

thousand dollars for a competent biochemist to develop production methods. Thus, if there is no patent regime, imitators can free ride on most of the innovator's investment.

Patents in general do affect the cost of duplication and imitation. Levin and colleagues¹⁸ learned in a broad-ranging survey of corporate R&D decisions that patent protection increased imitation costs by 40 percentage points for pharmaceutical products (relative to a scale on which equally costly imitation is 100), by 25 points for typical chemical products; by 7 to 15 points for semiconductor, communications equipment, and computer products; and by an average of 17 percentage points for machine tools, pumps, and compressors. Although "reverse engineering" is not a free lunch in many industries, timely duplication of a major patented new product was reported to be impossible in only 12 of the 127 surveyed industries.

Nonetheless, there are several reasons why competitive imitation might be impeded even without patents, leaving sufficient incentive for investments in R&D. To imitate, one must know about the innovation and its advantages, and knowledge is always imperfect. Once a new technology is made public, it takes time for potential imitators to learn about it and decide whether it is worth copying. Studies of the diffusion process reveal that adoption spreads, first slowly and then more rapidly. Mansfield¹⁹ found the pace of imitation to be positively correlated with the profitability of adopting the new technology. For product innovations, this means that the pace of imitation is a variable under the innovator's control. Companies pricing their new products to make a quick killing will encourage rapid imitation,²⁰ while those pursuing dynamic limited-pricing strategies may be able to retain sizable market positions for a considerable period.

This conclusion is supported by the findings from several surveys of R&D executives, revealing quite uniformly that, in most industries, patents are not very important compared to other incentives for innovation. Levin et al.²¹ asked 650 U.S. R&D executives to evaluate the effectiveness of alternative means of protecting the competitive advantages from new and improved products and processes. For both products and processes, the nonpatent strategic advantages from being an innovator were found to be

¹⁸ Richard C. Levin, A.K. Klevorick, R.R. Nelson, and S.G. Winter, 1987, *op. cit.*

¹⁹ Edwin Mansfield, *Industrial Research and Technological Innovation*. New York: W.W. Norton, 1968.

²⁰ Mansfield et. al. found that 60 percent of the successful patented innovations were imitated within four years. See, E. Mansfield, M. Schwartz, and S. Wanger, "Imitation Costs and Patents: An Empirical Study", *Economic Journal*, 91, 1981: 907-918.

²¹ Levin et al., 1987, *op. cit.*