

## Chapter 2

# Research and Development and Economic Theory

The optimal organization of research and development (R&D) in a market economy is one of the unsettled questions of economics. R&D has great externalities that make its support more complicated than the support needed for most goods. In a market system the private benefits and private costs are contrasted to approximate the social welfare. Thus, the organization of R&D has become a key issue in the transition to a market system of the former centrally planned economies. This is particularly true for the former USSR, which has been a major source of science and technology.

The phenomenon of technological change and the need to keep up with that change are not new. The impact of improved production and new invention and thus increased productivity, efficiency, quality, comfort, and real output per capita have, in the past, had important economic (in industry and commerce), social, and political consequences. Technology has facilitated the inception of solutions to pressing economic problems (i.e., hunger, disease, working conditions), and is paving the way to answers that are required to deal with the continual flow of today's urgent issues such as sustainability of development, economic reform, conservation of resources, environmental issues, and the "quality of life" (which includes value of leisure time and time allocation). In addition, technological change transforms the structure of firms and industries and the basic nature of competition in an economy (Rosegger, 1980, p. 3). Thus, it is the technological change that causes changes in productivity that influence the progress and style of economic growth.

In general, technology consists of research, development, and related investments in new technology. Technological change is described as being

either disembodied or embodied.[1] Disembodied change happens automatically; that is, it requires no investment in plants and equipment. The isoquant curves of the production function shift toward the origin with time, independent of changes in the factor inputs (Stoneman, 1983, p. 4). On the other hand, embodied change is introduced into the productive process by being inherent in new investments of either capital or labor (i.e., as machinery, equipment, or personnel with new skills). The rate and direction of, and inevitably the influence on, related economic factors (such as growth and standard of living) of embodied technological advance are functions of the economic environment in which the change occurs.

The results of numerous studies on the private and social rates of return on agricultural and industrial research and development (in some cases this included extension or diffusion assistance) in a market-oriented economy show that the rates are not only positive, but also quite high. Therefore, based on the consensus that productivity growth is largely determined by the pace of technological progress, it is actually the underlying spending on and effectiveness of research and development activity, which is at the heart of technological change, that directly influence the progress and style of economic growth.[2] Overall, technological progress is inhibited via social, institutional, and economic difficulties.

Economic and technological advantages depend on changes in management organization and behavior. These exist most beneficially as dynamic processes and not in static states. According to most of the studies to date, the rate of technological change is by no means constant. It occurs in what Joseph Schumpeter referred to as creative gales of destruction. Schumpeter also emphasized that this process of change is characterized by *both* organizational innovations and technical innovations (originating in applied R&D) and their interdependence. Therefore, modern-style growth and, consequently, development of a national economy result in part when individuals and firms (in particular, private ones) commit resources to search for ways of doing things better, usually in the form of new institutional or technical technology. The critical point is that these economic agents primarily act in this manner because they expect future economic gains.

## 2.1 Characteristics of R&D: The Theory

More than two centuries ago, Adam Smith, the father of economics, identified the division of labor, free markets, and technical change in the form of new machines as the three important causes of increasing incomes (Coombs