Methodology for Evaluation of Truck Weight Regulation Enforcement Programs

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Highway agencies all over the world recognize that overweight trucks are a major cause of premature pavement deterioration. Compliance with truck weight regulations in each jurisdiction varies because of differences in enforcement levels, tolerances, fine schedules for violations, and other punitive actions. The object of this research was to develop a methodology for assessing the effectiveness of a truck weight enforcement program. Truck weight regulations and trucking activity in the Province of New Brunswick, Canada, were used as a case study. The methodology essentially compares incremental revenues that can be earned by overloading a particular truck configuration with the expected cost of getting caught, taking into account the fine regime and the level of enforcement. The results of the research demonstrated that fines are not structured in New Brunswick to be an effective deterrent for would-be violators. Alternative enforcement programs were postulated and the deterrent effect was evaluated.

Highway agencies all over the world recognize that overweight trucks are a major cause of premature pavement deterioration. Truck-weighing programs are the cornerstone of weight enforcement, but differences exist among agency programs in almost all aspects of enforcement. The differences include levels of enforcement activity, tolerance, fine schedules for violations, and other punitive actions taken against violators. All of these differences represent factors that go into determining the effectiveness of enforcement of truck weight limits. A change in any one of the factors alters the effectiveness of any program.

This study develops a methodology for assessing the effectiveness of one of the most important aspects of a weighing program, the schedule of fines. A case-study approach utilizing pertinent data for the Province of New Brunswick, Canada, was employed.

Case Study: New Brunswick Truck-Weighing Program

A recent paper presented to the Canadian Transportation Research Forum (CTRF) by members of the University of New Brunswick Transportation Group on the degree of enforcement of the New Brunswick Motor Vehicle Act presented evidence that the current fine schedule for overweight vehicles on New Brunswick highways does not present a deterrent to overweight loads (1). The observations were based on

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a 1 percent random sample of 1986 violations in which the cost of the fine from the point of view of the truck operator was estimated to be an average of \$0.03/kg of incremental payload attributable to the overload. This cost, however, represents 100 percent probability of being caught, which is not the case. Permanent weigh scales can be avoided, and scales are not open at all times. Therefore, the violator has an expected cost of \$0.03/kg multiplied by the perceived probability of getting caught. If the fine does not increase with each subsequent violation and if the trucker can earn incremental revenue that exceeds the amount of the fine by operating overweight, the expected return will exceed the expected cost; thus, many truckers are tempted to operate overweight.

RESEARCH OBJECTIVES AND SCOPE

The purpose of this study was to develop a means of assessing the New Brunswick Department of Transportation (NBDOT) truck schedule of fines in terms of deterring overweight operations. The study also developed alternative fine schedules based on current levels of enforcement, tolerance, and actions against violators.

At this point, the manner in which the deterrent effect is to be accomplished must be clarified. If an agency desires to effectively reduce the number of overweight vehicles, it might do so in a number of ways.

1. It might increase the likelihood that violators will be apprehended by increasing the level of enforcement.
2. The cost of violations to truckers once they have been apprehended might also be increased.
3. The cost of violations might be in the form of fines or actions taken against the violator. For example, violators may be required to unload the excess weight. In fact, NBDOT is contemplating the incorporation of a point system in which a computer would be used at the scale to record points lost. After the loss of a certain number of points, the violator's license would be revoked.

In order to limit the scope of this study to a manageable size, deterrence was assessed by altering the fine schedule, keeping all other factors contributing to the expected cost of the trucker constant (i.e., level of enforcement, tolerance, etc.). In effect the study assumes that NBDOT is operating its truck-weighing program at the highest level of justifiable enforcement and at levels of tolerance and punitive actions against truckers that the public will support.

METHODOLOGY

The first step in the analysis involved selecting a representative sample of commodity movements. It was determined from a 1984 truck origin-destination (O-D) survey (2) that the top 25 commodities accounted for 68 percent of all intra- and interprovincial movements. Hence, to make the study more manageable, the analysis was restricted to the top 25 commodities.

