The Industrialization of the U.S. Food System

Alan Barkema and Mark Drabenstott
Federal Reserve Bank of Kansas City

M. L. Cook
University of Missouri – Columbia

Fundamental changes are underway in the U.S. food system, changes that are altering the relationships between consumers, food retailers and wholesalers, food processors and farmers and ranchers. Today's consumer – who demands an ever-widening variety of healthful, conveniently prepared food products – is driving the changes in the food market. Meanwhile, advances in farm and food technology are enabling the food system to target a growing array of smaller consumer niches. Together, these changes in consumer demand and food technology are changing the traditional market structure linking consumers, processors and producers.

This paper analyzes the changes taking place in the U.S. food system in three sections. The first section describes trends in food demand and food technology that underlie changes in the U.S. food system. The second section develops an analytical framework for understanding structural changes in the food system. The third section extends and refines the analytical framework to consider the food system of the future.

Food Demand and Supply Changes

Food demand has undergone fundamental changes throughout the past decade, changes that have splintered the mass food market into smaller niches. Aiming food products at a vast array of market niches presents new challenges for retailers, processors and farm producers.

Meanwhile, a new generation of farm and food technology is entering mainstream use. The new generation, primarily biotechnology and information technology, has one great advantage over previous generations; it provides farmers and food companies with uncanny control over product characteristics. The new technologies enable producers and processors to define and control product quality at much earlier stages of product development. Such control is fortuitous because it enables the food system to deliver with precision the narrowly-defined food products that consumers increasingly expect.

Changes in Consumer Food Demand

U.S. consumers have become more specific about the food they purchase. The trend to greater specificity in food traits is not new; it actually began in Europe some two decades ago. Nevertheless, its arrival in the United States has spurred new behavior on the part of food processors and retailers. Four factors are key to the consumption shift: rising real incomes, demographics, lifestyle shifts and a greater emphasis on nutrition.

Rising Real Incomes

Affluence is clearly associated with an expression of more consumer choices. At the poverty level, families must attend to basic dietary needs. As rising incomes boost discretionary spending, more food purchases are driven by tastes and preferences. Rising incomes also tend to broaden the mix of foods through the purchase of more convenience foods and more meals away from home.

Despite the recent sluggish period, real incomes have risen rapidly in the United States over the past two decades. On a per capita basis, real disposable income is up about 40 percent over the past two decades (*Economic Report of the President*). Incomes have been stagnant the past five years, but a steady shift to two-income households reinforces growing demand for convenience foods. Overall, higher incomes support the trend toward a much greater variety of food products.

Demographics

Demographic shifts are also encouraging a wider variety of foods. Demographic factors with a fundamental impact include an aging population, faster growth in the number of households and greater ethnic diversity.

The U.S. population is living longer, and the segment that may have the biggest influence on food marketing – the baby-boomers – is reaching middle age. The aging baby-boomers are becoming more health conscious and adjusting their diet accordingly. Fruit and vegetable consumption are up and meat consumption is down in this segment of the population.

The United States is developing more heterogeneous households than in the past. In fact, the number of households is growing faster than the population. Single-person households, single-parent households and non-family households are growing in importance. The net result is that demand for foods is much more diverse as consumers express preferences for taste and convenience that match their lifestyles (Senauer, Asp and Kinsey).

The U.S. population is also becoming more ethnically diverse, supporting the move to a broader array of food products. The Asian and Hispanic segments of the U.S. population have recently grown two to three times as fast as the general population. This increasing cultural diversity further amplifies the trend to more food market niches.

Lifestyle Shifts

With more women in the work force, the demand for foods that offer greater convenience has continued to grow. Nearly three-fourths of women aged 25 to 54 are in the work force, compared with about half two decades ago. Demographers expect fewer women to join the work force in the 1990's, but the demand for convenience appears firmly established. Food companies, therefore, are likely to further enhance their range of offerings, including traditional, microwavable and frozen preparations.

Greater Emphasis on Nutrition

Consumers increasingly believe they are what they eat. Consumers are eating more fresh fruits and vegetables in response to concern about the risk of heart

disease and cancer. In fact, these foods top the list of foods with the biggest gains in consumption over the past decade (Barkema, Drabenstott and Welch). Meanwhile, consumers are cutting back on fat-rich foods such as whole milk and beef – foods among those with the biggest drop in consumption over the past decade. In short, consumers want a bigger variety of healthful foods.

From Mass Market to Niche Markets

Together, these changes in consumer demand have splintered the U.S. food market from a mass market into niche markets. In the past, food companies tended to sell one product to the masses. Today, food companies and retailers must tailor products to much smaller niches.

Perhaps the best evidence of the "nichification" of the food market is found at the local supermarket. To keep up with more demanding consumers, food companies are bringing far more products to the shelf. In 1990, 10,000 new food products were introduced, compared with just 2,000 in 1980. Moreover, to present a bigger variety of products, supermarkets keep getting bigger. The average size today is half again as big as a decade ago. Economies of scale and consolidation in the industry are also important factors in the move to bigger stores, but an insatiable consumer appetite for more variety should not be underestimated.

Another sign of nichification is the advent of regional marketing. Many food companies now develop different marketing plans for different parts of the country. In the past, companies varied the way a product was advertised across the country. Today, they develop different products, too.

One fundamental implication of the move to niche markets is the new power of information. Food retailers and processors are just beginning to use scanner information from supermarket check-out counters. Increasingly, that information will influence product development decisions all the way back to the nation's farms and ranches.

In fact, consumer information is shaping production decisions throughout the economy, not just in the food system. Peter Drucker recently pointed out that production decisions "will increasingly be based on what goes on where the ultimate customers...take buying action" (Drucker).

