

# ORGANIZATIONAL ECONOMICS IN AGRICULTURE

## POLICY ANALYSIS

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The ongoing industrialization of U.S. agriculture encompasses important changes in farm production practices, in the organization of farm input and output markets, and in the mix of activities carried out by farm operators. These shifts raise important issues for the role of government in the sector and for the design of research and data programs to support public-policy analysis. Basic frameworks of organizational economics—in particular, concepts from principal-agent models, organizational design, and transaction costs—have direct applications in addressing these issues.<sup>1</sup> While organizational economics has been used in some areas of policy analysis, the concepts are underutilized in other areas.

“Industrialization” encompasses four important organizational shifts, to more differentiated food products; to more explicitly coordinated production and marketing channels, such as contracts; to expanded use by farmers of leasing arrangements, alliances, and service purchases; and to increased farm sizes. These shifts are the most prominent organizational responses to an underlying collection of causal forces at play, including the mechanical, chemical, and biological innovations that drove twentieth century advances in agricultural productivity, as well as more recent information and biotechnology advances.

The forces underlying agricultural industrialization affect the design and impact of, and support for, various public policies in agriculture. Policy has long encompassed commodity programs designed to support farm household incomes and manage supplies; market

information programs, including market news reports and product standards and grading, designed to improve the performance of cash markets; research and extension programs designed to reduce production costs, develop new uses for commodities, and reduce environmental degradation; some direct regulatory interventions aimed at controlling the spread of diseases; and conservation programs, which have achieved a new salience in recent years under expanded funding and a wider application of direct environmental regulations in agriculture. Finally, concerns about competition among farm-product buyers and among farm-input sellers have again become widespread amid high and rising concentration in some processing and input industries.

We use selected examples from work at the Economic Research Service (ERS) to describe the links among organizational economics, policy analysis, and U.S. agriculture. We first provide examples associated with concentration, contracting, and the erosion of open markets. Analyses in those areas have long made use of ideas from organizational economics but, in the following section, we explore a more recent application to the design of a U.S. Department of Agriculture (USDA) conservation program. We then use an analysis of technology adoption to argue that organizational economics can draw on organizational features from agriculture in addition to informing agricultural policy analysis. Our examples draw on data from the annual Agricultural Resource and Management Survey (ARMS) of farm operators designed and conducted by ERS and USDA’s National Agricultural Statistics Service. Work at ERS often combines research and data program development, and we conclude by linking data development to the issues described in the article.

### Organizational Economics, Government Policy Analysis, and Contracting

Production and marketing contracts account for growing shares of agricultural production

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<sup>1</sup> Some concepts in organizational economics can coexist uneasily. For example, the conflict between transactions-cost-based theories of contracting and theories based on risk-sharing motives is a principle theme in Allen and Lueck’s recent book on the organization of agriculture.

**Table 1. Share of Value of Product under Contract**

	1991–93	1994–95	1996–97	1998–00	2001
All production	28.9	34.2	32.1	37.3	36.4
Poultry and eggs	88.7	84.6	84.0	88.8	88.1
Hogs	n.a.	31.1	34.2	55.1	60.6
Tobacco	0.3	0.6	0.3	1.9	48.6
Rice	19.7	25.2	25.8	30.5	38.5
Corn	11.4	13.9	13.0	12.9	12.8

Source: USDA ARMS for years listed.

Note: The figures given are the percentage of total value.

(table 1). Contracts covered 36% of the value of production in 2001, up from 29% in 1991–1993 while earlier data suggest that contracts covered 12% of production in 1969. Contracts and vertical integration govern the production and marketing of most poultry, a majority of hogs, and a large and growing share of fed cattle.

Contracting's expansion raises several issues for agricultural policy analysts. One concerns competition in livestock. Increased contracting followed sharply increased meatpacker concentration and coincided with rising farm to wholesale price spreads in pork and choice beef. Some observers drew a causal connection from these events, from increased concentration to the use of contracts as an instrument to exercise monopsony power in livestock markets. The issue took on added salience during debates over the 2002 Farm Bill when the Senate passed a proposal, left out of the final bill, to ban control of livestock by major packers.

