



1st Quarter 2011 | 26(1)

## IMPACTS OF PRODUCT DIFFERENTIATION ON THE CROP INPUT SUPPLY INDUSTRY

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JEL Classifications: Q13, L10, L20, L80

Keywords: Agribusiness, Input Supply Industry, Seed, Pesticide, Farm Machinery, Structural Change, Porter's Five Forces

In the last issue of *Choices*, Olson, Rahm, and Swanson (2010) describe changes in the plant input supply industry using the framework of Michael Porter's Five Forces model. They illustrate with examples, particularly from fertilizer manufacturing. The Porter Five Forces model explains the structure and performance of the crop production input supply industry well if all forms of rivalry are considered. For a fertilizer manufacturer, the principal forms of rivalry appear to be price competition, control over raw material supply, and logistics. A fertilizer manufacturer has limited opportunities to differentiate its products, leading Olson, Rahm, and Swanson to ignore this form of rivalry. However, many of the changes in the rest of the crop input supply industry can best be understood through a focus on product differentiation.

Seed, pesticide, and farm machinery manufacturing companies compete far more through product differentiation than through price. Product differentiation also has played a major role in determining the structure of crop production input retailers, including fertilizer retailers. Differentiated crop inputs have greatly increased productivity in crop production. Branding and advertising help crop producers identify the most productive crop inputs. Product differentiation also has rewarded the companies that have invested the most in it with higher market share and profitability.

The authors of the agribusiness theme articles in the last issue of *Choices* recognize two additional drivers: technology and other factors, primarily regulatory policies. Technology has impacted structure and performance of the crop inputs industry primarily through product differentiation. Regulatory policies have determined where these technologies have been allowed and supported by government or prohibited. Over the past 15 years, technology developments have dramatically increased product differentiation and thereby transformed most of the crop production segment of agribusiness.

### Observed Forms of Rivalry

The primary forms of rivalry for the seed, pesticide, and farm machinery industries are:

- Product differentiation through performance
- Product differentiation through bundled services
- Price competition through discounts, rebates, and loyalty programs

Product differentiation through performance takes many forms. Seed companies develop multiple hybrids and plant varieties through genetics. Biotechnology has allowed seed companies to add additional traits, such as herbicide tolerance and insect control through the BT genes. Pesticide companies develop and patent new active ingredients and formulations. Farm machinery companies offer multiple configurations of product features. Seed and pesticide companies actively advertise the crop yield and cost advantages of their products. Farm machinery companies advertise the productivity advantages of their products in acres per hour, fuel efficiency, more uniform plant stands, and reduced harvest losses. In general, success in large-scale crop production is driven by productivity and most crop inputs are marketed based on their differentiated

productivity advantages. Quality of product is equally important in production of some crops like fruit, but productivity is always critical for success.

Product differentiation through bundled services also takes many forms. Crop input retailers provide recommendations on which product to use and application rate, usually at no additional cost. Crop input retailers commonly offer application services, sometimes for free and often for less than the full cost of application. Precision farming technology enhances recommendation and application services by allowing variable rates of application within a field. Credit services are often offered with products by both retailers and manufacturers. After-sale service is an extremely important form of product differentiation for seed, pesticides, and farm machinery. Seed and pesticide manufacturers provide consultation, money-back guarantees, and additional product in cases where customers claim that products fail to perform as advertised. Recently, Monsanto partnered with the crop insurance industry to offer programs to growers that both lower crop insurance rates and offer additional yield guarantees to customers of its biotechnology traits.

Farm machinery manufacturers provide maintenance and repair services through dedicated, often exclusive dealers. Precision farming technology has greatly expanded services provided by farm machinery manufacturers and their dealers. Farm machinery manufacturers now provide GPS correction signals, GPS guidance such as John Deere's AutoTrac™, and software to analyze machine-collected data and create prescriptions. Advances in cellular and other wireless communications technology have prompted manufacturers to begin offering remote machine monitoring systems and wireless transmissions of work orders and prescriptions. The complexity of precision farming technology has made equipment installation and setup important, differentiating services for farm machinery manufacturers and their dealers.

