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**The Determinants of Private Agricultural R&D: Evidence from India**

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# The Determinants of Private Agricultural R&D: Evidence from India

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## Introduction

- Over the last three decades, Indian agricultural input industries have gone through a major transformation. According to estimates by Pray and Nagarajan (2012), private agribusiness R&D in India grew from \$23 million in 1985 to \$250 million in 2009 (2005 US dollars), which is the most recent year for which reliable data is available. State-owned firms that grew during the Green Revolution have either stagnated or declined, while Indian corporations that were protected from foreign competition are now exporting agricultural tractors and pesticides. Additionally, foreign multinational corporations are rapidly increasing their role in the seed, pesticide, and machinery industries. The entry of large Indian firms and multinationals has increased competition in the input industries. Much of this can be attributed to strong demand for inputs and policy changes such as strengthening of intellectual property rights (IPRs). Simultaneously, development of new technology has enabled firms to offer new products (such as genetically modified crops) and services (in large part due to advancements in information technology).
- In this paper we empirically examine government policies, technology, institutions and R&D investments that have contributed to the transformation of India's agricultural input industry. Previous research has suggested that IPRs, biotechnology, market size and industry concentration have all been important determinants of private sector R&D growth in India (Pray and Nagarajan (2012)).
- The literature on Indian agricultural R&D often overlooks the role and impact of the public sector on the private sector. Public research can have both complementary and substitutive effects on private research, depending on the context (Fuglie and Toole, 2014). The relationship between public and private research is dynamic and may change over time, with competition and substitution at early stages and becoming more complementary as the economy grows and investments increase.
- To explore this issue and other factors that may be impact the growth of private R&D in India, we extend the prior studies and introduce improved controls for exogenous factors such as global breakthroughs in science and technology, public sector research, structural transformation, and changes in capital markets. The Indian agricultural input industry has undergone significant changes over the last decade, including greater consolidation, investments by the government in not only in agricultural research, but research in general and higher education, and greater exports by agricultural firms (especially machinery). By including a new set of controls, we are able to isolate the impacts of policy on private R&D.

## Data and Variables

This paper uses a unique firm level data on sales, R&D and financial costs data for firms, from 1990 till 2018 for four major agri-input sectors namely seed, pesticide, tractor-farm equipment and fertilizer industries in India. The dataset used for this analysis comes from The Centre for Monitoring Indian Economy (CMIE), annual reports of the firms and through interviews and secondary level surveys with firms involved. Public R&D data is from Department of Science and Technology and the Agricultural Science and Technology Initiative (ASTI) database. Among the variables considered are firm's ability to appropriate returns such as through IPRs and industry concentration. Global private sector R&D is used as proxy for the technology opportunity variables. Since the cost of financing influence a firm's decision to invest in R&D we include capital investment costs, access to external financing, subsidies, grants, and cost of borrowing (interest rates). Finally, we use certain time-specific dummies capturing impacts of policies on agri-input transformation, and ownership nature of the firms to denote firm diversification besides length of firm existence (age).

## Methods

- An econometric model, using cross-sectional data at 7 different time periods starting from 1990s till 2018 has been used to predict the determinants of R&D expenditure and R&D intensity, constructed using firm level data from the agricultural input industry to test the importance of the above mentioned factors. Two sets of regressions were estimated, one a pooled regression across all four sectors for estimating the factors of appropriability, technological opportunity besides market size. The second set of regressions, focusing exclusively on the most capital intensive industries such as fertilizer and pesticides, uses a framework surrounding the effect of cost and revenue aspects on R&D, and the empirical importance in determining R&D capacity and decision making. Our preliminary estimation results indicate positive relationship of firms' R&D to variables associated with industry transformation such as firm size, ownership by multinationals, and declining industry concentration. The results also provide evidence on strengthening patent policy as well as growth in the size of research intensive industries like the seed industry also contributed to the growth of agribusiness R&D in India. For capital intensive industries such as fertilizers and pesticides, financial cost of capital, especially level of debt and external financing potential and market size affects firm's R&D levels. More rigorous estimation along with additional variables such as lagged public R&D, age of the firms and other variables of interest based on literature are also used in the analysis.

## Results

Our results provide strong evidence and further support the previous studies on the role of policies towards increased market size, competition and size of input firms besides cost of financing in increasing private sector R&D investment in agri-input industry growth. The study also provides further insights related to the role of liberalization efforts, industry consolidation, FDI and policies at different time periods with regard to the growth of domestic vs. MNCs involvement and the modified role or the presence of state-owned enterprises (SoEs) and their impact on agri-input industry transformation as well in provision of inputs in India.

## References

- Dasgupta, P., & Stiglitz, J. (1980). Industrial structure and the nature of innovative activity. *Econ. J.*, 90(358), 266-293.
- Pray, C. E., & Fuglie, K. (2001). Private investments in agricultural research and international technology transfer in Asia. ERS Agricultural Economics Report No. 805. Washington, DC: Economic Research Service, US Department of Agriculture.
- Pray, C., & Nagarajan, L. (2014). The transformation of the Indian agricultural input industry: Has it increased agricultural R&D? *Agric. Econ.*, 45, 145-156.
- Pray, C., & Nagarajan, L. (2012). Innovation and research by private agribusiness in India. International Food Policy Research Institute, Washington DC.
- Schimmelpfennig, D., Pray, C. E., & Brennan, M. (2004). The impact of seed industry concentration on innovation: A study of U.S. biotech market leaders. *Agricultural Economics*, 30, 157-167.