverages to persons under 21 years of age under certain conditions.

Oct. 1983. A Senator from Indiana introduced S. 1948 as a counterpart to H.R. 3870.

Oct. 4 and 19, 1983. [H1] The House Subcommittee on Commerce, Transportation, and Tourism held hearings on H.R. 3870. This well-attended hearing, held when there was increasing momentum for federal action but ambiguity about the form that action might take, featured an exhaustive witness list and active participation from committee members.

Nov. 1983. The Presidential Commission on Drunk Driving issued its final report, keeping the recommendation for a uniform minimum drinking age of 21 for the purchase and public possession of all alcoholic beverages.

Jan. 1984. The president publicly rejected the support of the Presidential Commission on Drunk Driving for a uniform minimum drinking age of 21.

Jan. 24, 1984. Members of Congress introduced H.R. 4616, a bill to amend the Surface Transportation Assistance Act of 1982 by increasing appropriations for highway safety.

Feb. 7, 1984. Several senators introduced S. 2263, the Uniform Minimum Drinking Age Act, to amend the Surface Transportation Assistance Act of 1982 by reducing the amount of federal highway aid for states that do not enact a legal minimum drinking age of 21.

Feb. 22, 1984. Members of the Congress introduced H.R. 4892, a counterpart to S. 2263.

Feb. and March 1984. The House Subcommittee on Surface Transportation held hearings on surface transportation issues, including a discussion of the drinking-age issue.

April 5, 1984. Members of Congress introduced H.R. 5383, a bill to reduce a state's apportionment for federal aid for highways in specific fiscal years for states with drinking ages below 21.

April 25, 1984. A member of the Congress from California introduced H.R. 5504, the Surface Transportation and Uniform Relocation Assistance Act of 1984.

April 30, 1984. The House passed H.R. 4616 by voice vote.

May 24, 1984. Senators from New Jersey and Rhode Island introduced S. 2719 as a revision of S. 2263, a counterpart to H.R. 5383, and an attachment to H.R. 4616, the Child Safety Restraint Act.

June 7, 1984. The House approved H.R. 5383 as an amendment to H.R. 5504, which would reduce federal highway funds by 5 percent in fiscal year 1987 and 10 percent in fiscal year 1988 for states not enacting a minimum drinking age of 21.

June 13, 1984. The administration reversed its position on the minimum drinking-age issue through support of H.R. 4616 from the secretary of the Department of Transportation.

June 14, 1984. [H2] The Senate Subcommittee on Surface Transportation held hearings on measures to combat drunk driving.

June 19, 1984. [H3] The Senate Subcommittee on Alcoholism and Drug Abuse held hearings on a national minimum drinking age. This hearing, like H2 before it, was pro forma, as legislative and executive support for the NMDAA was already established. No members other than the chair attended. Each witness read a prepared statement, but there were few questions.

June 26, 1984. The Senate passed S. 1948 by a vote of 81-16, as an attachment to H.R. 4616. The Senate then passed its version of H.R. 4616 by a voice vote.

June 27, 1984. The House cleared the Senate version of H.R. 4616, including H.R. 5383.

July 6, 1984. The Senate version of H.R. 4616 was approved and sent to the president.

July 17, 1984. The Child Safety Restraint Act (H.R. 4616), which included legislation for a national minimum drinking age of 21, was signed into law (Public Law 98-363) amending the Surface Transportation Assistance Act of 1982. This act was strongly lobbied for by the Mothers Against Drunk Driving, the Parent Teachers Association, the National Safety Council, the National Council on Alcoholism, and the insurance industry.

Sept. 21, 1984. South Dakota brought an action against the secretary of the Department of Transportation in the U.S. District Court for the District of South Dakota, asking the court to declare the uniform national drinking age sanction of the Surface Transportation Assistance Act of 1982 unconstitutional, on the grounds that it violated the 10th and 21st amendments of the U.S. constitution.

May 3, 1985. The U.S. District Court issued a memorandum opinion and judgment dismissing the South Dakota case against the national drinking-age legislation.

May 16, 1985. Members of the Congress from Louisiana and Vermont introduced H.R. 2537 to apportion federal highway funds withheld from states for failing to establish a minimum drinking age of 21 if certain alcohol-related traffic fatalities are significantly reduced.

June 3, 1985. A member of the Congress from Louisiana introduced H.R. 2645 to repeal the national minimum drinking-age law.

June 26, 1985. South Dakota appealed the District Court's decision to the Court of Appeals for the Eighth Circuit, contending again that the 10th and 21st amendments were violated by the national drinking-age legislation. Nine other non-complying states supported South Dakota's appeal.

July 11, 1985. Senators from Missouri and New Jersey introduced S. 1428, to make permanent the withholding of 10 percent of the apportionment from the Highway Trust Fund to states that have not adopted the national minimum drinking age.

Sept. 27, 1985. NHTSA and the Federal Highway Administration issued a notice of proposed rulemaking to implement section 6 of Public Law 98-363, which refers to the withholding of federal-aid highway funds.

Oct. 21, 1985. The Chair of the House Subcommittee of Investigations and Oversight, Committee on Public Works and Transportation, asks the GAO to review "existing evaluation[s] of drinking age laws to determine the extent to which they provide empirical support for federal and state initiatives to change the legal drinking age."

Nov. 12, 1985. S.1428 was amended to S. 1730, the Consolidated Budget Reconciliation Act.

Dec. 20, 1985. S. 1730 was folded into H.R. 3128, the Budget Reconciliation Act, which did not pass but was carried over into the next year.

April 7, 1986. The president signed the Budget Reconciliation Act, which made permanent the withholding of 10 percent of federal highway funds from states not complying with a uniform drinking age.

May 21, 1986. The court of appeals for the eighth circuit affirmed the district court's dismissal of South Dakota's complaint challenging the constitutionality of the national drinking-age legislation.

Sept. 16, 1986. **[H4]** *Relying on an early draft of the GAO report, the House Subcommittee of Investigations and Oversight, Committee on Public Works and Transportation, conducts hearings to assess evidence on the efficacy of minimum drinking age laws.*

March, 1987. The GAO issues its final report, "Drinking-Age Laws: An Evaluation Synthesis of Their Impact on Highway Safety." This report finds that "raising the drinking age has a direct effect on reducing alcohol-related traffic accidents among youths affected by the laws."

June 23, 1987. The U.S. Supreme Court affirms the constitutionality of the uniform national minimum drinking age in *South Dakota v. Dole*.

June 29 and Aug. 2, 1988. **[H5]** *The Senate Committee on Environment and Public Works, followed by the Subcommittee on the Consumer, Committee on Commerce, Science, and Transportation, hold hearings on the Drunk Driving Prevention Act of 1988, which is ultimately tabled in the Senate after being opposed by the Reagan Administration.*

Feb. 27, June 27, 2002. **[H6]** *The Senate Subcommittee on Transportation and Related Agencies, followed by the House Subcommittee on Highways and Transportation, hold hearings on various traffic safety related issues.*