Controlling Contradictions Among Regulations

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Congress pursues externalities one at a time. The resulting legislation embodies the same sequential approach, instructing regulatory agencies to set and enforce standards for a single problem. Rarely, if ever, are agencies instructed or even permitted to account for contradictions with other federal legislation and rulemaking.

Much has been written about how an agency should behave in order to optimize social welfare in pursuing some particular objective (E. J. Mishan, 1976; Edith Stokey and Richard Zeckhauser, 1978). After accounting for uncertainty, the optimal scale of the program is the point where marginal benefit is just equal to marginal cost; the program should be done at this scale only if total benefits exceed total costs. The benefit-cost literature has debated the conditions required to maximize social welfare. The debate was recently rejuvenated by President Reagan's Executive Order 12291, requiring benefit-cost analysis for each major regulation; the alternative that maximizes net benefits must be chosen unless the statute specifies otherwise.

There is also a large literature on the political economy of the situation (James Wilson, 1980; S. G. Breyer, 1982). Neither Congress nor regulatory agencies act like philosopher kings, pursuing social optima in a frictionless world of full information. Instead, decisions are sensitive to what data are available at the time action is taken, the income distribution implications of governmental actions, and institutional considerations including the current people in power.

A further potentially important difficulty that hasn't been treated in the literature is the possibility that various congressional goals and legislation may be directly or indirectly contradictory. Optimizing one externality assumes that it is independent of other externalities. This is unlikely. Insofar as the externalities are interdependent, the current system will produce suboptimization or outright contradictions. In what follows, I model the contradictions among regulations, show the errors, and then show how a wider perspective can help.

I. A Model of Contradictory Automobile Regulations

In 1966 Congress enacted the National Traffic and Motor Vehicle Safety Act to regulate the safety of automobiles. In 1970 Congress passed amendments to the Clean Air Act that required emissions of carbon monoxide and hydrocarbons be reduced by approximately 95 percent (90 percent for oxides of nitrogen), compared to an uncontrolled car. Finally, in 1975 Congress enacted the Energy Policy and Conservation Act requiring that the average new car sold in 1985 get 27.5 miles per gallon. Although the last act recognizes the possibilities of contradictions with previous acts, that is not dealt with in detail. In administering the act, the National Highway Traffic Safety Administration (NHTSA) has paid little attention to contradictions.

The automobile situation might be represented by the following:

\[ U(s, f, e, c, p), \]

where social utility \((U)\) is a function of the attributes of each automobile: safety \((s)\), fuel economy \((f)\), emissions \((e)\), comfort-performance \((c)\), and price \((p)\). All attributes are desirable except higher price.

To simplify, each of these attributes depends on three underlying attributes of the vehicle: weight \((w)\), horsepower \((h)\), and emissions control devices \((d)\), each of which is the instrument for requiring safety, fuel economy, and emissions, respectively. In par-
ticular, the relationships are shown as

\[(2) \quad s(w); f(w, h, d); e(h, d);\]

\[c(w, h, d); p(w, h, d).\]

Safety increases with weight, both because additional safety features add weight and because larger cars are somewhat safer than small ones. Fuel economy decreases with weight, horsepower, and emissions control. Emissions increase with horsepower and decrease with emissions control devices. Perception of comfort-performance is assumed to decrease with weight, other factors held constant. Comfort tends to increase with weight while performance increases with horsepower and decreases with emissions control. Finally, price increases with weight, horsepower, and emissions control.  

Thus, the social utility function can be rewritten as

\[(3) \quad U(s(w), f(w, h, d), e(h, d),\]

\[c(w, h, d), p(w, h, d)).\]

The NHTSA is instructed by its legislation to increase highway safety. In this simplified model, increasing safety requires increasing vehicle weight (for example, by requiring more safety features). Were NHTSA to follow its legislation in an unthinking, inflexible manner, they would set the derivative to zero, as the following directs.

\[(4) \quad \text{Max } S: \frac{ds}{dw} = 0.\]

