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The Effects of Biotechnology on Concentration and Structure in the Agricultural Inputs Industry

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Market Report	Yr Ago	4 Wks Ago	10/13/00
Livestock and Products, Average Prices for Week Ending			
Slaughter Steers, Ch. 204, 1100-1300 lb Omaha, cwt.	$70.53	$64.80	$67.43
Feeder Steers, Med. Frame, 600-650 lb Dodge City, KS, cwt.	83.88	88.23	88.83
Feeder Steers, Med. Frame 600-650 lb, Nebraska Auction Wght. Avg.	90.87	93.85	99.07
Carcass Price, Ch. 1-3, 550-700 lb Cent. US, Equiv. Index Value, cwt.	109.86	98.60	103.92
Hogs, US 1-2, 220-230 lb Sioux Falls, SD, cwt.	33.50	43.50	45.00
Feeder Pigs, US 1-2, 40-45 lb Sioux Falls, SD, hd.	28.50	37.00	34.00
Vacuum Packed Pork Loins, Wholesale, 13-19 lb, 1/4" Trim, Cent. US, cwt.	99.30	118.90	120.60
Slaughter Lambs, Ch. & Pr., 115-125 lb Sioux Falls, SD, cwt.	63.37	68.50	65.25
Carcass Lambs, Ch. & Pr., 1-4, 55-65 lb FOB Midwest, cwt.	155.00	163.00	153.00
Crops, Cash Truck Prices for Date Shown			
Wheat, No. 1, H.W. Omaha, bu.	2.74	2.89	3.16
Corn, No. 2, Yellow Omaha, bu.	1.63	1.46	1.80
Soybeans, No. 1, Yellow Omaha, bu.	4.47	4.47	4.38
Grain Sorghum, No. 2, Yellow Kansas City, cwt.	2.71	2.57	3.09
Oats, No. 2, Heavy Sioux City, IA , bu.	1.10	1.20	1.25
Hay, First Day of Week Pile Prices			
Alfalfa, Sm. Square, RFV 150 or better Platte Valley, ton.	92.50	105.00	115.00
Alfalfa, Lg. Round, Good Northeast Nebraska, ton.	32.50	67.50	67.50
Prairie, Sm. Square, Good Northeast Nebraska, ton.	*	82.50	82.50

* No market.

In the last five years, biotechnology has emerged as a major focus of interest in agriculture. This article focuses on one of the many questions that have arisen around this new technology. In particular, the purpose of the paper is to identify the scope and significance of the links between biotechnology and the structure and conduct of the agricultural inputs industry and to develop a framework for analyzing the distribution of the benefits of innovations due to biotechnology.

Agricultural biotechnology has significant impacts on the structure of the agricultural inputs industry. The farm input sectors most affected by the current biotechnology products are the seed and chemical industries, although the farm machinery industry and farm fuel sector are also affected. The fertilizer sector is largely unaffected, at least for the foreseeable future. The most important of the impacts of biotechnology are an increasing industry concentration, an increasing vertical and horizontal integration and the increasing importance of multinationals in the seed industry.

The factors affecting the structure of the agricultural seed and chemical industry can be divided into supply side and demand side factors. The supply side factors are mostly linked to intellectual property rights (IPRs), while the demand side factors are linked to the substitutability and complementarity of biotechnology products. Other factors that influence structure include the high-risk nature of biotechnology, regulatory requirements and an increasing emphasis on quality assurance and identity preservation.

IPRs create concentrated markets because they convey a limited monopoly to the company or individual possessing the intellectual property. This limited monopoly is granted to companies and individuals to create an incentive to undertake research and to make investments in intellectual property. More concentrated markets are also the outcome of economies of scale and scope, both of which are created and enhanced by IPRs. Economies of scale exist when average costs fall as more output is produced. Economies of scope exist when the total cost of producing two outputs together is less than the cost of producing the two outputs separately.

Since economies of scale and scope mean that larger and

more diversified firms have lower average costs, there is clearly an incentive for firms to become larger. Indeed, those that do not, are vulnerable to being driven out of the market by larger, lower cost firms. Of course, there is a limit to how large firms can get. While development and production costs may fall with an increase in the size of the firm, other costs, particularly those associated with administration, rise. Nevertheless, economies of scale and scope clearly create pressures for consolidation.

