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The Proceedings of Economic and Policy Implications of Structural Realignments in Food and Ag Markets

**A Case Study Approach
(Proceedings Include Revisions)**

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Performance Consequences of Vertical and Horizontal Structural Change:

Inter-organizational Relationships in the Seed/Genetics/Biotechnology Sector

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In the fast paced corporate restructuring that has gripped agribusiness in the past year or two we have been hard pressed to step back and view the changes objectively and analytically. However, if we are to provide sound economic analysis that is exactly what must be done. In an environment of hype, media shoot-outs and high-pressure consumer education advertising Dr. Moore has provided us with a basis for constructively looking at two leaders in the biotechnology/'life science' industry.

The changes that have been apparent in organizational structure have their roots in strategic decisions probably made prior to 1990. Consequently the strategies were implemented prior to the 1996 FAIR Act, in fact more within the environment of the previous Farm Bill. In an economic analysis framework these corporations were acting in a competitive market structure making strategic decisions that were oligopolistic with respect to the impact on their customers, but that would also create an oligopsonistic market for input supply companies themselves. Market power was clearly the motivation in either case.

Within the context of the farm programs, supply was relatively inflexible because of program restrictions on acreage, but there was potential for supply enhancement through crop management practices and new technology. In an unconstrained market environment supply of raw commodity inputs would be expected to be more elastic as producers have greater flexibility in switching among crops. In this same argument the concentration of assembly for bulky commodity inputs is likely to be greater because of shipping costs.

From a strategic perspective the decision makers were faced with a competitive input supply market but a relatively concentrated food manufacturing environment even by the late 1980's. The reporting of these ratios for the supply side of the processing sector is not new or unique.

However, these ratios have no implication for the equivalent level of market power as buyers of commodity inputs.

Food Manufacturing Industry	CR4 in 1992
Breakfast Cereals	85
Wet Corn Milling	73
Refined Cane Sugar	85
Refined Sugar Beet	71
Soybean Oil Mill Products	71
Other Vegetable Oil Products	89
Malt Beverages	90
Macaroni and Spaghetti	78

We have typically assumed that, while processors demands for commodity inputs are specialized between species, i.e. beef versus pork, corn versus wheat, they are not specialized within the species, i.e. the fungible commodity perspective. Studies of the processing industry would indicate that this assumption would have held until this past decade. The 'art' of processing is rapidly giving way to the science as computerized monitoring systems and statistical process controls are replacing the human element in the processing sector. Consequently our assumptions of fungible commodity (spot) markets are being violated to an increasing extent in describing the physical supply flow.

Could the transition to a more monopolistic, certainly less competitive, market been envisioned at the time at which Monsanto and DuPont were making key strategic decisions? While the support in academia for such notions was limited to a few voices, discussion groups among agribusiness leaders were debating how quickly the transition would take place, not whether it would.

Farm output enhancing technology was an optimum strategic approach to consider at the beginning of the decade, relationships between producers and the input suppliers were of long standing, one might even say of trust; an important criteria in creating joint ventures and alliances (Moore, Sporleder). From a strategic planning perspective, an input supplier focussing on a demand enhancing approach at the beginning of the decade would have required considerable vision. That vision would have necessitated taking a proactive role in creating a relationship between producers and their consumers at all points in the supply chain from the handler forward.

Analysis of the performance of Monsanto and DuPont as representatives of the emerging class of 'life science' corporations requires analysis of the input supply sector but also the broader industry supply chain within which they have influence, i.e. both vertical and horizontal components. Analyzing performance within this oligopolistic framework requires a dynamic approach since strategic actions may have few short run observable results. The need to capture the reaction of one firms to the action of its' rival has recently triggered the use of game theory (Sexton). Games of incomplete information are used to capture key factors in firm decision making.

Conceptual Approach to the Biotech Seed Industry

Dr. Moore presents three different types of genetic engineering as influencing changes in market relationships and structures. These were:

1. Improved efficiency of the plant's physiology, e.g. reduced fertilizer requirement, increased yield.
2. Improved qualitative (functional) properties of the plant product, e.g. high oil or low phosphorous corn.
3. Inclusion of genetic resistance to a proprietary herbicide.

