

New pharmaceutical products may be divided into a number of classes concerned with the innovative character of a new drug. In the first category are the single chemical entities which have not been introduced previously into United States markets. While these are largely innovative, they do include salts or derivatives of older products. Other classes deal with new combinations of active ingredients and new dosage forms of previously introduced products. These groups contain imitative as well as innovative characteristics. At the same time, many new products are purely imitative and merely duplicate products already on the market. In this study, we shall measure technical change by means of two variables. The first of these deals only with the introduction of new chemical entities, while the second includes a large imitative component and encompasses new products of all types.

New products vary not only in terms of the degree of innovative character which may be associated with them, but also in terms of their economic impact. To deal with this factor, we have weighed each new product on the basis of its sales during the first two calendar years following introduction.⁵ We shall designate Y_1 to equal total sales, in their first two years, of all new chemical entities introduced by the firm during the period between 1955 and 1960, and Y_2 to equal a comparable sum when "new products" assume the broader definition.⁶

The scale of research and development has also been measured in two ways, both dealing with the number of persons employed in research establishments.⁷ The first variable is the average number of professional R and D personnel employed in 1955 and 1960. The second deals with the average number of total personnel employed in R and D facilities at these two points in time. This latter value equals the sum of professional and supporting personnel.

The sample used in this study includes 57 pharmaceutical firms,⁸ and accounts for nearly 80% of total pharmaceutical prescription and hospital sales during the period between 1955 and 1960. Moreover, the sample is not dominated entirely by large companies, but rather covers the entire range of the size distribution of pharmaceutical firms.⁹ The distribution of the sample is J-shaped with one-

⁵ Sales data by product were obtained from a marketing research firm, R. A. Gossett & Co., Inc., which supplied information for the years 1955 through 1961. These figures are derived from a representative sample of the nation's drug stores and hospitals. One shortcoming of these figures is that they do not represent total output but only that portion which is sold to consumers via prescriptions and to hospitals, and thereby do not include sales to government, corporations, or those made in physicians' offices. Prescription and hospital sales, however, account for approximately 80% of total pharmaceutical sales. See Lucy Kramer, "Drugs and Medicines" in *Public Health Reports* (Oct. 1958), 932. We are forced to assume that our conclusions would not be substantially altered if the remaining portion were included. Information on new products was obtained from Paul deHaen, a consultant to the pharmaceutical industry. In addition to providing information on year of introduction, these surveys noted the therapeutic classification of each new product and whether the product at introduction was a new chemical entity, duplicate, new compounded product, or new dosage form. For a more detailed discussion of the value and limitations of these data, see W. S. Comanor, *op. cit.*, 99-106.

⁶ The data on pharmaceutical sales, used in the creation of these variables, have not been deflated for price changes but rather have been expressed in current dollars. This step was taken because of the high degree of price stability among pharmaceuticals during the period under consideration. See the price index computed by John M. Firestone in United States House of Representatives, *Drug Industry Antitrust Act*, Hearings before the Antitrust Subcommittee of the Committee on the Judiciary, 87th Congress, 2nd Session (1962), 608.

⁷ Information on this subject for the years 1955 and 1960 has been published in National Academy of Sciences—National Research Council, *Industrial Research Laboratories in the United States*, tenth and eleventh editions. These surveys distinguish between professional and supporting staff within R and D establishments. In addition, for those companies in which the research effort was divided among a number of separate laboratories, the size and direction of research of each laboratory were, in most cases, listed individually. Since in many large diversified firms, the pharmaceutical R and D laboratories were distinguished from other research facilities, it was possible to limit our data for these firms to pharmaceutical research personnel. In the inevitable instances when we came across laboratories in which work was done on non-pharmaceutical as well as pharmaceutical projects, the facilities were included when it appeared from the summaries provided that the major part of the effort was concerned with pharmaceutical endeavors.

⁸ The sample was chosen on the basis of data availability but with the condition that no substantial merger took place with other pharmaceutical firms between 1955 and 1960. Exceptions were made for those mergers which occurred during 1960 and in which the 1960 R and D survey reported separate and distinct research facilities. It was assumed, in these cases, that the pre-merger firms behaved and acted independently throughout the period.

⁹ Size, in this study, is measured by the mean value of annual prescription and hospital sales between 1955 and 1960.