Strong demand complementarities, which mean that a single firm producing both chemical and biotechnology products can be more profitable than can separate firms producing these products, are additional factors in explaining the amalgamation of seed and chemical companies. Consolidation is also encouraged by the high-risk nature of agricultural biotechnology and the requirements for regulatory approval. Development and marketing risks mean that the revenue from successful products has to cover not only the costs of these products, but also the costs of unsuccessful products. Once again, large companies typically have an advantage, since they are able to spread the costs of unsuccessful products over more output. Similarly, large companies have an advantage because they are able to spread the cost of regulatory approval over more output.

The linkage between the supply and demand factors are seen in the characteristics that contribute to an escalation strategy. An escalation strategy is one in which a company spends large amounts on R&D to achieve a dominant role in the market, i.e., the firm tries to leap-frog its competitors to become the dominant firm. Escalation can be a profitable strategy when there is a high degree of substitutability with competitors products on the demand side, and there are scope economies on the supply side.

Both of the factors required for an escalation strategy are present in the agricultural biotechnology industry. On the supply side, intellectual property, e.g., the isolation of a gene that provides particular advantages and which can be inserted into a number of crops, means there are scope economies. There are also clear scope economies associated with the enabling technologies that are required to use these genes. And on the demand side, herbicide and insect resistant seeds and the accompanying chemicals are clearly a substitute product for traditional seeds, herbicides and pesticides. One example of a firm that appears to be following this escalation strategy is Monsanto, although Dow and others are following somewhat similar strategies.

Pressures for either greater vertical integration or increased strategic alliances and contracting are also created by intellectual property. Where IPRs are well defined, contracting and strategic alliances are more likely because they lower the transaction costs associated with negotiating, monitoring and enforcing contracts. When IPRs create opportunities for exploitation and when intellectual property is associated with intangibles (which are inherently difficult to monitor and enforce in contracts), then IPRs can increase transaction costs associated with contractual arrangements, thus making vertical integration more likely. The presence of key intangible assets is also an important factor in the creation of multinational firms.

There is some empirical evidence that the increased industry concentration is influencing the pricing of seeds and chemicals. The use of Technology Use Agreements is indicative of a non-competitive market structure. As well, agricultural biotechnology companies appear to be pricing biotechnology packages so that they are comparable to traditional seed and chemical packages. The result is that while some producers have clearly benefitted from biotechnology, this benefit is not uniform. Instead, the distribution of benefit is highly influenced by agronomic characteristics and geographical location of producers.

The pricing of biotechnology packages so that they are comparable to traditional seed and chemical packages suggests that the yield and agronomic characteristics of traditional seed are likely to play an important role in ensuring that farmers benefit from biotechnology products. This connection between traditional seed and biotechnology products suggests an important role for public breeding programs (these programs could be funded by either government or by farmer organizations). Continued support for public breeding programs may be one of the most effective ways of ensuring that increased market concentration does not result in unduly high prices for biotechnology products.

The benefits of biotechnology to farmers is not the only important issue. Also of critical importance is the benefit or perceived benefit of biotechnology products to consumers. If consumers do not view biotechnology products as identical to traditional products, then consumers as a group can only benefit if the development of biotechnology products with no new consumer traits goes hand-in-hand with retail price reductions. Even with a price reduction, some consumers may not perceive a benefit and will not purchase the product. If consumers do not purchase the products, this in turn has repercussions for farmers and the seed industry. For instance, there is evidence that some farmers in North America are now growing less transgenic crops because they are unsure of the market that will exist for the product or because they believe the market for these crops will be discounted.

In summary, the structure of the inputs industry has been significantly affected by biotechnology. An important factor in the changing structure has been intellectual property rights. Intellectual property rights, of course are introduced to encourage innovation and the development and diffusion of new products and technologies. Thus, from a public policy perspective, the question needs to be asked as to whether the benefits of intellectual property outweigh the costs. Seen in this light, the concerns about the ability of public breeding programs to obtain the "freedom to operate" are important. Since publicly developed technologies are likely to be critical in providing a viable substitute for products from the seed and chemical firms, the issues of patent scope and licensing arrangements become critical. Also important are consumer perceptions about the benefits of agricultural biotechnology.

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Note: This article is based on "The Effects of Biotechnology on Concentration and Structure in the Agricultural Inputs Industry: a Discussion Paper," by K. Giannakas and M.E. Fulton, *Agriculture and Agri-Food Canada*, Ottawa, 2000.