In short, decision-making power ultimately will shift to the people with information on consumers. Wal-Mart, for instance, now uses check-out scanning information to place orders directly with suppliers. In moving to that system, Wal-Mart displaced manufacturers as the driving force in the production process.

Another aspect of the nichification process is consumers' desire for more information about the foods they buy. The recent national debate over food labeling illustrates that consumers want to know more about the characteristics of their food. Thus, consumers are becoming more specific in their food preferences, *and* they want to be assured that their preferences are met.

Changes in Farm and Food Technologies

Far apart from the supermarket, a new generation of farm and food technology is emerging to enable food producers to target myriad market niches. The promise lies in the nature of the technology, particularly its ability to control food characteristics, thus

enabling food companies to hit the smaller target offered by the consumer. Technology, therefore, is the happy companion of a more demanding food consumer.

Technologies on the Horizon

A number of new technologies are in prospect – some on the verge of commercialization, others further away. But the common denominator of the technologies is their inherent ability to control product characteristics (Office of Technology Assessment). In the past, most advances in farm and food technology were output increasing, cost decreasing, or both. Today's new technologies offer similar economic benefits, but they also enable products to be tailored to a food market niche. It has been said of biotechnology, for instance, that its beauty "lies in its specificity" (Institute of Food Technologists).

With the latest biotechnology, plants and animals can be engineered to yield products that match consumer preferences. Scientists are working on ways to make plants resistant to insects or tolerant of herbicides that would kill competing weeds. Transgenic plants, in which genes have been inserted to change product characteristics, are just beginning to hit the market. The Flavr-Savr tomato, developed by Calgene Inc., will be the first widely available transgenic product. Similarly, new animal technologies promise the opportunity to clone hybrid animals, to increase feed efficiency and to cut fat in the final product.

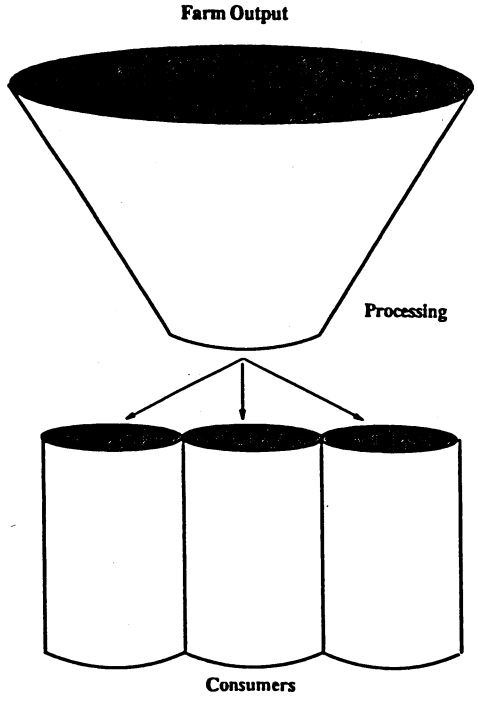
New technologies will also fine tune food processing. New techniques for removing fat are being used to produce "restructured" meats, such as the McLean hamburger. Genetic engineering processes are being explored to produce processing agents for fermenting cheese or to yield food flavoring ingredients. A key value of the new processes is that they produce a consistent product; processors can sell the same product every time. Thus, consistent quality is a hallmark of the new food market.

Changing Food Market Structure

A food market of numerous niches means food companies must develop products carefully to hit smaller targets. New technologies provide exactly the product control that food companies need. And that control is established much earlier in the product development process.

A figure of the food system helps to illustrate these points. In the traditional food system, bulk farm commodities flowed into the processing sector through commodity markets (Figure 1).

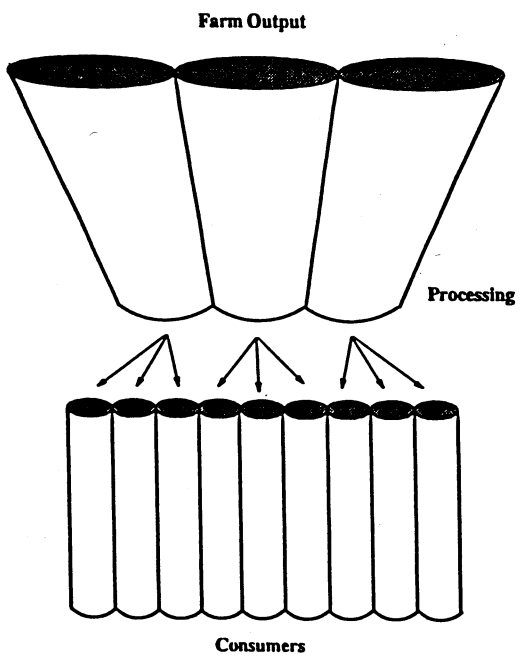
Figure 1. Traditional Structure of the U.S. Food System.



The commodity hopper was wide because the quality grades were wide. Put another way, processors had latitude because consumers accepted food products with broad quality characteristics. In the traditional food system, the product differentiation consumers saw in the market was all achieved by the processors. Similarly, any changes in consumer behavior were accommodated by changes in processing.

In the new food system, farm products flow into the processing sector through narrower market channels (Figure 2). The channels are narrower – that is, the hoppers are smaller – because the quality tolerances are tighter. Consumers are more specific about quality characteristics, and this is reflected in the greater number of products reaching them. In the new food system, changes in consumer behavior are matched by changes in processing *and* changes in farm output.

Figure 2. Evolving Structure of the U.S. Food System.