The NHTSA is not so foolish. Clearly, adding safety devices is subject to diminishing returns and, even for an agency pursuing only a single goal of safety, enough is enough. However, the judgement about how much safety is enough has changed from administration to administration. For example, President Ford ordered an elaborate social experiment to determine the effectiveness of air bags in practice. President Carter cancelled the experiment and ordered either air bags or passive seat belts on all cars. President Reagan ordered the requirement vacated (and the Supreme Court rescinded the revocation). Better decisions would result if Congress clarified NHTSA’s goals. In particular, NHTSA could be instructed by Congress to examine the effects of its safety decisions on all automobile attributes, not just on safety. To do this, they would take the partial derivative of relation (3) with respect to weight and set this equal to zero, as shown in

\[(5) \quad \text{Max } U: \frac{\partial U}{\partial s} \frac{\partial s}{\partial w} + \frac{\partial U}{\partial f} \frac{\partial f}{\partial w} + \frac{\partial U}{\partial c} \frac{\partial c}{\partial w} + \frac{\partial U}{\partial p} \frac{\partial p}{\partial w} = 0.\]

Equations (4) and (5) represent a comparison between examining the effect of weight only on safety and examining the effect of weight on all vehicle attributes. Both partial derivatives in the first term are positive; the two partials in the next two terms are positive and negative, respectively. The two partials in the last term are negative and positive, respectively. Thus, equation (5) will have the effect of tempering the optimal weight of a vehicle, compared to the solution to equation (4). This is not surprising, since weight is being modeled here as desirable only for safety.

The solution to equation (5) is quite different from that to equation (4). From a social viewpoint, equation (5) would be expected to provide a much higher level of utility, even though it represented a lower level of safety.

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1 The existence and nice properties of \( s, f, \) and \( e \) are shown in my 1981 paper.

2 These statements assume other factors are held constant. Cars have become more fuel efficient and have lower emissions, compared with 1970. This was accomplished through innovation and higher manufacturing cost. Since 1974, manufacturers have made large investments in reducing vehicle weight, holding comfort-performance constant. Nonetheless, costs rise with increased weight, emissions, safety, and fuel economy held constant. The results would not change if an \( R&D \) or quality of manufacturing variable were added to each of the relationships in equation (2). Auto makers could be expected to invest in innovation and to increase the quality of manufacturing to the point where the marginal cost of more innovation and manufacturing quality would equal the savings in \( w, h, \) and \( d \) plus the increase in the desirability of the automobile.

3 Weight tends to increase comfort and decrease performance. Retaining simplicity leads to lumping these two together and assuming the partial derivative is negative.
However, in order to implement equation (5), NHTSA would have to know the numerical values of the other partial derivatives. Since these could be expected to vary with the weight, horsepower, and emissions control of vehicles, NHTSA would have to make some assumption about these. Alternatively, NHTSA could consult those who regulate emissions and fuel economy.

The Environmental Protection Agency (EPA) regulates emissions (actually, the agency does little more than implement the standards set by Congress). If EPA were trying to minimize emissions, it would increase emissions control devices. If EPA were instructed by Congress to account for the other consequences of its decisions, it would determine $d$ by taking the partial derivative of relation (3) with respect to $d$ and set this equal to zero, as shown in

$$\text{Max } U: \frac{\partial U}{\partial f} \frac{\partial f}{\partial d} + \frac{\partial U}{\partial e} \frac{\partial e}{\partial d} + \frac{\partial U}{\partial c} \frac{\partial c}{\partial d} + \frac{\partial U}{\partial p} \frac{\partial p}{\partial d} = 0.$$ 

As with NHTSA, the EPA would have to know the values of the various partial derivatives, which depend on the levels of weight and horsepower set by other agencies.

Another part of NHTSA regulates fuel economy. If they were instructed only to maximize fuel economy, they would set horsepower to zero, an absurd result—that might account for congressional recognition in this act that there may be contradictions among regulations. If they were instructed to set horsepower by optimizing social utility, they would take the partial derivative of relation (3) with respect to horsepower, resulting in the following:

$$\text{Max } U: \frac{\partial U}{\partial f} \frac{\partial f}{\partial h} + \frac{\partial U}{\partial e} \frac{\partial e}{\partial h} + \frac{\partial U}{\partial c} \frac{\partial c}{\partial h} + \frac{\partial U}{\partial p} \frac{\partial p}{\partial h} = 0.$$ 

As before, they would have to know the values of weight and emissions control set by regulatory agencies.

Thus each agency would have to know the numerical values of partial derivatives whose values are controlled by federal regulatory agencies. My proposal is not to have the Office of Management and Budget draw up a list of assumptions that each agency should used. While this is somewhat typical governmental solution, it is far from optimal. Instead, what is required is simultaneous optimization of relation (3) with respect to weight, horsepower, and emissions control, by simultaneously solving equations (5)–(7).