Many of the earliest applications of transactions-cost economics (outside of agriculture) were directed at “nonstandard” organizational designs that had attracted regulatory or antitrust hostility, such as vertical integration, tying, or exclusive dealing. The applications sought to provide efficiency-based explanations for the organizational designs. Similarly, economists working in the transactions-cost tradition argued that livestock production and marketing contracts don't necessarily act as instruments of monopsony power. Knoeber's analysis of relative performance contracts, commonly used in poultry and more recently in hog production, emphasized the role that they play in providing incentives for effort on the part of growers while also minimizing grower risks. Other work from a transactions-cost perspective argued that contracts may (a) ensure the commitment of investment by growers and integrators in large-

scale facilities when the risk of holdup in concentrated spot markets might deter that commitment and (b) may transmit accurate quality incentives to producers when spot markets fail to do so (Martinez). In these analyses contract production serves to improve market efficiency by lowering costs and by better tying product attributes to consumer demand.

One weakness of transaction-cost analyses is that they typically don't nest market power and efficiency explanations. In Joskow's summary, they “frequently ignore the possibility that there may be market power motivations or market power consequences for these organizational arrangements as well.” Since there are studies that use the traditional tools of microeconomic theory to analyze how contracts can be designed to extend market power, the challenge for policy analysts is to judge the circumstances in which efficiency or market power explanations are likely to apply and to attempt to specify the trade-offs when they both apply.

Recent work used ARMS data to test some of the hypotheses drawn from transactions-cost analyses. Key and McBride tested the idea that contract production may be associated with increased productivity and reduced costs by comparing productivity in contract and non-contract hog operations. They found that there were important economies of scale in hog production, that the larger enterprises were more likely to contract, and that hog-finishing enterprises with production contracts had substantially higher levels of productivity than independents even when controlling for size. The findings provided strong support for some concepts advanced by organizational economics.

More recently, Key used ARMS data and the framework of organizational economics to assess the links between farm financing constraints and contract production for crops and livestock. Contracts can lower the costs of debt capital by reducing the risks that lenders face

from asymmetric information. If that's true, then contract operations can obtain greater debt financing and, hence, grow larger. Holding net worth constant, Key finds that contract operations do take on more debt per dollar of net worth than independent producers of the same commodity and that they then grow larger. His findings provide a theoretical and empirical framework for the observation that the adoption of contracting increases with farm size, and suggests a causal link running from contracting to farm size, instead of the reverse.<sup>2</sup>

Contracting has had an important impact on another policy area—USDA's longstanding provision of agricultural market information to the public. Recent efforts to improve traditional price reporting, by requiring packers to report prices from marketing contracts and cash markets, do not address markets for growers' services under production contracts where fee-for-service compensation is often not tied to market prices and volumes. Different types of information are needed when the relevant markets for producers are not commodity markets but markets for growers' services.

Concepts from organizational economics can be informative in evaluating the performance of these markets, and ARMS can be used to identify and test policy-relevant hypotheses. We illustrate those uses in table 2 with 2001 information on fees and terms in hog and broiler production contracts. Note how widely fees in production contracts vary, with interquartile ranges that are 28% of the mean in hogs and 43% in broilers. Contract terms varied widely as well: note the difference in table 2 between hog and broiler contracts in contract length; more than half of broiler contracts reported either no specified contract length, or a length specified at less than a year, while only 17% of hog contracts fell into those categories. At the same time, over 80% of broiler contracts called for the farm operator to make a specified durable investment as a condition of the contract.

The findings raised some immediate questions that can be pursued within the framework of organizational economics. Why do fees vary so widely? Does the variation simply re-

**Table 2. Fees and Terms in Hog and Broiler Production Contracts, 2001**

Contract Characteristics	Broilers	Market Hogs
Contract fees (\$ per head)		
Mean	0.23	10.71
25th percentile	0.16	9.50
75th percentile	0.26	12.50
Contract quantities (no. head)		
25th percentile	214,281	1,700
Median	336,000	5,483
75th percentile	516,000	13,000
Contract terms (% of contracts)		
Length <12 months	39.7	17.3
No length reported	11.7	0
Confidentiality clause	15.4	27.2
Specified investments	83.5	30.1
No spot market alternative	77.0	55.9

Source: Data derived from the 2001 ARMS.

flect the workings of relative performance contracts or do information asymmetries play a role? Why do broiler operators accept short-term contracts that carry long-term liabilities? Is this a market failure, or do other features of the market for growers' services limit the risks faced by broiler producers with these contracts? Why do hog producers carry different contract terms?

