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A structural analysis of U.S. drunk driving policy

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ABSTRACT

The expected penalty for drunk driving can and does vary by blood alcohol content. This paper outlines the schedule of penalties that best achieves two key social objectives, efficacy and efficiency (subject to constraints), shows how the associated optimality conditions can be implemented with available data to analyze policy ex ante or ex post, and then uses these findings to assess four fundamental features of current U.S. drunk driving policy. Large penalties at very high alcohol concentrations are supported, but not reductions in per se blood alcohol thresholds, the most significant recent change in policy.

1. Introduction

This paper introduces a theoretically-grounded, structural method for evaluating drunk driving policy, which treats the law as a menu, or schedule, of expected penalties associated with different blood alcohol concentrations (BACs). The optimal schedule of penalties, or "penalty structure," is characterized with simple equations that can be evaluated with epidemiological and economic data. Deviations from optimality suggest beneficial changes in policy. While this has not been previously attempted for drunk driving, similar methods have fruitfully analyzed the widely-used "points system," whereby a driver's license is suspended after he tallies a specified number of points for traffic law violations within a given time period (Bourgeon and Picard, 2007; Dionne et al., 2011).

Methodologically, one could not draw a greater contrast with the traditional way of analyzing drunk driving policy, "reduced form" regressions relating traffic fatalities to law variables and controls. The two approaches complement each other in several respects.

Our approach is prospective where traditional methods are retrospective. They depend on data on past outcomes. Often, because of differences in sample and technique, the literature on the effects of any given law does not converge until long after the law has been widely implemented, by which time the decision window on that policy may have closed (Grant, 2013). Our approach, in contrast, utilizes behavioral primitives that, we show, are stable across time. It can thus evaluate policy before it has been implemented anywhere.

While traditional methods estimate the effects of policy, ours examines the economic influences underlying those effects. The intellectual cornerstone of U.S. drunk driving policy is deterrence theory: drivers are rational actors who will respond purposively to disincentives for driving drunk. (For example, the drunk driving countermeasures promoted by the National Highway Traffic Safety Administration, or NHTSA, are heavily weighted toward deterrence, as are those most studied by economists.) Our approach can determine if regression-estimated behavioral responses so conform, looking inside the "black box" of deterrence, in the process reinforcing some studies' findings while contradicting others.

Finally, while traditional methods focus on the effects of specific laws, ours takes the broad view, examining general features of policy in light of various social objectives. As severely impaired drivers are far more dangerous than moderate drinkers, an improved penalty structure could significantly impact alcohol-related traffic safety, where U.S. progress has been scant for fifteen years, during which the rate of alcohol involvement in fatal accidents has not budged.

In fact, our analysis finds significant deviations from optimality. These support one major recent policy thrust, increasing penalties at high BACs, but not another, lowering illegal BAC thresholds. The analysis also supports appropriate Congressional initiatives

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that promote policy uniformity, but not those that have mandated different treatment for youth and adults.

2. Theory

Based on the work of Kenkel (1993a, 1993b, 1996), we abstract from the resource costs of imposing punishment, which are second order, and from the production and service of alcohol, as these markets are sufficiently competitive that any changes in prices or profits resulting from policy changes should be short lived.[1] We also abstract from the extensive margin – loosely speaking, the level of penalties – to focus instead on the intensive margin, how penalties rise with BAC. The former has been adequately studied by Kenkel (1993a, 1993b), who finds that penalties are inefficiently low.

Following Kenkel and the tenets of deterrence theory, each driver is assumed to maximize utility, taking into account alcohol costs and expected penalties,[2] and internalizing only his own expected accident costs, ignoring those imposed on others. The driver must balance the consumer surplus from drinking with the penalties he may receive from driving afterwards. The latter is represented by $S(c)$, the expected value (or opportunity cost) of any penalties that may be received for driving drunk, expressed as a function of blood alcohol concentration, c. The former is represented by the function $V_i(c)$, the private "value" of drinking and driving. To conform with S, it too is expressed in terms of c, and thus represents the amount driver i would be willing to pay, in the absence of penalties, to be able to purchase enough alcohol to achieve a given BAC. This will vary across individuals because of variation in preferences, the price paid for alcohol, and the rate at which alcohol increases individuals' BAC. For our purposes it suffices to subsume all of this into V.

The driver's privately optimal consumption level, c^*, maximizes V–S. In the absence of penalties, this sets $V'=0$. In the presence of penalties, however, each driver curtails his consumption until $V'=S'$. Table 1 defines all variables used in this paper and lists the data source from which each is measured.

