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Research Investments and Market Structure in the Food Processing, Agricultural Input, and Biofuel Industries Worldwide

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What Is the Issue?

Growth in the productivity of the global food and agricultural system will be largely determined by today's investments in research and development (R&D). In recent decades, the private sector has become a major player in developing innovations for food and agriculture. Factors spurring private companies to invest in food and agricultural research include the emergence of biotechnology and other new scientific developments, the strengthening of intellectual property rights (IPR) over agricultural innovations, new regulatory requirements, the expansion of markets for improved agricultural inputs and food products, and rising consumer demand for more diverse foods. More recently, rapid growth in the market for biofuel has pushed companies to expand their R&D investments in this area as well.

This report quantifies investment trends by for-profit companies in food manufacturing, biofuel, and agricultural input R&D and explores how these trends are affected by changes in market demand and industry structure. In particular, the report examines changes in the organization and structure of agricultural input industries (crop seed and biotechnology, crop protection chemicals, synthetic fertilizers, farm machinery, animal breeding and genetics, animal health, and animal nutrition) and whether increases in market concentration in these industries are associated with increases or decreases in the level and intensity of R&D investments.

For comparative purposes, we present some aggregate statistics on public-sector research spending for food and agriculture and ways in which these investments differ or complement R&D in the private sector. However, we do not delve much into the interactions between public and private R&D. For a detailed examination of the evolving role of the public and private sectors in agricultural R&D in the United States, see Fuglie and Schimmelpfennig (2000).

What Did the Study Find?

During 1994-2007 (the latest year for which estimates are available), annual private-sector food and agricultural R&D grew from \$11.3 billion to \$19.7 billion, or 4.3 percent per year (or, in constant 2006 dollars, from \$14.6 billion to \$19.2 billion, or 2.1 percent per year). In high-income countries, private-sector R&D spending appeared to be roughly equivalent to public-sector spending on food and agricultural R&D, although public R&D spending continues to be larger if only agricultural-related R&D is considered.

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Growth in R&D investment was uneven across industries. The most rapid increase in R&D was in crop breeding/biotechnology. Significant growth in R&D spending also occurred in farm machinery and food manufacturing. However, real (inflation-adjusted) R&D spending declined for crop protection chemicals and animal nutrition.

Other key findings include the following (figures below are in current or nominal dollars, unadjusted for inflation):

- In 2010, global private-sector investments in R&D related to *agricultural inputs* reached \$11.03 billion, an increase from \$5.58 billion in 1994.
- In 2007, global private-sector investments in R&D related to *food manufacturing* reached \$11.48 billion, an increase from \$6.02 billion in 1994.
- In 2009, global private-sector investments in R&D related to *biofuel* reached \$1.47 billion, with most growth in this area occurring since 2000.
- Generally, the largest four to eight firms in each sector accounted for about three-fourths of the R&D in that sector, with larger firms spending more than smaller firms on R&D as a percentage of product sales (with the exception of small biotechnology firms). Typically, the large firms are multinational operations with global R&D and marketing networks.
- In most of the agricultural input industries, market concentration increased during 1994-2009, with the highest levels observed in the animal breeding and crop seed sectors and the largest increase observed in the crop seed sector.
- Rising levels of market concentration were not associated with larger R&D investment in agricultural input sectors.
- The globalization of food and agricultural R&D may accelerate the rate of international technology transfer, reducing productivity differences across nations and regions.

How Was the Study Conducted?

We used a number of approaches to construct estimates of private R&D spending by sector. For research-intensive agricultural input industries, we built a database of agriculturally related research spending firm by firm over time, for all firms in the sector (including “legacy” firms, or firms that exited the industry during the period of study) that have or have had significant R&D expenditures. For large conglomerates, for which agriculture may be only one business segment, we separated agriculturally related R&D spending from R&D spending on nonagricultural business segments. We gathered this information by canvassing a broad set of material, including company annual reports and websites, reports by industry associations and consulting services, and personal interviews with company representatives. Altogether, we reviewed R&D information on more than 800 agricultural input companies worldwide. These firm-level data also enabled us to examine hypotheses regarding the relationship between industry structure and R&D spending: Do larger firms spend more (as a percentage of product sales) on R&D than smaller firms? Has the rising concentration of several agricultural input industries affected overall levels of R&D spending by that industry?

For agricultural input industries in which firms do not often report their research spending, we estimated agricultural R&D for the industry by taking a percentage of total agricultural input sales, with the percentages (or research intensities) derived from observations on R&D spending from a subset of firms and from previous surveys of the industry. For the food manufacturing industry, we relied on country-level estimates produced by the Organisation for Co-operation and Development, which covers primarily high-income countries.

With these sources, we developed a global time series of R&D expenditures by agricultural input industries from 1994 to 2010, the food industry from 1990 to 2007, and for biofuel in 2009. We examined how trends in R&D spending were associated with changes in market demand and industry structure and reviewed the evidence on the factors causing structural changes in agricultural input industries.