A Taxonomy of Vertical Coordination

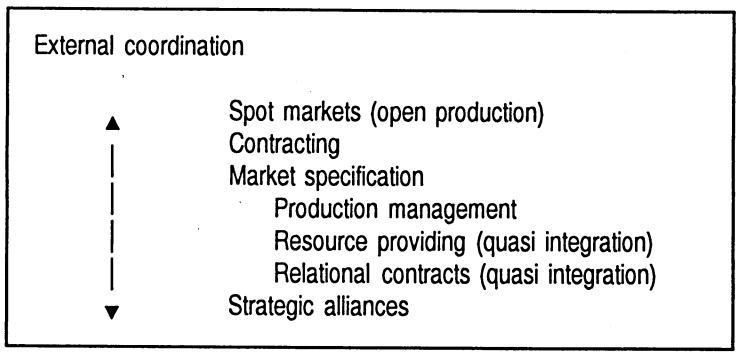
The primary job of the food market is to insure that food products hit the right target, no matter how small. The way the food market matches food products and market niches is called "vertical coordination." The food market is typically viewed as a vertical channel ending with consumers at the bottom or downstream end. Upstream from consumers are successive levels or stages of the market, including food retailers, wholesalers, processors, farmers and ranchers and input suppliers.

The traditional structure of the food market relies on price signals to guide food products to the right target. Price signals link consumers to retailers, retailers to wholesalers, wholesalers to processors and processors to farmers and ranchers. But in many cases, consumer preferences have become more specific than price signals can handle. A fountain of information is flowing out of the supermarket, but the traditional marketplace loses much of it before it reaches the farmer. Thus, the traditional market structure – designed for undifferentiated food commodities – is rapidly becoming obsolete. In its place, market structures are developing to channel precisely engineered food products to myriad new consumer niches.

A number of different market structures or mechanisms are available to coordinate the transformation of farm products into food products and aim them at market niches. The various coordinating devices form a continuum ranging from external coordination at one extreme to internal or administrative coordination at the other (Figure 3).

External coordination indicates that the exchange of information and goods between adjacent stages of the food market occurs outside any single firm or economic entity. The most extreme form of external coordination is open production – in which the production process is completed before marketing commitments are struck – with subsequent sale on spot markets.[1]

Figure 3. A Taxonomy of Vertical Coordination.



External coordination requires a well-defined system of grades and standards and accurate price signals. Grades and standards must be sufficiently flexible and detailed to classify all important attributes of the product to be traded at each juncture in the food market. Price signals, in turn, must mesh closely with the grades and standards. As the communication link between the adjacent market stages, prices must accurately convey important product differences at each stage in the market.

Under internal or administrative coordination, on the other hand, exchanges between adjacent stages of the food system occur within a single firm, the defining characteristic of vertical integration.[2] Thus, the price signals of external coordination are replaced with administrative decisions within the firm.

Several other coordinating devices lie along the continuum stretching from external to internal coordination. For example, firms positioned in adjacent stages may make various kinds of contractual arrangements to coordinate their interactions. The contracts may be fairly simple, specifying only the price, quantity and quality of some product to be traded at some future time and place. Or the contract may be more detailed, specifying production techniques or requiring the use of certain production inputs.

As the contracts become increasingly all-encompassing, they can take on more of the characteristics of vertical integration, leading Williamson (1979) to call these relationships "quasi-integration." Thus, the distinctions drawn from line to line along the continuum of Figure 3 generally signal small organizational differences.

While all of these coordinating devices are at work in the U.S. food market, the structure of the market appears to be shifting from open production toward contracting and vertical integration (Table 1).

Contracting and integration remain uncommon in grain, oilseeds and cotton production. The availability of government price- and income-support programs for producers of these crops has likely reduced the need for other forms of coordination. In contrast, contracting and integration are common in vegetable production, crops which are generally not subject to government programs. The shift toward internal coordination is even more pronounced in the broiler industry, where contracting and some vertical integration have been the predominant forms of coordination since the 1960's. More recently, a surge in contracting and integration activity suggests

Table 1. Structural Trends in Agricultural Markets.

	Production Contracts		Vertical Ownership	
	1970	1990	1970	1990
	Percent			
Program Crops				
Feed Grains	0.1	1.2	0.5	0.5
Food Grains	2.0	0.1	0.5	0.5
Soybeans	1.0	0.0	0.5	0.4
Cotton	5.0	0.1	1.0	1.0
Non-program Crops				
Vegetables for Fresh Market	21.0	25.0	30.0	40.0
Vegetables for Processing	85.0	83.0	10.0	15.0
Potatoes	45.0	55.0	25.0	40.0
Livestock				
Hogs	1.0	5.0	1.0	5.0
Eggs	20.0	45.0	20.0	50.0
Broilers	90.0	92.0	7.0	8.0

Source: Manchester

hog production may be following the path blazed by the broiler industry some three decades ago (Hurt and others).

Choosing a Coordinating Scheme

The range of different coordinating devices in use simultaneously and a gradual shift toward internal coordination in the U.S. food market points to a key question: Under what conditions is one of the coordinating schemes of Figure 3 favored over the others? Or as Coase (p. 335) puts it, "It is surely important to enquire why coordination is the work of the price mechanism in one case and of the entrepreneur in another."

In brief, Coase suggests the fundamental reason for performing a variety of tasks in a single firm is that entrepreneurs find it is cheaper to manage those tasks or services internally than to purchase some or all of them from others.

