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Implementing technology-forcing policies: The 1970 Clean Air Act Amendments and the introduction of advanced automotive emissions controls in the United States

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Abstract

Technology forcing is a strategy where a regulator specifies a standard that cannot be met with existing technology, or at least not at an acceptable cost. Using the 1970 U.S. Clean Air Act for controlling automobile emissions as a baseline example, we demonstrate the importance of the regulatory implementation process if regulations are to foster technological change. The 1970 legislation required steep emissions reductions for new 1975 and 1976 automobiles, which presented automakers with major technical and economic challenges. Nevertheless, the U.S. Environmental Protection Agency successfully forced the adoption of two marquee control technologies—the catalytic converter in 1975 and the three-way catalyst in 1981. We focus on three factors critical to the implementation process: agency credibility to enforce standards, competitive pressures to drive industry research and development, and uncertainty about technological development.

Keywords: Technology forcing; Automobile regulations; Policy implementation; Air pollution control

1. Introduction

The degree to which regulations can effectively, and perhaps even efficiently, accelerate the development of advanced pollution control technologies is a continuing theme of environmental policy

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Table 1
Federal emissions standards, 1968–1981

Model year	HC	CO	NOx
Uncontrolled vehicle	8.7	87	4.4
1968	6.2	51	–
1970	4.1	34	–
1972	3.0	28	–
1973			3.1
1975	1.5 (0.41)	15 (3.4)	
1976			(0.41)
1977			2
1980	**0.41**	7	
1981		**3.4**	1

Measurements are in grams per mile. Numbers in parentheses are the 1970 Clean Air Act standards. Numbers in bold indicate that the standards in place satisfied the 90% requirement.

[1,2]. Economic analyses of the relationships between instrument choice and technological change have focused in two areas: the relative effectiveness of alternate policy instruments in providing incentives for firms to innovate [3–8], and whether the benefits of induced innovations warrant the regulatory compliance costs [9,10]. Most economic models take the policy implementation process as given, hence overlooking or abstracting from the importance of stakeholder involvement in the regulatory process. Yet, interactions of legislators, firms, regulators, and the courts play a critical role in shaping regulatory policy and firm behavior, which influence both technological and environmental outcomes.

In this paper, we examine implementation process in the context of technology-forcing policies directed at the U.S. automobile industry. Technology forcing is a strategy where a regulator sets a standard that is unattainable with existing technology, at least at an acceptable cost. Technology-forcing policies are well suited for a study of the role of regulatory implementation in fostering technological change for two reasons: First, the specific intent of technology-forcing policies is to elicit advancements in environmental control technologies. Second, technology-forcing policies create an adversarial setting where regulators and firms each actively attempt to shape and to change the actions of the other party. Specifically, regulators want to force firms to commit resources to R&D whereas firms want regulators to delay, relax, or rescind the standards. Consequently, the outcomes of these conflicts are key determinants as to whether and how environmental regulations affect the rate of technological innovation and diffusion.

Our focus is on the implementation of the 1970 U.S. Clean Air Act and its effects on the development and diffusion of advanced emission control technologies for new automobiles. The Clean Air Act mandated 90% reductions in tailpipe emissions over a four- to five-year period and instructed the nascent Environmental Protection Agency (EPA) to implement these standards (see Table 1). Congress intentionally set technology-forcing standards, presenting automakers with major technical and economic challenges. The internal combustion engine was a mature technology that had not seen any substantial improvements in 20 years, and it was not clear whether the standards could *ever* be met without replacing it altogether.[1] Even if the necessary technologies emerged, the industry faced billions of dollars in R&D, capital and equipment, and installation costs. Congress and the EPA were aware of

[1] Personal correspondence with Tom Austin, November 27, 2001. Mr. Austin was one of the primary analysts dealing with technical feasibility issues for EPA. He later became Deputy Executive Officer responsible for the California mobile source program, and is now president of a Sacramento, CA consulting firm.