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RESEARCH AND TECHNICAL CHANGE IN THE PHARMACEUTICAL INDUSTRY*

(William S. Comanor)

In recent years there has been a good deal of discussion concerning the relationships among market structure, research and development, and the rate of technical change. Much of this discussion has focused on the question of whether large firm size is a necessary condition before firms will engage in research, and whether research and development (R and D) is likely to grow more or less than in proportion to increases in firm size. A further set of questions deals with the relationship between research and the rate of technical change experienced by the firm. Can variation in the latter be explained largely by differences among firms in the size and character of their research programs? Are economies of scale in R and D likely to be present? What is the effect of firm size on the productivity of a research establishment? This paper provides an empirical analysis, concerned with these questions, of the experience of the United States pharmaceutical industry during the period between 1955 and 1960.

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The empirical investigation in this paper utilizes multiple regression techniques on a cross-sectional basis at the firm level. It examines the impact on technical change of a number of variables associated with the character of a firm's research and development effort. At this point, we will define the measures used to represent technical change and R and D, and describe the sample upon which the analysis is based.

Research and development establishments in the pharmaceutical industry¹ are concerned to a very large extent with the introduction of new products, and only meagerly with the development of new processes.² This is due to the fact that the primary motivating force behind R and D outlays in this industry lies specifically in the attempt to achieve scientific or chemical product differentiation.³ If products at reasonable levels of cost, these are properly included under new product research, for we are concerned here not merely with the discovery or invention of the product, but with the total R and D outlays, associated with its introduction. As a result, research output, in this paper, is measured entirely in terms of new products and we assume that the research effort designed to produce new processes is small and can be safely ignored.

A concern with research output in terms of new products requires consideration of all products introduced which are new to the firm regardless of whether they have been introduced previously by competitors. This includes those products which are innovations or imitations and those which lie in an intermediate position, embodying varying degrees of differentiation relative to products already on the market. This last category, which in the pharmaceutical industry includes the great majority of new products, covers the entire spectrum of which pure innovations and pure imitations are the extreme values. Our measures of research output are, thus designed to represent the rate of new product technical change experienced by the firm.⁴

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¹In this study, we shall distinguish ethical drugs from proprietaries, and shall consider the pharmaceutical industry in terms of the former. Pharmaceuticals are marketed and sold only through the medical professions, and require, for the most part, a written medical prescription.

²So great is this emphasis that a 1958 trade journal survey of research budgets of pharmaceutical firms divided expenditures into four categories without providing a category for new process research. See *Chemical and Engineering News* (March 17, 1958), 52. Although funds are expended to develop techniques for mass producing new prod-

³See W. S. Comanor, *op. cit.*, 65-85.

⁴Technical change is considered to encompass imitation as well as innovation, and thereby deals with the entire process by which new technology is placed into actual practice.