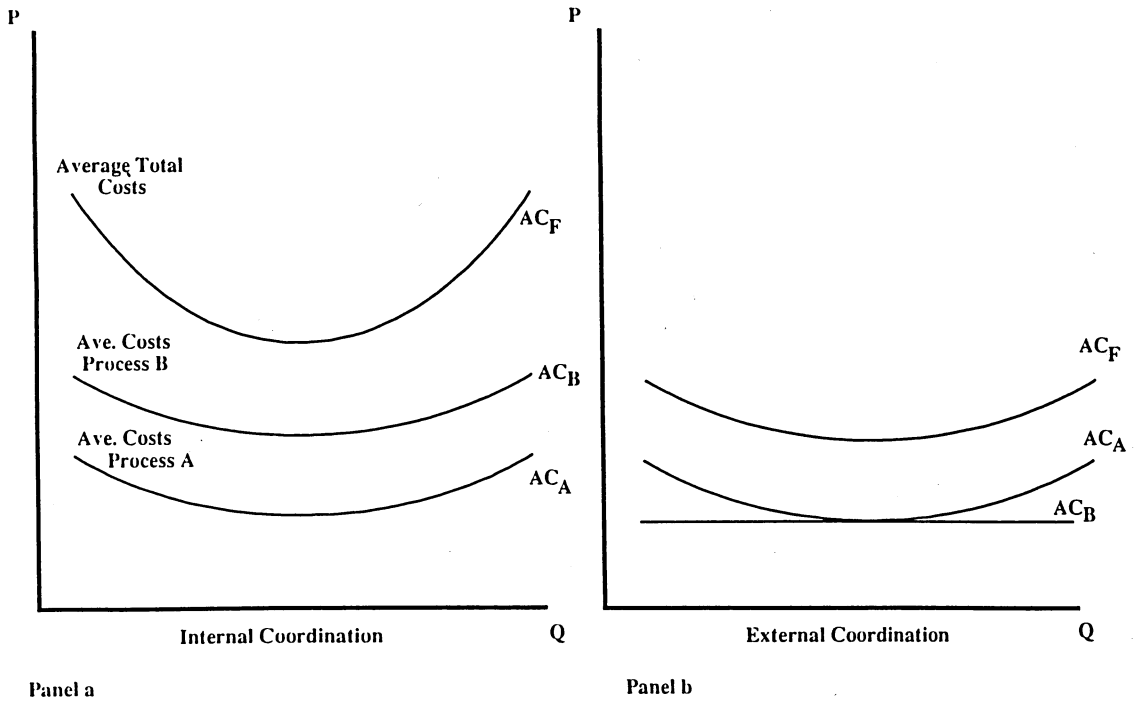
Infant Industry

Stigler's description of the industry life cycle is a good starting point for considering how internal and external coordination can affect firm costs. In Stigler's view, the firm is an agglomeration of various processes, such as purchasing inputs, transforming inputs to outputs and marketing final products.

Panel "a" of Figure 4 depicts the cost structure for a pioneering firm (Firm 1) in a new or infant industry. The firm performs two functions or processes, process A and process B, described by average cost curves AC_A and AC_B, which sum to the firm's average total costs AC_F. The firm has no choice but to manage processes A and B internally, because the firm is virtually the only firm in the new industry.

As the industry grows, however, additional firms enter the industry and the industry-wide volume of both process A and process B increase. Eventually, industry volume is large enough to support a firm (Firm 2) which specializes in process B, exploiting economies of scale unavailable to the original pioneering firm. Thus,

Figure 4. Growth of the Infant Industry.



Firm 1 can lower its total production costs by relying on Firm 2 for process B, which it can buy at a price lower than its own production costs regardless of volume (Panel b, Figure 4).

This simple example suggests external coordination should become more common and internal coordination less common as a new industry grows, a trend opposite that occurring in the U.S. food market.