Price competition exists, but most of it occurs through selectively applied discounts, rebates, and loyalty programs. Companies with less market share commonly set list prices at a small discount to the list prices of market leaders in order to boost market share. List prices for generic and store-brand products are less than list prices for branded products. However, branded products are usually priced according to customer value and established companies are cautious about destroying the perceived value of products through price competition. Aggressive discounting by a manufacturer would also alienate retailers because it reduces their revenue. Pesticide retailers sometimes respond to aggressive discounting by promoting competitive products. Discounts from list price are offered to selected growers who are the most price-motivated. Additional discounts and price rebates are provided for loyalty, participation in marketing programs, and volume of purchases. Many of the percentage discounts for these programs are widely known by customers, but eligibility is determined by sales persons on a case-by-case basis.

Two technologies have strongly increased product differentiation for the crop production input supply industry in the past 15 years:

- Biotech seed
- Automated GPS-guidance systems and related precision farming technology

Biotech seed was commercially introduced in 1996 with Monsanto's BollGard™ trait to control insect pests in cotton and Roundup Ready™ soybeans for broad spectrum weed control. Both the BT and Roundup Ready™ traits were soon extended to corn and licensed to other seed companies. Adoption was rapid with 92% of U.S. soybean acres planted with Roundup Ready™ soybean seed and 60% of U.S. corn for grain acres being planted with one or more corn seed traits within 10 years of introduction. Substantial cropland areas in Argentina, Brazil, Canada, India, and China are now planted with biotech crops, but adoption elsewhere has been largely prohibited by government policies. The technology used to develop biotech seed traits also greatly accelerated the development process without genetic modification for new hybrids and varieties with high yields or desired quality characteristics.

Biotechnology in seed production has helped the largest seed companies grow their market share and profitability. Only the largest seed companies could afford the hundreds of millions of annual research dollars required to fully utilize the biotechnologies. Monsanto—after acquiring DEKALB, Asgrow, Holdens, and Corn States seed companies—and Pioneer Hi-Bred made the greatest investments, developed the highest-yielding seed, raised their prices to reflect higher value, and grew market share. Many small, regional seed companies in the U.S. could not afford to keep pace and invest in the capital intensive business of molecular breeding and biotech, agreeing to in-license the technology or participate in mergers and acquisitions to maintain competitiveness. Many independent seed companies ultimately cashed in via sale to the innovative biotech-seed companies such as Monsanto and Pioneer Hi-Bred, eager to invest in continued growth.

## Pesticide Industry Transformed

RoundupReady™ seed transformed the pesticide industry. Glyphosate, the active ingredient in Roundup herbicide, became more widely available for broad spectrum weed control at lower costs post-patent, and Roundup Ready technology enabled the use of this effective weed control herbicide across all major crops. Monsanto first reduced list prices for Roundup herbicide by 16-22% in September 1998 and recaptured the value through increased prices for seed with the RoundupReady™ trait in soybeans. This forced other pesticide manufacturers to lower conventional soybean herbicide prices in order to remain competitive to Roundup's "system" pricing including the seed trait cost and the herbicide cost. Roundup's patent expired in 2000 and Monsanto launched a three-tiered pricing strategy based on product differentiation. The flagship Roundup herbicide product was sold with the most effective formulation and a branded after-sale service program, RoundupRewards™. The middle tier was Roundup Original without the most effective formulation but with RoundupRewards™. The lowest tier consisted of retailer store brands with the Roundup Original formulation and all after-sale service provided by the retailer. Monsanto also differentiated its herbicide products by providing retailers with industry-leading logistics and order-to-cash processes as bundled services. After several years, competitive manufacturers improved their formulations and increased the volume of generic products to the point that Monsanto abandoned the multi-tier strategy, but it remains one of the most successful post-patent strategies of record with growers choosing Monsanto Roundup brands for substantial price and value premiums over generic products for many years. Today, many pesticide patents have expired and manufacturers are selling both a differentiated, branded product with superior formulation and service and a low tier generic/store brand product.

