In an attempt to meet the qualitative problem two categories are defined. The first is designed to include drugs which were in one degree or another an improvement over older products. These varied from drugs which were considered medical breakthroughs to drugs which reduced the incidence of undesirable side effects observed with established chemotherapeutic agents. Drugs which fell in this category were counted as examples of technological progress.

The second category includes those drugs which from a technical point of view were no advancement over older products. The range in this category is from drugs which had the same degree of effectiveness and the incidence of side effects as older products to drugs which were removed from the market or limited in their application because of undesirable side effects. Also included in this category are drugs where medical opinion was divided or clinical experience too limited to form a statistically valid sample of the value of the drug. Drugs falling in this category were counted as examples of product differentiation which exhibit no significant technological progress.

To classify each of the drugs in the sample the Medical Letter[1] and the AMA's New and Nonofficial Drugs were selected as authoritative publications that best summarized clinical experience with each drug. Thus the classification of a drug is directly dependent upon its technical efficiency relative to a particular medical problem. This scheme gives no weight to sales volume as an index of the relative value of a drug. This recognizes that physicians are responsive to the promotional claims of the manufacturers and will prescribe a new drug before sufficient clinical experience is amassed to establish the comparative value of the new drug relative to older products. As a result a drug significant in the management of a disease of low incidence in the population and a correspondingly low volume of sales receives the same weight as a drug which cures diseases of high incidence and high volume of sales.[2]

Biases in the sample are undoubtedly numerous and difficult to evaluate and could operate in either direction. First, the source publications do not clearly indicate the basis of selecting a particular drug for discussion. Inclusions may well be in response to the promotional claims of the manufacturer with the recognition that the majority of practicing physicians have neither the facilities, the time, the training, nor the range of patients necessary to conduct statistically valid tests of such claims. Second, definitive judgment of the place of a particular drug in the physician's tool kit may require several years of experience before the population treated is sufficiently large to expose undesirable side effects. Thus, a drug currently considered significant may, with further testing, be found to have only a restricted application. Third, drugs now considered insignificant may, through modifications in techniques of administration, or in combinations with other drugs, be found valuable in the management of specific diseases. Finally, there is a bias in restricting the sample to new chemical structures. It is possible that combinations of old drugs, for example, may increase the number of diseases controllable through chemotherapy. But there is no evidence to date that this technique has produced anything of importance.

In Table I of the sample of 528 new chemical drugs is divided according to the classification scheme outlined above. Column I contains estimates of the total number of new chemical structures innovated yearly between 1945 and 1965.

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[1] The Medical Letter is a publication designed to acquaint the practicing physician with the latest information on drug products.

[2] For a different approach to the qualitative problem see W. S. Comanor, "Research and Competitive Product Differentiation in the Pharmaceutical Industry in the United States," *Economics*, Vol. 31, November 1964, pp. 372–84; and "Research and Technical Change in the Pharmaceutical Industry," *Review of Economics and Statistics*, Vol. 47, May 1965, pp. 182–90. Comanor's investigation of the whole range of new drug innovations weights each innovation by its sales volume for the first two years following its introduction. My objection to following this approach in the present study is that the time required to develop experience with any particular new drug to support a definitive opinion on its technical worth seems to exceed the two-year period following introduction.