United States
Department of
Agriculture

Economic
Research
Service

Agricultural
Economic
Report
Number 837

USDA

Contracts, Markets, and Prices

Organizing the Production and Use of Agricultural Commodities

James MacDonald, Janet Perry, Mary Ahearn,
David Banker, William Chambers, Carolyn Dimitri,
Nigel Key, Kenneth Nelson, and Leland Southard

Visit Our Website To Learn More!

Want to learn more about contracts, markets, and prices? Visit our website at **www.ers.usda.gov.**

You can also find additional information, both paper and electronic, about ERS publications, databases, and other products at our website.

It's Easy To Order Another Copy!

Just dial 1-800-999-6779. Toll free in the United States and Canada.

Ask for *Contracts, Markets, and Prices: Organizing the Production and Use of Agricultural Commodities (AER-837).*

National Agricultural Library Cataloging Record

Contracts, markets, and prices : organizing the production and use of agricultural commodities.
(Agricultural economic report ; no. 837)
1. Contracts, Agricultural--United States. 2. Farm produce--Prices--United States.
3. Produce trade--United States. I. MacDonald, James M.
II. United States. Dept. of Agriculture. Economic Research Service.
III. Title.
HD9005

United States
Department
of Agriculture

Agricultural
Economic
Report
Number 837

November 2004

A Report from the Economic Research Service

www.ers.usda.gov

Contracts, Markets, and Prices: Organizing the Production and Use of Agricultural Commodities

James MacDonald, Janet Perry, Mary Ahearn, David Banker, William Chambers, Carolyn Dimitri, Nigel Key, Kenneth Nelson, and Leland Southard

Abstract

Production and marketing contracts govern 36 percent of the value of U.S. agricultural production, up from 12 percent in 1969. Contracts are now the primary method of handling sales of many livestock commodities, including milk, hogs, and broilers, and of major crops such as sugar beets, fruit, and processing tomatoes. Use of contracts is closely related to farm size; farms with $1 million or more in sales have nearly half their production under contract. For producers, contracting can reduce income risks of price and production variability, ensure market access, and provide higher returns for differentiated farm products. For processors and other buyers, vertical coordination through contracting is a way to ensure the flow of products and to obtain differentiated products, ensure traceability for health concerns, and guarantee certain methods of production. The traditional spot market—though it still governs nearly 60 percent of the value of agricultural production—has difficulty providing accurate price signals for products geared to new consumer demands (such as produce raised and certified as organic or identity-preserved crops modified for special attributes). We are likely to see a continuing shift to more explicit forms of vertical coordination, through contracts and processor ownership, as a means to ensure more consistent product quantity and quality.

Keywords: Contracting, marketing contracts, production contracts, vertical integration, vertical coordination, market structure, risk analysis, price signals.

Acknowledgments

The authors thank the management team from ERS's Resource Economics Division and Market and Trade Economics Division for their support of the program to study contracting in agriculture. We received excellent editing from Courtney Knauth of ERS's Information Services Division and we also thank Wynnice Pointer-Napper for the design and layout of the report and Susan DeGeorge for the cover design. We're grateful for the many useful comments from ERS reviewers Mitchell Morehart, William McBride, and Steve Martinez, USDA reviewers Warren Preston of the Agricultural Marketing Service and Gary McBryde and Jaime Adams of the Grain Inspection, Packers and Stockyards Administration, and Brent Hueth of Iowa State University. We appreciate the advice of Marvin Hayenga of Iowa State University and Roger Schneider of USDA's Grain Inspection, Packers and Stockyards Administration, who helped us frame our questions and develop the research.

Contents

Summary

Contracts govern 36 percent of the value of U.S. agricultural production, up from 28 percent in 1991 and 12 percent in 1969. Contracts are now the primary method of handling sales of many livestock commodities, including dairy, hogs, broilers, and turkeys, as well as of major crops such as sugar beets, tobacco, fruit, and processing tomatoes. In recent years, we have seen dramatic shifts toward contracts and away from spot markets in hogs and tobacco, and producers of fed cattle expect similar shifts in coming years.

However, spot markets still govern nearly 60 percent of the value of agricultural production and remain an efficient way to produce and distribute many products. This is especially true for more generic products for which differentiation is less important to the final consumer. The use of contracts is closely related to farm size. Farms with at least $1 million in sales have nearly half of their production under contract. Those farms accounted for 42 percent of the value of U.S. agricultural production in 2001, up from 26 percent 10 years earlier.