Automated GPS-guidance systems were introduced by John Deere as AutoTrac™ in 2002, using global positioning systems (GPS) technology developed for precision farming. Other farm machinery manufacturers soon followed with similar guidance systems and systems have since become increasingly precise and more fully automated, including turns and curves. Precision farming uses the ability to identify global position from GPS satellites in computerized agronomic data collection and operation of variable-rate application and seeding controllers. Yield mapping using GPS receivers and mass-flow yield sensors are now commonplace, but variable rate applications have only reached 15-35% of crop acreage in North America due to data management challenges and skepticism regarding the profitability of this practice. The range reflects various market research results for different types of variable rate applications and seeding. Market research focused on very large crop producers suggests that a majority of them are using variable rate technology, so adoption of variable rate technology will likely grow as farms grow larger.

Automated GPS-guidance was initially expected to be just a convenience, reducing operator fatigue. However, large growers discovered that it allowed:

- accomplishing many management tasks by phone while operating machinery
- continuing field operations many more hours each day without any loss of crop yield
- small increases in fuel efficiency and acres per hour
- reductions in overlapping input applications

Automated GPS-guidance systems therefore have accelerated the concentration of crop production through a smaller number of growers.

Automated GPS-guidance systems have become an important form of product differentiation for farm machinery manufacturers. For large growers who are aggressively expanding their acreage, the GPS-guidance and other information systems in a tractor or combine are now just as valuable as the horsepower and field capacities in acres per hour. Farm machinery manufacturers now market integrated solutions of iron and electronics to maximize the productivity of crop producers. Furthermore, the services that a machinery dealer provides to install and set up these complicated information systems are an important source of product differentiation.

Olson, Rahm, and Swanson (2010) apply a Herfindahl-Herschmann Index to all the companies in NAICS code 333111 and suggest moderate concentration in the farm machinery industry. Casual observation might support this conclusion. If one goes to a large farm machinery exhibition such as the Farm Progress Show in the United States or Agritechnica in Germany, one will see a large number of machinery exhibitors. However, when a crop producer looks for a farm machinery dealer that can sell a full line of machinery that is integrated with information systems for automated GPS guidance and data collection, set up the machinery, and provide rapid repairs as needed, there are very few choices. In many regions there may be only two. As a result of manufacturing a full line of equipment and GPS-based information systems, plus having a very strong dealer

network to provide services, John Deere maintains a high market share in North America and obtains higher prices than its principal competitors. Crop producers have many choices if they want to hook together equipment from several manufacturers and obtain after-sale service from several dealers and service providers, but a large number prefer buying integrated systems and obtaining service from one dealer. The costs of establishing an effective dealer network limit the impact of new entrants. It appears to be for this reason that Claas has a tiny presence in the North American market for all but forage-harvesting equipment although it sells high-quality products and has a high market share in Europe. Similarly, John Deere has a smaller market share in Europe largely because its European dealer channel is not yet as fully developed as its North American dealer channel.

New technology has increased product differentiation through bundled services by crop input retailers. Most crop producers use fertilizer recommendations made by crop input retailers and many also use seed and pesticide recommendations made by these retailers. Most of these recommendations are provided at no additional cost. The services provided by crop input retailers have grown as growers have adopted precision farming technology. Although some of the market-share growth for large retailers such as Helena Chemical, Growmark, and Crop Production Systems is due to bargaining power in purchasing, a large part is due to economies of size in providing precision farming services.

Recently, seed manufacturers have started to further differentiate their products by providing precision farming services at no additional cost to help growers select the best hybrids or varieties for each field and the best seed population per acre. This is partly a response to growers' challenges in learning about new seed products that replace familiar seed products about every three years. Pioneer initiated these services with its FIT program that provides free yield maps in addition to seed recommendations. This year Monsanto announced plans to provide similar services, including remote sensing to identify crop stresses—IntelliScan™— and providing custom seed recommendations for higher yield potential—IntelliSeed™.