Biotechnology and genetic engineering have also been defined by two forms; supply enhancing and demand enhancing (reference). In this case the 1st trait described above would be supply enhancing. The third trait would be a constrained form of supply enhancing. The second trait would be of the demand enhancing form. By describing the traits by this form and then associating the strategic actions of the two companies there is a link to the conceptual models that have been followed.

Supply chain management is an explicit outcome from quality management or continuous improvement. In automotive, textile and IC related manufacturing the focus on knowing and working with input suppliers in order to attain 100% processing efficiency was the mantra of the 1980's. A second part of this mantra was 'meeting the needs of the customer'. With their basis in the chemical processing industries, Monsanto and DuPont were both part of the 1980's management cultural transition. Again we see the parallel of the supply and demand enhancement approaches to developing a strategic plan.

Supply enhancing: Traditional genetic manipulation through hybridization to gain disease resistance was a key factor in both companies' markets. Release of new varieties that exhibited resistance to an economic pathogen or virus could result in significant market decline for a product designed to protect the plant against infection. Part of the research and development process would require an extensive knowledge of geneticists and plant breeders who might be working on a product contrary to the company's market interests. Not only were the private industry relationships in place but so were the public-private linkages through organized autonomous experimental testing of products for market release.

Demand enhancing: In contrast the linkages and relationships were far from being in place in the supply chain past the first handler level. The regular exchange of information through farm level education programs was almost unheard of at the beginning of the decade. Outliers such as Frito Lay, were scrutinized carefully but few were copying the model. If the input supplier were asked to define 'customer', the producer would almost certainly be the first response. Similarly, the producer thought of the grain handler as the customer.

Of the two approaches, the supply enhancing approach would lead to greater near term profitability while the demand enhancing approach was unlikely to yield short run results. In developing a strategic plan that would move corporate structures like Monsanto and DuPont into the next century, the capital reserves and the vision of the Board and stakeholders would be very influential in determining which path was chosen. Clearly, the early alliances connecting to other input suppliers provided an optimum short run strategy. A key question is whether it is the optimum long run strategy and whether a strategic approach used towards supply enhancement was mutually exclusive of incorporating demand enhancing activities.

In the short run, DuPont would probably respond that, while not mutually exclusive, focusing only on demand enhancing factors could backfire. Their early experiences with high oil yielding corn varieties were unsuccessful when producers were faced with significantly lower yields and an inadequate market structure to differentially handle the crop. A static grain handling infrastructure has been perceived as the primary constraint to demand enhancing strategies. Balancing the producers' yield requirements with the customers needs, and building an infrastructure that included an alliance with Continental Grain negated the downside risk for the producer regarding the physical aspects of farm business. However, to maintain the integrity of this infrastructure required the producer to sign Technology Use Agreements, including only selling the crop to specified handlers. DuPont had learned that if the integrity of the enhanced value in the seed was not kept intact through to the final consumer the implicit financial incentive structure would break down. DuPont's full operationalizing of their Optimum corn program also included known export customers. The supply chain was almost complete.

There are again supply and demand enhancing considerations in using intellectual property rights and knowledge as driving forces for organizational change. In either case there must be a perceived value to either the supply potential or the new market structure, and that value must exceed the costs of establishing the new product or structure.

For supply enhancing GMO's the pipeline to establishing value should not be long. If the additional yield per acre is realized the producer should see the value in net revenue. The discovery of value in demand enhancing GMO's is well described by Moore in his reference to exogenously versus endogenously determined value. In the absence of a captive pipeline, the demand enhanced GMO supplies may face value, or price, discovery within the traditional (homogenous) commodity markets. A major difficulty with endogenizing the value discovery process is the parallel reliance of most processors on the exogenous, commodity markets for their risk management. Unless there is a strong form governance relationship, this pipeline is likely to be undermined.

Challenges to the Performance of Oligopolistic Competition in Biotech Corporations

Oligopolistic biotechnology corporations have vertically integrated to control the supply pipeline and to reduce or eliminate the deadweight loss through exercising market power. Producers who face oligopoly power from such input supply industries may have incentive to vertically integrate to eliminate the market power and the distributional loss caused by the exercised market power. The recent announcement by the North Dakota wheat producers that they may consider a Wheat Board in order to gain market power in price determination.