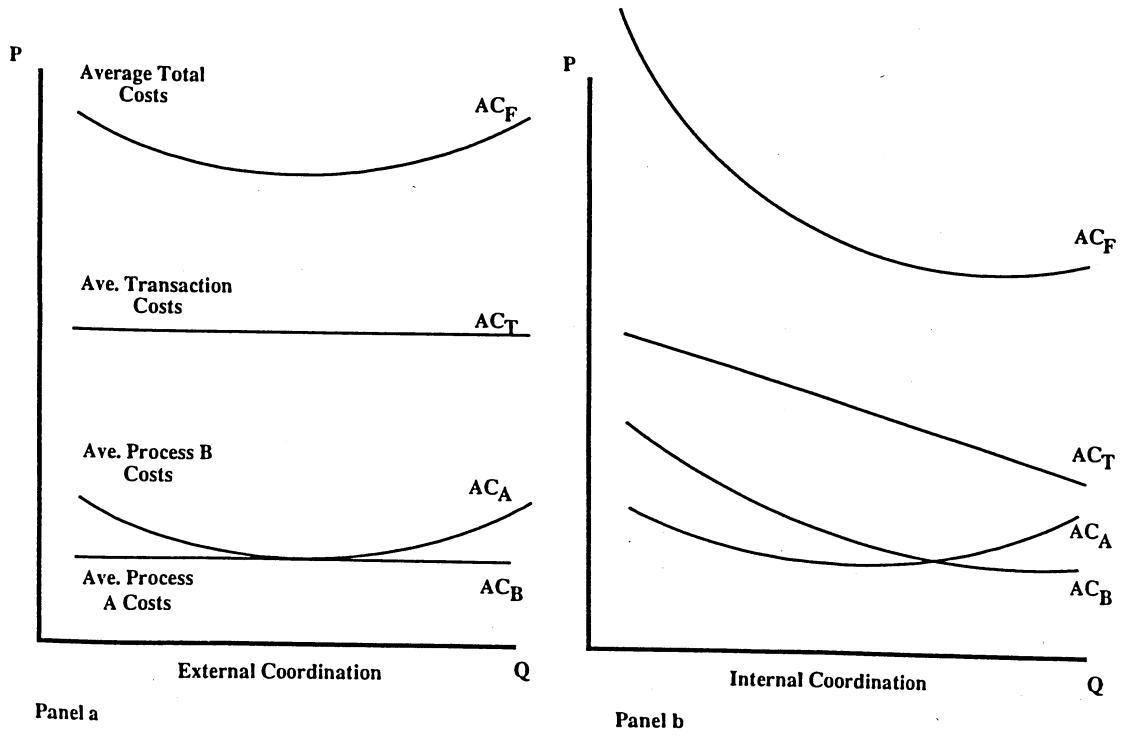
Adding transactions costs

The discussion so far has focused on production costs and ignored transaction costs, which can change the picture markedly. Williamson's extensive work in the area has extended and refined Coase's original argument attributing the choice of a coordinating or governance structure to the firm's cost minimizing decision. Williamson suggests that firms weigh the effects of different governance structures on production *and* transaction costs, with an eye to minimizing their sum.

A few minor adjustments to the sketch of Stigler's growing infant industry provide a useful illustration of Williamson's ideas (Figure 5).

Panel a of Figure 5 again shows the cost structure of the original pioneering firm (Firm 1) after its decision to rely on Firm 2 for process B. But Figure 5 also accounts for Firm 1's transaction costs (AC_T) – the costs of managing its relationship with Firm 2. These costs might include the cost of legal services required to

Figure 5. Growth of the Infant Industry with Transactions Costs.



draw up contracts between the two firms, the cost of insuring Firm 2's performance with regard to quantity, quality and delivery time of product B and the cost of managing the risk that Firm 2 might not perform as expected. The addition of these significant transaction costs pushes up Firm 1's total average costs (AC_F).

As an alternative to its external relationship with Firm 2, however, Firm 1 may consider returning to internal management of process B (Panel b, Figure 5). For example, Firm 1 may have developed a new technology for process B and it may wish to protect its research and development investment by maintaining close control of the technology within its own walls. Moreover, the new technology for process B may require a large investment in assets that decline sharply in value in their next best alternative use.[5] Thus, Firm 2 and other firms may be reluctant to make a sizable investment in the new technology, fearing a substantial loss on the investment if the future volume of sales to Firm 1 is uncertain. Thus, the risk of loss on an "idiosyncratic" investment in "transaction-specific" assets favors the internal control of process B by Firm 1.

The new technology may also enable Firm 1 to exploit economies of scale in process B as readily as Firm 2. Firm 1 would probably have to add additional layers of management to accommodate the internal management of process B. But the unit cost of the larger management load (AC_T) declines as production volume rises. Thus, Firm 1 may find that transaction costs are smaller under internal coordination than under external coordination when

Figure 6. Key Factors in the Firm's Coordination Decision.

	External Coordination	Internal Coordination
Transaction frequency		
For the firm	-	+
For the industry	+	-
Transaction standardization	+	-
Administrative burden	+	-
Information technology		
Internal systems	-	+
External systems	+	-
Asset specificity	-	+
Uncertainty (Price, Quantity,	-	+

production volume is large enough to support the bigger management burden. Thus, at large production volumes, internal coordination enables Firm 1 to maintain low production costs (the sum of AC_A and AC_B), reduce transaction costs (AC_T) and in turn, reduce total costs AC_F.

Key Factors

The description of the evolving relationship between Firms 1 and 2 highlights several factors that affect a firm's choice of internal or external coordination (Figure 6). The "+" and "-" signs of Figure 6 can be read like the signs of correlation coefficients between the relative size of the factor in the first column and the extent of either internal or external coordination, respectively. The list of factors in Figure 6 is a natural extension of the three key factors cited by Williamson: 1) transaction frequency, 2) asset specificity and 3) uncertainty.

A high *transaction frequency* is required to support the extensive management structure required for internal coordination by any single firm. But, as transaction frequency increases throughout the industry, opportunities to exploit economies of scale through specialization in separate firms favor external coordination.

Moreover, as transaction frequency increases, transactions are likely to become more standardized and routine, reducing the need for close management oversight. Thus, transaction standardization can ease the firm's administrative burden. Otherwise, management of a large number of diverse functions can stretch the firm's administrative resources.

Developments in information technology, which improve the firm's internal management systems, further enable the management of extensive interests, ease the firm's administrative burden and further encourage internal coordination. For example, the revolution in office automation technology is a key factor behind the rapid consolidation underway in the financial services industry, enabling the industry to offer a broader array of services with a smaller staff.

On the other hand, developments in information technology, which improve market information systems, can favor external coordination, by making previously complex transactions routine. For example, advances in electronic screening techniques may someday enable country elevators to routinely grade loads of grain on numerous criteria, ranging from milling characteristics to the content of various oils and amino acids.[6] Grain pricing might then be based on an extensive set of characteristics far too complex for the current grading and pricing system to handle.

Asset specificity, which describes assets that are highly specialized for certain transactions between any two firms, also encourages internal coordination. Often, specialized assets enable the exploitation of economies of scale through internal coordination. But *uncertainty* is a much more important force favoring internal coordination when specialized assets are involved. The value of specialized assets generally shrinks when they are used in their next best alternative use.

Thus, large investments in specialized assets increase the potential loss caused by an unexpected market outcome. Internal coordination reduces the risk of loss by replacing the unknowns of the market with the administrative structure of the firm.

Hypotheses

These factors determining a firm's choice of internal and external coordination suggest a sequence of three hypotheses of why internal coordination is on the rise in the U.S. food market:

1. Changes in food demand and advances in farm and food technology have fragmented the U.S. food market into smaller niches. The proliferation of niche markets and the declining importance of traditional generic markets have boosted the frequency of non-standard or highly specialized transactions throughout the food system.

