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Introduction

This volume is the third publication of the National Bureau of Economic Research (NBER) Innovation Policy and the Economy (IPE) group. The appreciation of the importance of innovation to the economy has increased over the past decade. At the same time, there is an active debate regarding the implications of rapid technological change for economic policy and regarding the appropriate policies and programs for research, innovation, and the commercialization of new technology. This debate has only intensified with the economic and security challenges that our nation has recently faced.

The IPE group seeks to provide an accessible forum to bring the work of leading academic researchers to an audience of policymakers and those interested in the interaction between public policy and innovation. Our goals are:

- to provide an ongoing forum for the presentation of research on the influence of public policy on the innovative process;
- to stimulate such research by exposing potentially interested researchers to the issues that policymakers consider important;
- to increase the awareness of policymakers (and the public policy community more generally) concerning contemporary research in economics and the other social sciences that usefully informs the evaluation of current or prospective proposals relating to innovation policy.

This volume contains the papers presented in the group's meeting in Washington, DC, in April 2002.

The first two chapters examine the challenges that dynamic high-technology industries pose to policymakers. The first chapter, "Short-Term America Revisited? Boom and Bust in the Venture Capital Industry and the Impact on Innovation," seeks to understand the

implications of the recent dramatic decline in venture capital fundraising and investment on innovation. Is this decline likely to handicap America's ability to develop economically important discoveries in the years to come, as the business press has claimed? The chapter argues that the situation may not be as grim as it initially appears. While there are many reasons for believing that *on average* venture capital has a powerful influence on innovation, the effect is far from uniform. In particular, during boom periods, the prevalence of overfunding of particular sectors can lead to a sharp decline in the effectiveness of venture funds in stimulating new discoveries. While prolonged downturns may eventually lead to good companies going unfunded, many of the dire predictions seem overstated.

Dennis Carlton and Robert Gertner explore the implications for antitrust policy of the dynamic process by which intellectual property is created. Picking up on themes sounded in last year's IPE Volume by Richard Schmalensee and David Evans, they emphasize that analytic procedures based on static models of competition can have perverse results when applied to the dynamic process of research and development. In particular, they show that analysis of proposed mergers that is based on changes in concentration and market shares in defined "innovation markets" is unlikely to lead to robust conclusions about the competitive effects of the merger. This is because there is no necessary connection between such apparent changes in "R&D competition" and the magnitude of R&D performed, the extent of ultimate product competition, or consumer welfare more broadly. They then turn to consideration of the implications for competition policy of *open vs. proprietary* systems for software or hardware components that are used together. They show that private incentives for making such a system proprietary are different from the social benefits of keeping them open. They suggest that antitrust authorities therefore pay particular attention to activities that undermine standard setting and other activities that facilitate the maintenance of open systems.

Roger Noll, in "Federal R&D in the Antiterrorist Era," turns attention towards the role that innovation policy is playing in the development of the government's response to the September 11 attacks. Looking beyond the Administration's stated policy goals, Noll evaluates the most likely trends in the antiterrorism era, drawing on an historical record in which political and administrative processes play a decisive role in determining the size, allocation, and effectiveness of the Federal R&D spending. From this perspective, Noll concludes that, although

the connection of the antiterrorism effort to R&D thus far is tenuous, defense-related R&D expenditures are likely to grow faster in the next few years than they did during the 1990s. But these increases are not likely to come at the expense of other R&D: indeed, other government R&D may increase over the medium term. Moreover, given the recent emphasis in federal innovation budgeting on applied research and development, it is possible that these new expenditures may, in some areas, substitute for private spending. Finally, if the overall supply of scientists and engineers is unresponsive to these budgetary increases, federal R&D spending increases may be dissipated in higher R&D costs, rather than as increases in R&D output. In this case, the greater spending on R&D brought about by antiterrorism policy and politics will have a very limited impact on the rate of long-run technological progress or economic growth.

The last two chapters look at the challenges posed by encouraging innovation in the developing world. Jean O. Lanjouw's analysis, "Intellectual Property and the Availability of Pharmaceuticals in Poor Countries," explores alternative intellectual property regimes for pharmaceuticals in less developed countries. Lanjouw's analysis is premised on the insight that the benefits and costs associated with an intellectual property regime for pharmaceuticals depends on the characteristics and distribution of particular diseases. Some diseases, such as malaria, primarily affect poor countries; in these cases, patent protection in the developing world may increase the overall incentives for public and private research financing. For major global diseases, such as cancer, however, the primary markets are overwhelmingly in the developed world, and the efficacy of intellectual property protection in poorer countries is less clear. As a very small part of the global market (in terms of revenue), protection in poorer countries is unlikely to provide a substantial boost to R&D incentives; however, intellectual property protection may substantially lower the ability to offer effective treatment. An optimal global framework for pharmaceutical patents therefore requires differentiating protection based on an interaction between disease and national market characteristics. The nuance required to achieve this differentiation is unlikely to be achieved with traditional intellectual property and regulatory mechanisms. Lanjouw outlines a new mechanism, however, that takes advantage of existing facets of U.S. patent law to balance several subtle policy objectives: allowing firms to take advantage of intellectual property protection in richer countries for global diseases, providing incentives

to relinquish intellectual property claims in poorer countries for these same diseases, and yet simultaneously providing intellectual property protection in poorer countries for diseases whose scope is limited to such countries. Lanjouw concludes that substantial welfare gains may be achieved by taking advantage of nontraditional policy instruments that allow for a more differentiated intellectual property environment.

In "The Global Innovation Divide," Jeffrey Sachs provides a broad overview of the role of science and technology in the process of economic development. He notes first that, by any measure one examines, the difference between the haves and have-nots with respect to the rate of innovative activity is even greater than the differences in wealth or income. The world can be divided roughly into three parts: About one-sixth of the world's population lives in areas where innovation occurs endogenously. In a middle group of countries or areas, there is relatively little endogenous innovation, but innovation does diffuse and is adopted from other places. But perhaps one-quarter of the world's population lives in a bottom group that is relatively untouched by technology. This divide can be attributed to a combination of the increasing-returns nature of the innovation process, the inability of poor countries to devote public funds to research or technology, and the fact that many technologies are ecology-specific, so that technology developed in the mostly temperate innovating countries is difficult to adapt to the mostly tropical poorest countries. Sachs then discusses how the bottom group of countries could begin to make the transition to technology users. He highlights the role of direct aid from the rich countries, greater research attention in rich countries to problems prevalent in the tropics, review of policies on intellectual property, and re-examination of mechanisms for technology transfer.

While the issues discussed here are undoubtedly difficult, the chapters highlight the role that economic theory and empirical analysis can nonetheless play in evaluating key policies affecting innovation. They suggest that contemporary research in economics can usefully inform the evaluation of current and prospective innovation policy alternatives.

Adam B. Jaffe, Josh Lerner, and Scott Stern