### Organizational Economics and USDA Program Design

Principal-agent problems constitute a major area of work in organizational economics. They refer to situations in which: (a) one actor (the principal) relies on another (the agent) to advance the principal's goals; (b) the principal lacks the information to monitor the agent's relevant actions; and (c) the interests of the principal and the agent are not directly aligned. In such cases principals must develop incentive contracts to align the agent's interests with the principal's.

Agricultural environmental policies are generally designed to address market failures through incentives and regulations. Prominent examples include the Conservation, Wetland, and Grassland Reserve Programs, the Farm and Ranchland Protection Program, and the Environmental Quality Incentives Program. The programs carry elements of principal-agent problems, and program design must take issues of incentives, moral hazard and adverse selection, and risk sharing into account.

<sup>2</sup> ARMS data for 2001 show that farms with at least \$1 million in value of production used contracts for 47% of production while contracts covered 29% of production from other farms. Farms in that size class accounted for a sharply growing share of all U.S. agricultural production between 1991 and 2001, rising from 26% to 42%, growth that was almost exactly offset by the decline of the share held by farms with \$250,000 or less in product (in 2001 dollars).

Analyses of these programs rarely use the language of organizational economics, instead often relying on incremental adaptations from our standard toolbox, but explicit organizational economics concepts have begun to appear recently.

Consider one such program, the Environmental Quality Incentives Program (EQIP) under which USDA seeks to advance conservation goals, such as improved water and air quality, reduced soil erosion, and improved wildlife habitat, and acts to achieve those goals by contracting with farmers to carry out conservation management practices on working farmlands.

The program is administered through contracts of one to ten years duration, under which USDA provides technical assistance, shares up to 75% of the cost of carrying out specified conservation practices, and provides additional incentive payments for specified practices. The innovative features of EQIP design include (a) a bidding mechanism whereby farmers compete for funds based on their “bids,” or proposals to deliver packages of conservation practices at specified cost shares, and (b) targeting of funds to specific resource concerns, such as soil erosion, nutrient management, or wildlife habitat conservation, aimed at achieving the greatest possible environmental benefits per dollar of program expenditure.

The targeting process relies on local work groups (in conservation districts) to develop priority areas, which are then developed into state-level priority guidelines. USDA uses the state priority guidelines to evaluate and rank proposals from farm operators. Ranks accorded to farm proposals then depend on the expected benefits associated with each practice in a proposal, as well as the proposed cost share (with lower proposed cost shares for USDA leading to higher rankings given expected benefits).

Cost sharing is clearly designed to align the incentives of principal and agents to produce public benefits where there are only limited agent benefits. But the relation between the principal (USDA) and farmers is characterized by information asymmetries that generate problems of adverse selection and moral hazard (Cattaneo). Adverse selection occurs prior to a farmer’s decision to enter a contract, given that USDA can observe the costs to install a practice, but not the “private” benefits accruing to the farmer. Farmers have an incentive to try to be compensated in excess of the minimum amount necessary to induce them to

enter into an agreement (the minimum cost share would be the difference between the private benefits and costs). The competitive bidding process, whereby farmers propose a cost share, aims to limit adverse selection by inducing farmers to compete on offered cost shares in order to obtain contracts, thereby increasing the benefits per dollar of program expenditure.

However, after a farmer has entered into a contractual agreement, moral hazard can arise. Moral hazard, originally used in insurance to refer to risky behavior that resulted from being insured, refers generally in economics to post contractual opportunism in principal-agent models. In the case of EQIP, because of the conservation authority’s limited enforcement capability, farmers with EQIP contracts may fail to carry out some practices to which they had committed. Specifically, farmers may bid low cost shares in order to win EQIP contracts and, later, withdraw some proposed practices—between 1997 and 2000, approximately 11% of planned conservation practices under EQIP were never implemented. Recent ERS work (Cattaneo) analyzes the drivers of contract withdrawals under EQIP and considers the role of moral hazard in the withdrawals. Using the framework of adverse selection and moral hazard implied by organizational economics, Cattaneo offers a series of options for control of moral hazard through EQIP contract designs.

### **What Is Distinctive about the Organizational Economics of Agriculture?**

Agricultural economists usually draw on concepts in organizational economics developed in the broader economics literature. Yet agriculture offers distinctive features for organizational economics, and we focus on one: the intertwined relationship between farm households and farm businesses, which complicates the ways we think about farm firm decisions.