2. The new farm and food technologies required to target smaller consumer niches require large idiosyncratic investments in highly specialized, durable assets and human capital.

3. Internal rather than external governance is better suited to targeting smaller consumer niches, capturing economies of scale and protecting against the risk of loss on large investments in highly specialized technology.

These three hypotheses summarize the major factors that appear to be pushing up the incidence of internal coordination in the U.S. food system. But key questions remain. In which industries is internal coordination likely to advance most rapidly in the years ahead? Which coordinating devices – such as contracting or vertical integration – will predominate? And what are the welfare effects of increasing internal coordination? That is, who wins and who loses among producers, processors and consumers as the structure of the food system changes? These are the underlying issues of our concluding section.

Future U.S. Food System Organization

This matter, and the issues underlying it, present an intriguing challenge for food system research in the years ahead. These issues are too extensive to be resolved in a single paper. But as a first step in exploring these issues and peering into the food system of the future, this section extends and refines the conceptual framework developed in the previous section. Four theoretical models of industry organization – all with roots in the transactions cost framework – are developed. These models provide additional clues to the path (or paths) the U.S. food system may follow as it evolves.

Model I

The main concern of organization is that of adaptation to changing circumstanc-

es, like those described in the first section of the paper. Changing circumstances impact the attributes of transactions in a multitude of ways. Transactions that differ in their attributes are aligned with governance structures that differ in their costs and competencies in a transaction cost economizing way.

Williamson (1975, 1985), building on Coase's (1937) premise that the basic unit of analysis in examining a firm's behavior should be the transaction rather than the production function, posited relationships between governance structures and transaction attributes (Figure 7). He argues that transactions are difficult to observe and, therefore, difficult to measure in addition to being costly to perform. The cost of executing transactions is particularly impacted by 1) bounded rationality, 2) self-interest seeking with guile (opportunism), 3) small numbers bargaining situations (imperfectly structured markets) and 4) asymmetrical distribution of information (information impactedness) (Williamson 1975). Consequently, in competitive circumstances, organizations will devise governance structures that attempt to reduce the costs of transactions. Williamson (1975) hypothesizes that the two extremes of institutional form of governance structure are 1) the autonomous market or external coordination and 2) hierarchy (the firm) or internal coordination. In 1979 he refined his model to include an intermediate range of institutional forms call "bilateral relations."

The important conclusion of Williamson's initial work is that the attributes of transactions determine, or are at least associated with, the form of governance structure. Williamson argues that when asset specificity and uncertainty are low and transactions are frequent, the most efficient governance structure is the autonomous market. On the other hand, if there exists a high degree of asset specificity, high uncertainty and low frequency, the most efficient governance structure is a hierarchy. That is to say, the transactions will be internalized within a firm. Relatively speaking, observation of medium levels of asset specificity, uncertainty and frequency would suggest that the governance structure would be some form of bilateral relations such as a neoclassical contract, strategic alliance or cooperative agreement.

Figure 7. Williamson's Transaction Properties – Governance Structure Model.

Transaction Properties	Governance Structure		
	Market	Bilateral Governance	Hierarchy
Asset Specificity	Low	Medium	High
Uncertainty	Low	Medium	High
Frequency	High	Medium	Low

Model II

Williamson (1979) refined his first model by introducing Macneil's contract classification scheme which distinguishes between discrete and relational transactions. In this approach, his primary interest is to examine the relationship between the degree of asset specificity and the frequency of transactions. The model consists of a two-by-three matrix (Figure 8), in which governance structures are matched with investment characteristics – nonspecific, semi-specific (mixed) and idiosyncratic – and two frequency measures – recurrent and occasional.

Williamson argues that market governance or classical contracting is the dominant governance structure for nonspecific transactions of both occasional and recurrent contracting. This conclusion is consistent with his arguments in proposing his first model.

Neoclassical contract law or trilateral governance is the most appropriate for transactions that occur occasionally and are of semi- or highly-idiosyncratic investment nature. To accommodate the long-term nature of these types of contracts, a governance structure is sought that is not too expensive yet has "flexibility" and "gap-filling" characteristics. Third party assistance in the form of arbitration machinery meets these criteria and has advantages over costly litigation in resolving disputes and evaluating performance.

As frequency increases from occasional to recurrent, and as the specificity of investment increases from none to mixed or idiosyncratic, the market governance structure becomes more susceptible to opportun-

Figure 8. Williamson's Efficient Governance Model.

Frequency	Investment Characteristics		
	Non-Specific	Mixed	Idiosyncratic
Occasional	Market Governance Classical Contract	Trilateral Governance Neoclassical Contracting	Trilateral Governance Neoclassical Contract - - - - - - - Unified Governance Relational Contract
Recurrent	Market Governance Classical Contract	Bilateral Governance Relation Contracting	Unified Governance Relational Contract

ism. Williamson proposes bilateral governance – relational contracting – in the case of recurrent, semi-asset specific transactions and a unified (vertical integration) structure in the case of recurrent, highly-idiosyncratic, asset specific transactions. These two types of transactions are far more complex from a contract point of view and necessitate what Macneil (1974) calls a relational contract – a contract that accommodates "a minisociety with a vast array of norms beyond those centered on the exchange and its immediate processes."

Williamson argues that a bilateral governance structure, where autonomy of the separate parties is maintained, is more appropriate when transactions are recurrent and semi-asset specific. This is particularly true when quantity adjustments are more common than price adjustments and where any adjustment to price or quantity is caused by exogenous forces and is verifiable.

"Incentives for trading weaken as transactions become progressively more idiosyncratic" because of the ability to capture economies of scale (Williamson 1979). Therefore, if a transaction possesses the properties of high-asset specificity and occur frequently, Williamson's Model II would suggest that a unified structure (where the transaction is organized within the firm) is the most transaction economizing governance structure.