Data from Statistics Canada (3) were used to determine average freight rates for the selected commodities. Representative freight rates were estimated for short-, medium-, and long-haul distances for each commodity.

In order to estimate legal payloads for each commodity, it was then necessary to select specific truck types and axle configurations. Again, it was determined from the 1984 truck O-D survey that four truck types (two- and three-axle straight trucks and five- and six-axle tractor-semitrailers) accounted for 93 percent of truck movements. It was assumed that each truck type would operate with an axle configuration that permitted the maximum allowable gross vehicle weight. (Inspection of the O-D data confirmed the validity of this assumption.)

A range of HD overweight scenarios was then developed for each truck type, taking into account the weight limit regulations that apply to each of three classes of highway in New Brunswick. The overweight scenarios included both axle group and gross vehicle weight violations.

The next step in the analysis involved estimating the probability of detection. Data on number of vehicles checked were available for each weigh scale for 1984, 1985, and 1986. The ratio of vehicles checked to average annual truck traffic (AATT) was calculated for each weigh scale. The probability of detection was estimated to be 42 ± 12 percent. It should be noted that this is the actual probability of detection. The would-be violator may perceive the probability to be higher or lower at certain periods of time, the perception being influenced by a number of factors.

Using the actual probability of detection as a proxy for the perceived probability of detection by the violator, the expected cost of detection was estimated by multiplying the fine that would be levied for a given overweight scenario by the probability of detection. The expected cost of detection was then compared with the marginal revenue that would be earned from the excess payload above the legal limit for each scenario.

FINDINGS

Of the 40 overweight scenarios that were analyzed for each truck types, the results indicated that in most cases the marginal revenue attributable to excess payload exceeded the expected cost of detection by a substantial margin. In some cases, the margin reached as high as a factor of 10. The fines appear to be a deterrent for low-value commodities such as sand and gravel. However, in general it was concluded that effectiveness of the fine regime in deterring overweight violations was minimal.

To demonstrate the extent to which the fine would have to be modified in order to deter the tractor-semitrailer configurations, a number of computer runs were made in which the fine structure was increased by

1. Increasing the basic fine amount;
2. Increasing the graduation structure,
3. Changing the policy of penalizing the most overweight axle, and
4. Combinations of all of the above.

The alternative that produces a deterrent to a reasonable portion of commodity movements consists of increasing the basic fine to $200, penalizing all overweight axles by adding the overweight amounts on each axle group and using this sum to determine the fine, and doubling the graduation scheme. The increased basic fine compensates for the loss in deterrence from the perceived probability of getting caught. Increasing the graduation scheme increases the fine with increasing overweight amounts reflecting a greater deterrence of severe violations. By penalizing all overweight axle groups, the violator who distributes the overweight load to all axle groups, thus lowering the weight on the critical axle and therefore minimizing the fine, is not rewarded for his ingenuity. This phenomenon is evident from the current fine structure and policy.

CONCLUSION

The development of an effective enforcement regime for vehicle weight and dimension regulation involves a difficult trade-off between the level of enforcement (probability of detection) and the severity of punishment for violations (the fine regime). The costs of incremental enforcement are high and the resultant benefits will be minimal if the fine regime does not impose a sufficient financial penalty on violators. On the other hand, it is generally accepted that the "punishment should fit the crime." This research demonstrates that fines would have to be increased substantially, given the probability of detection, to produce an adequate deterrent effect.

It is important to recognize that many violations are beyond the control of the operator; for example, load distribution on axles, overloading by shippers, and variabilities in commodity weight density due to such factors as moisture content. Furthermore, some commodity movements that have a high risk of being overweight, such as forest products in New Brunswick, enjoy a high level of political sensitivity. The imposition of a severe punishment regime would therefore not be politically feasible.

In conclusion, it is by no means a simple task to strike an appropriate balance between the level of enforcement and the severity of punishment. However, if the case study presented in this paper is typical of weight and dimension enforcement regimes, it is evident that the severity of punishment should be increased.

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