through the CMR and pressure on those under contract to begin production. In addition, government funds were provided for plant construction and modification,[7] and as a result, the War Production Board permitted the sale of penicillin through normal trade channels in March of 1945.

After the removal of government restriction on the safe of penicillin, market forces operated to reduce prices. Tariff Commission data indicate that between 1945 and 1950 the realized price of penicillin fell from $3,955 to $282 per pound, while production increasing from 11,746 to 329,746 pounds.[8]

The behavior of penicillin prices can be explained by two factors—conditions of entry and the existence of a bulk market. A product patent on penicillin was unavailable, and the process patents were held by the Department of Agriculture, which followed a policy of freely licensing applicants; entry could not be restricted in manufacturing or selling based upon patents. Available evidence indicates that there were 16 penicillin suppliers in 1945, and 13 in 1950.[9]

The second factor was that several of the major drug producers were not integrated forward into direct selling to hospitals and retail pharmacies. These firms generally sold a significant proportion of their output through the bulk market to packagers who resold under their own brands. The FTC study reported 27 packagers in 1950, increasing to 45 by 1956, concluding that entry at this level was relatively easy.[10] Thus packagers purchased their supplies in the open market and sold in competition with the integrated producers.

The emphasis on price competition in the penicillin market was not at the expense of product improvement. Various modifications of penicillin were introduced. For example, Squibb introduced the first orally effective penicillin in 1945, Wyeth introduced benzathine penicillin which has a slower rate of absorption in 1951, and in 1955 Lilly marketed penicillin V claiming higher potency. Product patents were generally obtained on these specialties but usually only after interference proceedings had been declared by the Patent Office. Settlement took the form of withdrawal of a competitive patent application in return for a license to produce and sell under any patents that be issued. While data on realized prices of these products are not reported separately by the Tariff Commission, these prices generally drifted downward following the price of the basic drug although at a somewhat higher level.

Thus in the penicillin market the underlying condition of freedom of entry and the bulk market produced a market competitive in price and with product improvement.

The second major antibiotic following penicillin was streptomycin, discovered by Selman Waksman at Rutgers University in 1943. Under the terms of the research contract between Waksman and Merck, the latter received exclusive commercial rights to this drug. To exploit its position, however, Merck had to first convince the Patent Office that streptomycin was sufficiently important to warrant patent protection,[11] and second, to integrate forward into the retail market to avoid dependence upon the bulk market. Both steps were necessary. For with the sale of a patent product to packagers, the patent monopoly was exhausted and price cutting could legally begin.[12]

The demonstration of the potential importance of streptomycin resulted in Waksman's request to Merck that right of commercial exploitation be given up. The sequent agreements provided for the assignment of the patent application to a nonprofit foundation at Rutgers, and royalty abatement of $500,000 to cover Merck's development costs. In 1948 the patent was issued to the foundation which followed an unrestrictive licensing policy.[13] Seven firms in addition to Merck were licensed to manufacture streptomycin. Four of these firms, including Merck,[14] were not integrated forward, selling primarily in the bulk market to

[7] FTC, *op. cit.*, pp. 47–56.

[8] U.S. Tariff Commission, *Synthetic Organic Chemicals, United Production and Sale,* Reports No. 159 and 167 (Washington, Govt. Printing Office), various issues.

[9] The decline in the number of manufacturers was largely due to their adoption of inefficient production techniques. With the end of military purchases and the onset of price competition these firms would not cover costs and transferred their resources to other markets.

[10] FTC, *op. cit.*, p. 66.

[11] Prior to streptomycin the Patent Office took the position that the isolation of products of nature did not rise to the level of invention and hence were unpatentabble. Merck successfully argued that antibiotic products were transitory in nature and that their isolation constituted invention within the purpose of the statutes. F. Cacciapaglia, Jr., and H. B. Reckman, *The Proposed Drug Industry Antitrust Act—Patents, Pricing and the Public,* The George Washington Law Review, Vol. 30, June 1962, p. 890.

[12] The doctrine that the first sale of a patented product exhausted the patent monopoly was set out in Boston Stores Co. v. American Gramophone, 246 US 8 (1917).

[13] FTC, *op. cit.*, p. 229.

[14] Merck did not enter the retail market until its 1952 merger with Sharp and Dohne.