Farm households control land, labor, managerial, and financial resources, and key economic decisions allocating those resources among the farm business, off-farm employment and investments, and household consumption are often made simultaneously. Policy-relevant research often involves predicting farm business response to policy alternatives or, after the fact, explaining causal factors behind observed farm behavior. Although the primary focus may be on farm businesses, the research often cannot be effectively carried

out without consideration of the household. In short, organizational economics may need to be explicitly linked to household production economics, which has its intellectual roots in agriculture in the work of Reid, in order to provide an appropriate modeling framework for many issues. In particular, considerations from household production economics can provide a better understanding of the opportunity costs of applying owned inputs, such as family labor and management, and, therefore, an improved understanding of firm investment and organization decisions.

A recent example of the importance of considering the jointness of the farm household and business in farm decision making involves the work of Fernandez-Cornejo and McBride on the adoption of genetically engineered crops. Their research applied traditional models of diffusion, including measures of the financial benefits of adoption, as well as operator characteristics thought to be tied to innovation. One surprising finding stood out. They found no statistically significant improvement in net returns from using herbicide-tolerant soybeans, at either a whole-farm or enterprise level, even though HT soybeans had been widely adopted on U.S. farms (45% of acreage in 1998 and 83% by 2003). The finding suggested that other considerations might have been driving adoption.

Some commentators believed that adoption of herbicide-tolerant soybeans was driven by the relative simplicity and flexibility of weed control under HT programs. In general, simplicity and flexibility translate into reduced management time employed to supervise production, freeing time for home and off-farm uses. However, studies of technology adoption in agriculture rarely account for the opportunity cost of operator household time and Fernandez-Cornejo and McBride followed common practice and did not include an opportunity cost for unpaid household time in their measures of net farm business returns from adoption.

Fernandez-Cornejo and Hendricks used 2000 ARMS data to evaluate the effect of HT soybean adoption on off-farm household income and on farm income while accounting for selectivity by separately modeling decisions to adopt HT technology and to work off-farm (by both the operator and the spouse). Consistent with the earlier study, HT adoption had no significant impact on farm income. However, adoption had statistically and substantively

significant effects on off-farm income. A 10% increase in the probability of adoption was associated with an 8.4% increase in off-farm household income. The finding illustrates the importance of accounting for broader household factors in modeling farm business decisions, as well as the potential gains to organizational economics from including elements of firm and household interactions.

### **The Importance of Data**

Anecdotal observations about organizational shifts in agriculture are often offered in a variety of venues, sometimes sensationalized, long before there is hard documentation on the extent and importance of the shift. The quinquennial Census of Agriculture and the annual ARMS survey of producers are the major databases underlying ERS research programs that inform agricultural policy making. They are a rich research resource available to the larger research community.

ARMS (and its predecessor the Farm Costs and Returns Survey (FCRS)) is the primary source for several ERS data series, some of which were driven by Congressional mandates. These include annual estimates of net farm income, farm-operator household income, and annual cost of production estimates for selected commodities. The survey has collected data on contracting since at least 1986. At that time, the national and state estimates of net farm income were developed by merging statistics from a variety of independent data sources on inputs and outputs. The resulting official estimates of net farm income were often very different than estimates obtained from the FCRS data, and this led to considerable effort to identify the underlying reasons for the discrepancies. One of the major reasons for the differences was found to be the costs and returns for commodities produced under contract. Hence, several questions on fees, prices, and quantities produced under contracts, have been asked each year to facilitate estimation of farm income.

The ARMS-FCRS survey is also a primary source of data for research relating to organizational economics. For example, ERS designs questions to help in analysis of the causes and effects of contract use in various commodities, providing us with an opportunity to empirically test some hypotheses generated in organizational economics.

The surveys are annual cross sections, and not panels, which limits our opportunities to model dynamic responses through time. Moreover, since respondents are farm operators, we can obtain only limited information in the survey about decisions made by product buyers or input providers. However, our role in the survey provides us with the opportunity to tailor questions to precise areas of research interest. As a result, concepts from organizational economics can influence how we design our surveys, as well as how we do research and how we organize analyses of policy. That opportunity creates new challenges because we must design precise questions that will be understandable to a diverse range of respondents and yet still correspond to concepts from economic theory. That challenge creates an element of learning by doing to our survey work, particularly in recent efforts to understand issues touched on in this paper, including contracting, household and farm business decision making, and technology adoption. In recognition of its importance in both developing economic statistics for agriculture and policy analysis, the budget for ARMS was recently expanded to allow for substantially larger sample sizes. With larger samples we hope to, among other things, widen the scope of analyses applying organizational economics to agriculture.

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