Optimal Regulation

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The Economic Theory of Natural Monopoly

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Instructors who assign this book for a course can obtain copies of problem sets and exams by writing to the author at the Department of Economics, University of California, Berkeley, CA 94720.

For John

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Preface

Over the last thirty years, and especially during the last ten, the field of optimal regulation has emerged as a fairly unified body of thought with commonly accepted objectives and approaches. Stated most broadly, the problem that the field addresses is how to induce firms in noncompetitive markets to act in a way that is compatible with social goals. The task is complicated by a basic informational asymmetry: regulators usually have far less information about the costs and demand conditions facing the firms they regulate than do the firms themselves. Regulatory mechanisms must be established, therefore, that induce firms to produce the optimal output with the optimal inputs—but without the regulator knowing what these quantities are beforehand. Prerequisite to this task, of course, is the issue of what exactly constitutes "optimality" in each particular situation.

These questions have spawned an extensive literature. Taken as a whole, this literature tells an interesting and persuasive story. My motivation for writing this book was to tell this story, and to do so in a way that is accessible to a wider audience than the original literature. As an outline of the book, I give a summary of the story here.

Overview

In 1962, Averch and Johnson proposed a powerful method for examining the effects of regulation on the behavior of firms. They showed that the type of regulation most commonly used in the United States—rate-of-return regulation—induces firms to use inputs inefficiently. Baumol and Klevorick (1970), Bailey (1973), Das (1980), and numerous others clarified and extended this analysis, while reinforcing the basic conclusion. Empirical work showed that in many cases the inef-

ficiency induced by rate-of-return regulation can be quite costly to consumers, who bear these costs through their bills.

This finding gave rise to the need for other regulatory procedures that do not provide firms with an incentive to be inefficient. Creative proposals have been numerous. For situations in which a natural monopoly can be subsidized, regulatory procedures have been developed that induce the firm, in equilibrium, to price at marginal cost and use the cost-minimizing input mix. Examples include the "incremental surplus subsidy scheme" of Sappington and Sibley (1988), which requires that the regulator have information on demand but not costs, and a variant on this scheme proposed by Finsinger and Vogelsang (1985) that obtains optimality more slowly but does not require that the regulator have demand information.

When the natural monopoly cannot be subsidized, the question arises of what constitutes optimality, because pricing at marginal cost results in the firm losing money. This issue was resolved by, for example, Baumol and Bradford (1970). The optimality conditions are equivalent to those proposed much earlier by Ramsey (1927) in a different context. Consequently, the term "Ramsey prices" is used to denote optimality for nonsubsidized natural monopolies.

Vogelsang and Finsinger (1979) proposed a regulatory procedure that induces a nonsubsidized firm to charge Ramsey prices and produce efficiently in equilibrium. Under this procedure the regulator uses information on the firm's observed costs and output in one time period (say, a year) to constrain the firm's pricing choices in the following period. Over time, the firm moves to the Ramsey prices. This proposal raises a host of strategic issues for the firm. Sappington (1980) pointed out, for example, that the firm might, under certain circumstances, have an incentive to waste inputs in each period prior to reaching equilibrium as a means of manipulating the regulator into allowing higher prices in the next period. For the same reason, the firm might have an incentive to misreport its costs, reporting higher costs to the regulator than are actually incurred. Baron and Besanko (1984), Townsend (1979), and others developed optimal methods for auditing the costs of the firm to prevent or reduce the extent of misreporting.

A variety of different billing algorithms, called tariffs, have been used by regulated firms for charging their customers. Under time-of-use pricing, for example, the customer is charged a different price at different times of the day, with price being higher, presumably, in

the "peak" periods of the day when demand is high and capacity is strained. Multipart tariffs are another example; under these, the customer might be charged one price for consumption up to a certain level and then another price for consumption beyond this level. Some regulated firms in fact offer a variety of tariffs and let the customer choose the tariff under which to be billed. For example, a firm might offer both time-of-use prices and non-time-differentiated prices, with the customer signing up beforehand for one or the other. These tariffs are called self-selecting, because the customer selects among them.

Various authors have shown that each of these types of tariff situations has the potential to increase social welfare, at least under certain circumstances. And regulatory procedures have been developed to exploit this fact. Boiteux (1960), Williamson (1966) and others identified the optimal time-of-use prices. Then Riordan (1984) proposed a method to induce firms to choose these prices without the regulator knowing the firm's demand in each period. Willig (1978) and Panzar (1977) showed that multipart and self-selecting tariffs can be designed that benefit some customers and the firm without hurting any other customers. Sibley (1989) proposed a regulatory procedure, similar to the incremental surplus subsidy scheme mentioned above, that uses self-selecting tariffs in a way that induces the firm to move to optimality in equilibrium without the regulator having information on either costs or demand and without the need for direct subsidy.

Methods of regulation have even been proposed that essentially eliminate the need for regulation. These methods are based on the notion that competition among numerous firms that *could* produce in an industry induces optimality even if, as in a natural monopoly situation, only one firm actually *does* produce. Demsetz (1968) and Posner (1972) suggested that the monopoly franchise (that is, the right to be the monopolist) be auctioned off to the firm that offers to charge the lowest per-unit price. Under certain conditions (such as many noncolluding bidders), this auction results in the lowest possible price for consumers. No regulation is needed beyond the holding of the auction, at least in a static world. Baumol, Panzar, and Willig (1982) formalized and generalized the concept of competition among potential producers. In their theory of contestability, the threat of entry by new, competing firms regulates a monopolist effectively. That is, instead of establishing a regulatory procedure that induces optimality, the regulator can simply allow entry of competing firms into the industry. If certain conditions are met, this entry—or, more exactly, the

threat of entry—induces the existing monopolist to act optimally. Though allowed, entry does not actually occur as long as the monopolist behaves optimally; therefore the cost advantages of having only one firm are retained.

Purpose of the Book

Stated in this concise fashion, the field emerges as possessing a definite unity. The individual topics are interesting in themselves and as they relate to other topics. For my courses on regulation, I have found a way to present these topics meaningfully in lecture. However, I—and more directly, my students—have been frustrated in my attempt to provide useful and adequate reading material. No textbook covers this material as a whole, and some of the most important and most recent concepts are not included, to my knowledge, in any text. I have been assigning the original articles. However, most undergraduates, and some graduates, lack the technical background necessary to read them and quit trying after a few incursions. Even those students who can read the articles have difficulty connecting the concepts from different papers because terminology and the framework for analysis vary greatly. I wrote this book to provide a textbook for my courses on regulation, both undergraduate and graduate. I imagine, and hope, that other instructors will find the text useful also.

I have attempted to present the material in a form that elucidates the driving forces behind the results while using the minimum technical apparatus. The text is intended to be readable by upper-level undergraduates and graduates with strong, but not necessarily highly mathematical, training in microeconomics. Calculus is used only once,[1] and this one derivation can be skipped or skimmed without substantial loss because the concepts that motivate it are discussed nonmathematically. Algebra and basic logic are used extensively, along with graphical devices.

For graduate students especially, and for any reader wanting more complete rigor, the original articles still serve as the source and should be read. I have found, however, that even students with strong technical training often follow the arguments in the articles more readily, and with greater insight into the economics behind the mathematics, after going through the analyses in this book.

1. For result 5 of chapter 3. I have not been able to devise a noncalculus demonstration of this result and would be grateful to readers for suggestions.