This formulation makes clear the limitations of the current statutory injunctions to each agency and of the strategy followed by Congress of attacking one problem at a time. At the very least, an agency ought to consider the implications of its regulatory actions on the other attributes of the product it regulates. More generally, all agencies that regulate a single product ought to formulate policy simultaneously, taking account of the values to be set by other regulatory agencies.

II. Implementing the Model for Automobiles

To show this optimization is possible and helpful, I will attempt to apply it crudely to the automobile. The problem is more general since there are myriad agencies regulating products, services, workplaces, etc. Whenever two agencies or two parts of one agency regulate the same area, simultaneous optimization is warranted.

Given the crudeness of this model, I will not attempt to solve the three equations simultaneously. Instead, I will try to implement equation (5). The marginal social utility of safety might be expressed in terms of the social value of preventing a premature death. A large literature attempts to clarify this notion and provide values. I will assume the value is $500,000 per premature death averted (Joanne Linneroth, 1979; W. Kip Viscusi, 1983). Past data indicate that reducing vehicle weight from 4,500 to 3,000 pounds increases the chance of being killed or seriously injured in a crash from .04 to .06 (see my earlier paper). (I neglect the effect of in-
increased vehicle weight on pedestrians and other vehicles.) Such a weight reduction for the entire fleet would be expected to result in 11,400 more fatalities each year, other factors held constant. Thus 7.6 fatalities or serious injuries would be expected for each 1 pound decrease in weight per year in all vehicles.

The social value of gasoline conservation is presumably more than the current cost of gasoline (T. J. Teisberg, 1981). Some approaches have put valuations to the marginal barrel of crude oil that are several times the current price. I assume the value of gasoline is $2.50 per gallon. A weight reduction from 4,500 pounds to 3,000 pounds would be expected to increase fuel efficiency by 5.7 miles per gallon, from 14.3 to 20 miles per gallon. For a fleet of 110 million cars, each going about 10,000 miles per year, the savings would be $36 million per 1 pound decrease in weight per year for all vehicles. (It is more difficult to provide estimates of the social value of comfort-performance or the extent to which this varies with weight. I will neglect this term.) An additional pound of weight probably costs $.25 or an annual cost per vehicle of $.06. Thus, for 110,000,000 vehicles roughly similar to the 1974 model, a weight increase of 1 pound on each vehicle would have instantaneous values shown in

\[
\begin{align*}
(8) & \quad 500,000(7.6) - 2.50(14,700,000) \\
& \quad - 0.06(110,000,000) = 3,800,000

& \quad -36,700,000 - 6,600,000 = -39,500,000.
\end{align*}
\]

The immediate conclusion is that society would be better served by shaving weight off this vehicle than by adding additional safety features. In fact that has occurred, with a vast reduction in weight over time, and a consequent decrease in the inherent safety of the vehicle.

III. Implementation Problems

The above formulation assumes that various agencies will be attempting to maximize the same social welfare function. In fact, they are likely to give more weight to their own social problems; each agency could increase its institutional utility by presenting other agencies with misleading information about the functions, costs, or values of the variables to be evaluated. The literature on transfer pricing suggests some ways of attempting to elicit accurate responses.

More generally, current data are likely to provide an estimate of the incremental trade-offs close to the current values, rather than some functional form likely to hold over a wide range. However, what is appealing about this formulation is that an agency could switch from pursuing a single objective in a narrow way \((ds/dw)\) to a more general evaluation of the desirability of changing in the attribute under its control \((\partial s/\partial w)\). If the values of the other partial derivatives are small, the more general approach can be dropped. In practice, no agency is likely to seek the trouble associated with simultaneous optimization. However, for particular situations, such as has occurred for the automobile, simultaneous optimization is the answer to the question of why each individually desirable regulation does not add up to a desirable outcome.

IV. Conclusion

The decade of the 1970's imposed environmental and health and safety regulation throughout the economy, adding to the economic regulation, equal opportunity regulation, and other prior government regulation. One part of EPA tells a company it cannot dump wastes into the river; another part forbids emissions into the air; a third part regulates dumping onto land. At the same time, the Occupational Safety and Health Administration requires that workers be protected against harmful exposures to the chemicals. Regulation of the automobile received national attention because of the depressed state of the industry. However, many other aspects of the economy are subject to contradictory regulations generated by the "one at a time" approach of Congress to externalities. Although the more general analysis proposed is more difficult to implement, the effort is necessary.
REFERENCES