2.1. Efficiency

If the objective were economic efficiency, a social planner would determine each driver's consumption, c_i, $i=1.\ N$, in order to maximize total surplus:

$$\max_{c_1 \ldots c_N} \sum_{i=1}^{N} V_i(c_i) - X(c_i) \tag{1}$$

where $X(c)$ represents each driver's expected external accident costs, assumed as a simplifying assumption to be the same for all drivers. The familiar optimality condition, $V_i'=X'$, is achieved when the policymaker sets $S'=X'$ for all c. This is the standard Pigovian tax that forces agents to internalize external costs. Were S and X measured in dollars, one could assess policy efficiency directly by seeing if this equivalence holds in practice at each value of c.

While S and X can be proxied, however, this is not easily done in dollar terms: several values that would be required to do so, such as the costs imposed by license revocation or the fraction of accident costs that should be considered external, are not precisely known. Fortunately, for our purposes we can use a weaker condition, necessary though not sufficient for efficiency, that lets S and X be measured in arbitrary units. This "cost-effectiveness" condition, analogous to the equi-marginal principle in production theory, requires only that drunk driving damages be decreased at the least "cost" to consumers—that is, the smallest aggregate reduction in V. The social planner thus solves:

$$\max_{c_1 \ldots c_N} \sum_{i=1}^{N} V_i(c_i) \quad \text{subject to} \sum_{i=1}^{N} X(c_i) = \Phi \tag{2}$$

with Φ an arbitrary scalar. The optimality condition $V_i'=\lambda X'$, with $\lambda(\Phi)$ the scalar Lagrange multiplier on the constraint, is to be met for, at least, all $c_i \geq \underline{c}$, where $\underline{c}$ is the minimum BAC level for which there is a per se drunk driving violation—typically 0.08 g/dl. The policymaker can achieve this result by setting $S'=\lambda X'$ for all $c \geq \underline{c}$. Then X'/S' should be constant over this domain but the value of the constant need not be specified. When this ratio is not constant, an equal reduction in external damages can be obtained at less aggregate inconvenience to drinking drivers, by raising the marginal penalty at BAC levels where this ratio is large and lowering it where this ratio is small.

Putting this ratio into logarithms yields a unitless cost-effectiveness optimality condition:

$$\log(X') - \log(S') = \kappa \quad \forall c > \underline{c} \tag{3}$$

with κ a constant whose value is meaningful only when S and X are measured in identical units: then positive (negative) κ implies an inefficiently low (high) penalty. Note that any multiple kS^{CE} of a cost-effective penalty structure S^{CE} is also cost-effective: the extensive and intensive margins are separated. Given data on S and X, the left hand side of this condition can be evaluated at each value of c. If the resulting values are constant, optimality obtains; otherwise, the deviations from optimality suggest how policy can be improved.

2.2. Efficacy

The efficiency standard is potentially problematic in that it gives drunk drivers "standing" in the cost-benefit analysis that underlies policy design (see Trumbull, 1990; Kenkel, 1998). This may run counter to society's intention in branding the drunk driver a criminal. According to this perspective, drunk driving is not an externality problem, but a question of rights, and a per se illegal drunk driving BAC threshold may be construed as a point at which the individual no longer has the right to use public roads.[3]

[1] These papers also abstract from the supply side. In Kenkel's (1993b) simulation of the effects of stricter deterrence policies, the additional resource costs required are \$63 billion, while the value of the reduced death and injury, based on Kenkel (1993a), is over fifty times greater.
Punishment is implicitly assumed to involve transfers (fines) rather than deadweight losses (license suspensions or jail), which are never efficient. But the optimality condition below holds if a constant fraction (in c) of penalties are deadweight losses, which is reasonably accurate.

[2] This assumes drivers respond "rationally" to the disincentives provided by the law. While standard in economics, this is not likely to be strictly true here. For example, people modestly misperceive the chances of arrest and of having an accident with injury (Dionne et al., 2007), and respond more to the certainty of punishment than its severity (for an application to drunk driving, see Grosvenor et al., 1999). Nonetheless, it is probably a reasonable approximation. Sloan, Eldred, and Xu's (2014) survey data indicates that drunk drivers are more impulsive and present-oriented than the average person, but also (p. 77) that "persons who frequently drink and drive. . .know what they are doing and understand the legal consequences of their behavior." Hansen (2013) argues that these deterrence effects dominate other potential causal links between drunk driving laws and traffic safety, incapacitation and rehabilitation.

[3] The most recent extended Congressional debate on drunk driving policy, on a 1998 bill impelling the states to adopt a .08 per se illegal BAC limit for adult drivers, adopted just this perspective. It ignored the "cost" on which efficiency hinges, consumer surplus lost by reduced alcohol consumption among heavy drinking-drivers, focusing instead on social drinkers' right to consume modest amounts of alcohol and drive, and citizens' right to drive on safe roads (see *Congressional Record* 144, no. 19–20, 3–4 March 1998:S1236–S1305). A similar perspective emerges from Rodriguez-Iglesias, Wiliszowski, and Lacey's (2001) study of the legislative history of state 0.08 laws.