Model III

The first two models assume that efficiency in conducting transactions is the primary driving force in selecting governance structure. A more behavioral approach to forecasting which set of governance structures might evolve in the years ahead is drawn from the strategic management risk-trust literature. This line of reasoning (Arrow, Bromiley, Doz and Prahalad, Van de Ven and Walker, Zucker) argues that the Williamson approach suffers from a number of shortcomings including but not limited to 1) transaction cost economics (TCE) is static, 2) TCE concentrates almost exclusively on polar forms of governance structure, i.e., markets and hierarchies, (3 TCE emphasizes economizing on transactions exclusively as the driving force in managerial decision making to the exclusion of market power or equity objectives, and 4) TCE excludes all behavioral assumptions except opportunism.

An example of a more behavioral approach to the governance structure issue is that of Ring and Van de Ven. They propose a paradigm based on observable relationships between degrees of risk, reliance on trust and the type of governance structure adopted by parties to a transaction (Figure 9). Their conceptual framework includes four basic hypotheses: 1) low degree of risk and low reliance on trust transactions will be governed by autonomous markets; 2) high degree of risk and low reliance on trust transactions will be governed by hierarchies; 3) low degree of risk and high reliance on trust transactions will be governed by recurrent contracts (neoclassical contracts as defined by Macneil); and 4) high degree of risk, high reliance on trust transactions will be governed by relational contracts (all of these propositions include *ceteris paribus* conditions).

The Ring-Van de Ven paradigm has not been tested empirically and their hypotheses are subject to a plethora of caveats. But its simplicity, attention to dynamics and behavioral alternatives to opportun-

Figure 9. Risk, Trust, Governance Structure Interface Model.

Reliance on Trust Among the Parties	Risk of Transaction	
	Low	High
Low	Markets	Hierarchy
High	Recurrent Contract	Relational Contract

ism might make it an interesting alternative to the efficiency-driven transaction cost models.

Model IV

The first three models use relatively simple concepts and provide a two-dimensional approach to forecasting possible forms of governance structures. Mahoney extends these paradigms by synthesizing theoretical arguments and empirical results from the transaction cost-principal agent literature. He then develops a model based on determined advantages-disadvantages of vertical financial ownership relative to vertical contracts.

The Mahoney framework claims the choice of governance structure is a function of the relationship between asymmetric-information-caused separability, the degree of task programmability, and the degree of asset specificity. From the agency perspective, the non-separability problem occurs when individual output in team production is difficult to measure. Therefore, an asymmetric information problem occurs, resulting in the need for management monitoring. The problem is that observations of team output are a poor measure for making individual rewards. The agency theory variable – task programmability – can be defined as the ability to measure input into a task. If observing input or effort into a task is a poor measure for making rewards, Mahoney suggests that monitoring has little effectiveness, and it is labeled low task programmability. Asset specificity, the most important variable from transaction cost economics, measures the degree of idiosyncratic investment needed for a given transaction. If a transaction needs highly specific asset investments, a more hierarchical form of governance structure would be appropriate, according to Williamson (1985).

Mahoney's three-dimensional model results in eight alternative governance structures (Figure 10). The market is predicted to dominate when low asset specificity and low non-separability (individual output is easily measured) are combined. This is consistent with the results of the previous models examined in this paper, as is the prediction that high-asset specificity and high non-separability will lead to a hierarchical form of governance structure. Hierarchy is the most transaction economizing governance structure when asset specificity and non-separability (individual output difficult to measure) are both high. The other four combinations lead to

Figure 10. Transaction–Agency Costs Synthesis Model.

Degree of Non-separability	Low Task Programmability		High Task Programmability	
	Low Specificity	High Specificity	Low Specificity	High Specificity
Low	Spot Market	Long Term Contract	Spot Market	Joint Venture
High	Relational Contract	Clan (Hierarchy)	Inside Contract	Hierarchy

some type of strategic alliance, neoclassical contract or relational contract solution.

By addressing the information asymmetry weakness of transaction costs and the asset specificity weakness of principal-agent theory, Mahoney has synthesized these two efficiency perspectives into a conceptual framework that is waiting to be empirically tested.

Conclusions

The U.S. food system is changing. Food demand is changing from a mass market into a widening array of niche markets, challenging food producers and processors to aim their products at smaller targets. Meanwhile, advances in farm and food technology are enabling the food system to tailor food products for smaller niches. Thus, a new food system is evolving. Information in the new system is more important than ever before. Each link in the marketing chain between the farmer and the consumer needs accurate information on what the next step of the chain wants. In the old food system, market signals were too noisy to enable producers and processors to zero in on smaller consumer niches. The new food system promises to correct the noisy signal problem. In the new system, noisy market signals are replaced by crystal-clear contracts or the administrative decisions of a larger, vertically integrated business.

How will the food system of the future be organized? Recent trends suggest that some parts of the system are shifting toward more internal coordination. But it seems reasonable to assume the food system is likely to retain some mix of organizational structures including traditional markets, contracting and vertical integration. Two key questions face the industry and challenge its students and observers: 1) How will the mix of organization devices change in different parts of the industry? 2) How will structural change in the industry affect the distribution of economic benefits among producers, processors and consumers?

These questions are too large to answer in this paper. But the conceptual models developed here provide a framework for considering the key factors driving the changes taking place in the food system. Indeed, the changes taking place in the U.S. food system today may provide the best opportunity in decades for testing an

extensive theoretical literature. Empirical tests and predictions may be difficult. Some key factors are easily measured, such as production costs and economies of scale. Others are measured with more difficulty, such as the various components of transactions costs. And others are virtually impossible to measure directly, such as levels of trust and degrees of non-separability.