### **Other Factors**

The impact of other factors on the structure and performance of the crop production input supply industry becomes clearer when product differentiation is considered. Government policies sometimes have supported product differentiating technology and sometimes restricted it. Supporting policies include the patenting of pesticide and plant genetic innovations, enforcement of penalties for breaking license agreements not to replant biotech seed, making GPS signals available to the public, and funding research to develop precision farming technology. Restrictive policies include lengthy and difficult approval processes, court injunctions, and legislated prohibitions for planting biotech seed in many countries. It appears that the global market shares of Monsanto and Pioneer would be greater if not for the prohibitions of their biotech seed in many countries, and part of the opposition to biotech seed appears to be motivated by opposition to multinational corporations.

Other important factors impacting the structure and performance of the crop production input supply industry in the past 15 years include:

- globalization of markets
- increasing global demand for grain and oilseed production

Markets for crop products have become more global as consumers have sought year-round availability of perishable produce, as regional demand growth has exceeded regional supplies, and as a few large crop producers have expanded their operations to other countries. Markets for crop inputs have become more global because the technologies developed in one country have high value elsewhere and crop input companies have expanded their research and development to multiple countries. For example, most of the insecticides and fungicides used in North America are manufactured by the European companies: Syngenta, Bayer, and BASF, who all have large research units in the United States. Global markets help companies with well-recognized brands grow larger because they can quickly recover the required investments in facilities, personnel, and logistics in multiple countries.

Increasing global demand has outpaced increases in production for grain in 7 of the past 11 years (Potash Corp, 2011) and stocks for corn are forecast to hit their lowest levels since 1974 this year (Wilson and McFerron, 2011). Demand increases are mostly due to the effect of increasing incomes on meat consumption and increasing use of corn for biofuel production. These shortfalls have pushed up grain and oilseed prices, which have increased the returns to crop producers from using the most productive crop inputs. As crop producers have chosen the seed, pesticides, and farm machinery that are most differentiated by product performance, the market shares and profits for the manufacturers of these differentiated products have

climbed. Biotechnology has certainly helped increase production to meet rising demand for grains, but limited resources such as water and high-quality cropland as well as variable weather have constrained the supply response.

### Questions for the Future

The discussion above illustrates a number of ways that product differentiation has shaped the structure and performance of the crop production input supply industry. The Porter Five Forces model includes rivalry through product differentiation, so it is very capable of explaining these important structural changes. New technologies have greatly increased the productivity of pesticides, seed, and farm machinery that manufacturers have patented, branded, and bundled with recommendations, setup, and after-sale services. Government policies have supported the technologies that make products more differentiated in North America and selected other countries, but have restricted biotech seed sales in many European countries. Globalization of crop input markets and rising demand and prices for crop production have increased market shares for differentiated products and profits for their manufacturers.

Changes in technology will continue to differentiate products but the impacts on future industry structure and performance are less certain. A key question for farm machinery manufacturers is whether new information technologies will enable multiple service providers to collaborate in providing setup and after-sale services as effectively as large manufacturers with dedicated dealers do it today. Increasingly capable wireless data systems provide the potential for multiple parties to remotely monitor machinery, adjust settings, and diagnose the causes of breakdowns. ISOBUS standards (Schrimpf, 2006) now allow dealers to create integrated machinery systems from several manufacturers, particularly in Europe. There currently are large gaps in the ISOBUS standards that limit the capabilities of mixed manufacturer systems, but significant efforts are underway to fill these gaps. Pesticide manufacturers may see product differentiation opportunities increase as more weeds show resistance to glyphosate herbicide. Seed companies are trying to bundle precision farming services to further differentiate their products, but growers may be reluctant to give them more influence over decision-making. Product differentiation will continue to grow, but whether it promotes further industry concentration remains to be seen.

### For More Information

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