In the biotechnology market the entry barrier may well be capital and asset availability for merger and acquisition activity, or for the creation of a market structure with sufficient economies of size to compete with the Monsanto's and DuPont's of the 21st century.

An aspect of this new environment that is creating a peripheral, but vocal, debate is that of private versus public property rights in the seed market. The seed market has shared its domain between public and private sectors quite openly, with a relatively open exchange of information. Royalties on plant/genetic patents under the variety laws provided income back to the public institutions to reinvest in development programs. The magnitude of the costs associated with bringing new GMO's to the market constrains this relationship. Although there are some well-known partnerships between Universities and the private sector the question of public access to research performed in the academic arena is still sufficiently raw to

create conflict. In 1980, Congress passed two acts, which together allowed government contractors, small businesses, and non-profit organization to retain specified patent rights in government sponsored research. These acts further permitted the grantee to transfer the technology to a third party. The passage, in 1986, of the Federal Technology Transfer Act, federal laboratories were permitted to enter into cooperative research and development agreements (CRADA's) with private companies with the proviso that the patent rights to the collaborating party on inventions made by federal employees in the course of the study. It is hardly surprising that the first biotechnology outcomes became an issue in the early 1990's.

In 1995 the National Agricultural Biotechnology Council issued a report whose objective was to "ensure the survival of long-term basic research and insert social responsibility into the agenda-setting process to facilitate discoveries and their developments and commercialization to ultimately benefit the public." Much of the course of the debate centered on intellectual property rights (IPR) and the far reaching impact on life sciences in both the public and private sectors. If IPR's are viewed as assets, are these the newest forms of barriers to entry?

Analysis of conduct and performance in food manufacturing and marketing has often focused on the high cost of advertising and promotion as providing a barrier to entry and limiting the number of players in the market. Given the emphasis on this activity in the literature in explaining brand loyalty and market share it is unsurprising that the biotechnology companies have used a similar approach. Certainly it is one with which they are familiar in creating brand loyalty to pesticides.

In applying the use of transactions cost analysis to explain recent outcomes from these two strategic approaches it may be easier to understand the problems that beset the rapidity of the industrialization of agribusiness. Moore uses Sporleder's 'strategic fuzzy alliance (SFA)' to describe a cooperating and trusting relationship that must exist in the environment of joint ventures. Trust and business reputation is considered to be paramount in a successful venture. Both Monsanto and DuPont have their roots in agri-chemicals and are now emerging as 'life science' companies with green manufacturing objectives. If social as well as business reputation is considered then the final consumer may view the relationship very differently. Is the final consumer an important factor in this supply pipeline? Manufacturers going through the same type of transition process in the 1980's ignored consumer choice at their cost.

The Social Responsibility Question?

Consumer survey studies in the mid-1990's satisfied Monsanto that American consumers have positive attitudes towards biotechnology (Cline and Esfeld, Hoban and the Food Marketing Institute). If these studies truly reflected the international perspective, and particularly that of the European Community consumer, Monsanto would not currently be engaged in a major advertising education series that will run approximately two months in the leading newspapers. What did they miss and why was this critically important to their successful entry into these markets with a supply enhancing GMO.

Fundamentally, the question of whether a consumer perceives biotechnology to be important may not be the same as does the consumer have a need, or right, to know what comprises the food purchased? Does the concern for food content, and possibly therefore food safety, decrease with increased understanding of bioengineered food ingredients? If the wealth of research information on food product branding and advertising is transferable to this situation we might find a very powerful form of market constraint. Meloy has shown that repeated exposure to advertising serves to reinforce the customer first impressions rather than changing attitude and choice. The consumer response to Monsanto's early advertising in Europe might support that analogy. There are certainly implications in terms of the path chosen by biotech companies if consumer response is considered.

In Moore's analogy to Microsoft, as the aspiring monopolist in the software industry, there was a clear difference in consumer support and acceptance; consumers supported Microsoft's' action whereas in Europe the consumer is adamantly against Monsanto. Is this important to the question of performance - I believe so.

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