

Editors' Introduction:

Innovation and Dynamic Efficiency in Agricultural Biotechnology

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Innovation is the key to firm survival and growth in many industries, but nowhere more so than in agricultural biotechnology. Understanding the causes and consequences of biotechnology innovation requires negotiating a complex thicket of economic, policy, and technical themes. These themes include questions of optimal patent policy, market structure, and antitrust policy in both the innovation market and the output market, public-private collaboration, public-sector research and development (R&D) in agricultural biotechnology, and the management of intellectual property owned by universities and government research organizations.

This issue of *AgBioForum* leads the reader through these themes as it seeks to answer the question: What is the relationship between innovation and dynamic efficiency in agricultural biotechnology? The papers contained in this issue arose out of an IFAFS grant (# 00-52100-9619) and the capstone conference for this grant, "Innovation and Dynamic Efficiency in Agricultural Biotechnology" (Oct. 14–15, 2004, Washington, DC). Both the grant and the conference were designed to address these multiple and complex questions. The papers in this issue represent the culmination of three years of work, including construction and application of a new agricultural biotechnology patent database.

In the Introduction to the Research Issues (article 1), Pray, Oehmke, and Naseem set out the conceptual underpinnings of the innovation market approach to analysis of R&D and market structure issues. They bring patent, field trial, and deregulation data to bear on the issues as they paint an overview of the innovation market and define a set of researchable questions.

In the section entitled "Who Is Doing What?", Lesser (article 2) investigates the types and administration of intellectual property protection available to the US agricultural biotechnology community. He examines charges brought against the current intellectual property

rights (IPR) structure, including that the US Patent and Trademark Office has lowered its standards in the granting of patents resulting in many patents of dubious quality that could potentially block further inventive activity. King, Heisey, and Day-Rubenstein (article 3) delve into the explosion of agricultural biotechnology patents since the 1980s, examining both the type of public-sector and private-sector organizations that are patenting and the types of agricultural biotechnology innovations that are patented. King and Schimmelpfennig (article 4) examine the patent holdings of the six largest agricultural biotechnology firms. They find that these six firms obtained most of their patents through acquisitions of smaller firms with relatively large numbers of patents. Brennan, Pray, Naseem, and Oehmke (article 5) detail the structure of agricultural biotechnology innovation markets and try to ascertain whether there are relationships between the innovation markets and the levels of inventive activity, including whether concentrated ownership of patents diminishes innovation. Naseem, Oehmke, and Schimmelpfennig (article 6) turn their attention to a different form of IPR, plant variety protection, and its effects on crop yields. Focusing on cotton, they present econometric evidence that plant variety protection increased cotton yield growth, contrary to prior studies on other crops.

The section entitled "What Are the Current Effects of Industry Structure?" examines the effects of IPRs and market structure on the benefits generated by agricultural biotechnology innovations. Pray and Naseem (article 7) present case studies on the platform technologies of rice genomics research and plant transformation techniques. They find that the public sector played crucial roles in developing these techniques, that patents played a necessary role in getting the private sector to adopt these techniques, and that despite some patent thicket issues overall the social benefits have been positive.

Kesan and Gallo (article 8) compare the development of genetically modified corn and soybean industries in Argentina and the United States, focusing on differences in IPR systems. They conclude that appropriate IPR systems facilitate commercialization of the genetically modified crops, but not all types of IPR are appropriate for all types of crops. Acquaye and Traxler (article 9) analyze the effect of monopoly power over a new technology in relation to the pricing of that technology, with application to Bt cotton. They find that international price discrimination would allow greater developing-country access to new innovations.

The final section of this special issue asks the question “Whither Biotechnology Research?” Day-Rubenstein and Heisey (article 10) examine public-sector technology transfer to the private sector, especially by the USDA. They find that the administrative mechanisms used for technology transfer have changed somewhat, but the general research topic priorities have changed little. Jefferson-Moore and Traxler (article 11) examine the distribution of benefits from crop varieties genetically modified to improve quality, using high-oil corn as an example. They find that farmers will not benefit nearly as much from quality-improved crops as they

did from the first generation of insect-resistant and herbicide-tolerant crops.

In summary, the papers in this issue generally show that the pace of inventive activity in plant biotechnology has been and continues to be strong. There are examples of where the IPR system has been imperfect, but generally the IPR system has facilitated and in some cases has been necessary for the commercialization of biotechnologies, with limited observable negative effects on the pace of future innovation. Market structures in the innovation and output markets are increasingly concentrated. The pace of genetically modified variety deregulation has diminished as the innovation market has become more concentrated, but this has not prevented new firms from entering the industry. Concentration in the output market has not prevented farmers and consumers from capturing economic benefits from genetically modified crops, although a “second generation” of crops modified for improved quality traits may not prove to be as beneficial. In addition to providing legal infrastructure and policy support, the public sector has played and continues to play a pivotal role in the development of new agricultural biotechnologies and their transfer to the private sector.