These measurement problems notwithstanding, the issues are clear, and researchers are armed with a strong theoretical basis for considering the future structure of the U.S. food system.

ENDNOTES

1. The definitions of open production and the descriptions of various forms of contracting are drawn from the classic work of Mighell and Jones some three decades ago.

2. External coordination is often called "market" coordination and internal coordination is often called "non-market" coordination. This common description of internal coordination as "non-market" is a misnomer. One would be hard pressed to find decisions within the firm that are entirely devoid of market characteristics. For example, the daily tasks performed by firm employees are dictated by administrative fiat. But administrative fiat is generally implemented through an incentive system, including a range of wage, salary and other benefits, to coax maximum productivity from employees. These incentives form a market within the firm and also reflect labor market conditions outside the firm.

3. More than a half-century ago, Coase succinctly described the endpoints of this continuum of coordinating devices: "Outside the firm, price movements direct production, which is coordinated through a series of exchange transactions on the market. Within the firm, these market transactions are eliminated and in place of the complicated market structure with exchange transactions is substituted the entrepreneur-coordinator, who directs production," p. 334.

4. Blair and Kaserman suggest, "...the metric that varies as we move from the one end of this continuum to the other is the degree of control that one of the parties to the exchange exercises over the other."

5. Williamson calls such an asset "transaction specific."

6. Advances in infrared screening devices are already pushing back this frontier (Hurburgh).

REFERENCES

Arrow, K. 1971. *Essays in the Theory of Risk Bearing.* Chicago, IL: North-Holland.

Blair, Roger D., and David L. Kaserman. 1983. *Law and Economics of Vertical Integration and Control.* New York, NY: Academic Press.

Bromiley, P. 1991. "Testing a Causal Model of Corporate Risk Taking and Performance." *Academy of Mngmnt. J.* 35:37-59.

Coase, R.H. 1937. "The Nature of the Firm." *Economica* 4:386-405. (Reprinted in Stigler and Boulding. 1952. *Readings in Price Theory.* Chicago, IL: Richard D. Irwin, Inc.

Doz, I., and C.K. Prahalad. 1991. "Managing DMNCs: A Search for a New Paradigm." *Strat. Mmgmnt. J.*, Special Issue, 12:145-64.

Drucker, Peter. 1992. "The Economy's Power Shift," *WSJ*, 24 Sept., 1992, p. A-24.

Economic Report of the President. 1993. Washington, DC: U.S. Government Printing Office.

Institute of Food Technologists. 1988. "Food Biotechnology: A Scientific Status Summary," *Food Technology*, Jan.

Hurburgh, Charles R., Jr. 1989. "Grain Quality by End-Use Values, Moving into Market," *Feedstuffs* 61(40):1,38,55,56.

Hurt, Chris, Kenneth A. Foster, John E. Kadlec and George F. Patrick. 1992. "Industry Evolution." *Feedstuffs* 64(35):1,18,19.

Macneil, I.R. 1974. "The Many Futures of Contract." *South. Cal. Law Rev.* 47:691-816.

Mahoney, J.T. 1992. "The Choice of Organizational Form: Vertical Financial Ownership Versus Other Methods of Vertical Integration." *Strat. Mngmnt. J.* 13:483-98.

Maitland, I., J. Bryson and A.H. Van de Ven. 1985. "Sociologists, Economists and Opportunism." *Acad. of Mngmnt. Rev.* 10:59-65.

Manchester, Alden C. 1992. "Transition in the Farm and Food System." Washington, DC: USDA ERS.

Marion, Bruce W., and the NC-117 Committee. 1986. *The Organization and Performance of the U.S. Food System*. Lexington, MA: Lexington Books.

Mighell, Ronald L., and Lawrence A. Jones. 1963. *Vertical Coordination in Agriculture*. Washington, DC: USDA ERS Agr. Econ. Rep. 19.

Office of Technology Assessment. 1992. *A New Technological Era for American Agriculture*, OTA-F-474. Washington, DC: U.S. Government Printing Office, Aug.

Ring, P.S., and A.H. Van de Ven. 1992. "Structuring Cooperative Relationships Between Organizations." *Strat. Mngmnt. J.* 13:483-98.

Senauer, Ben, Elaine Asp and Jean Kinsey. 1991. *Food Trends and the Changing Consumer*. St. Paul, MN: Eagan Press.

Sporleder, Thomas. 1992. "Managerial Economics of Vertically Coordinated Agricultural Firms." *AJAE* 74:1226-1231.

Stigler, George J. 1951. "The Division of Labor Is Limited by the Extent of the Market." *J. of Political Econ.* 59:185-193.

Van de Ven, A.H., and G. Walker. 1984. "The Dynamics of Interorganizational Coordination." *Admin. Sci. Quart.* 29:598-621.

Williamson, O. E. 1975. *Markets and Hierarchies: Analysis and Antitrust Implications*. New York, NY: The Free Press.

_____. 1979. "Transaction-cost Economics: The Governance of Contractual Relations." *J. Law and Econ.* 22:233-261.

_____. 1985. *The Economic Institutions of Capitalism: Firms, Markets and Relational Contracting*. New York, NY: The Free Press.

_____. 1986. "Vertical Integration and Related Variations on a Transaction-Cost Economics Theme." *New Developments in the Analysis of Market Structure*, eds. J. E. Stiglitz and G. F. Mathewson. Cambridge, MA: Massachusetts Institute of Technology Press.

Zucker, L.G. 1986. "Production of Trust: Institutional Sources of Economic Structure." *Research in Organizational Behavior*, eds. B.M. Staw and L.L. Cummings, 8:53-112.