Why would farmers want to use contracts instead of spot markets? The report focuses on two explanations for the shift. Contracts may be seen as a device to limit price and income risks (*risk-sharing approach*), or they may be regarded as a means to reduce the costs of using spot markets to arrange transactions (*transactions-cost approach*). Either or both of these considerations may enter into the decision to use contracts.

Contracts can substantially reduce income risks associated with price and production variability, and contract terms can be calibrated to tailor the degree of risk reduction offered. Livestock producers frequently cite risk sharing as a major benefit of production and marketing contracts. However, there are many ways to reduce risks, and many contracts appear not to be targeted at risks. The transactions-cost approach demonstrates that contracts can be designed to improve incentives to lower production costs and deliver products with specific attributes. They can also facilitate coordination among stages of production—speeding adoption of new technology; improving information flows; managing quality, uniformity, and delivery; and enhancing access to credit. If transactions costs are important, then contracting can lead to improved productivity and higher product quality.

Increased contract use creates several types of concerns for producers. Contracts may lead to unanticipated new risks for producers. Under some conditions, they can allow buyers to exercise market power, reducing prices received by producers. And as more production shifts to contracts, reductions in spot market volumes can raise spot market costs.

Some contracts commit producers to long-term investments that will support production for a particular buyer. If contracts give producers only short-term purchase commitments, they will face new risks from contract cancellation or buyer failure. Moreover, many contracts specify fees for producer services rather than market prices. Without reliable market information on fees and services, producers can find themselves at a bargaining disadvantage with contractors.

Critics presume that contracts create market power for buyers and reduce farm prices. Under the right conditions, contracts can be designed to limit entry of potential rivals into concentrated markets. They can also be designed to limit the intensity of price competition among existing rivals or to expand buyer profits through price discrimination (by targeting lower prices at some sellers who have few alternatives). However, the success of such actions depends on the precise terms of agricultural contracts, the structure of the agricultural markets involved, and the responses of rival buyers. In particular, contracts that aim to create market power generally require highly concentrated markets with limits on entry by rivals, and they frequently need to have existing rivals adhere to similar contracts. Because contracts are often used in concentrated markets, there may be cases in which contract terms do allow buyers to exercise market power. However, since contracts can also lead to enhanced productivity and improved responsiveness to consumer demand, it is important for policy responses to target only those contracts that extend market power without offsetting gains in efficiency.

USDA has long provided agricultural market information to the public to facilitate smooth operation of the spot market. However, spot prices are relevant only to the extent that they provide information about the cost and value of products moving through the whole system. The expansion of contracting, particularly in hogs and fed cattle, may have reduced the value of traditional USDA price reporting to producers, and may consequently have raised the costs of using spot markets. Recently, Congress responded to these concerns after a drop in reported livestock transactions volumes. Seeking to improve the operation of spot and contract markets, it passed legislation designed to improve price reporting through the mandatory filing of spot and contract transaction data.

For a number of reasons, contracts are likely to govern a growing share of agricultural production over the next decade. First, demand for differentiated agricultural products to meet specific consumer preferences should continue to grow, and such products are generally produced under contract. Second, pressures will mount to ensure traceability of products for health and consumer concerns, and contracts provide one way to ensure traceability. Third, pressure to reduce environmental degradation associated with agricultural production will likely result in upgraded production technologies and require tighter management of production systems through contracting. Finally, large farms account for sharply growing shares of agricultural output. Contracting is closely associated with farm size, and contract use can be expected to grow along with the increase of large farms.

Contracts, Markets, and Prices

Organizing the Production and Use of Agricultural Commodities

Chapter 1

Introduction

Farmers have long used formal contracts in obtaining land, credit, and equipment, as well as in organizing the production and marketing of commodities such as vegetables for processing. Formal contracts now cover a growing share of agricultural production, a growth closely tied to shifts in farm size, product differentiation, and product monitoring.

As U.S. agriculture evolves, farms are getting larger, and many farm enterprises are becoming more specialized. Farm products are more differentiated and are often tailored to buyers' specific requirements. To meet the demands of these differentiated markets, farmers must provide extensive product information and, as a result, must invest in more monitoring and record-keeping technologies. Many of these changes stem from the efforts of processors and retailers to attract consumers through special product attributes and lower retail prices. Those efforts require control and monitoring throughout the many steps—known collectively as the supply chain—involved in producing and delivering products from the farm to consumers. Within the supply chain, formal contracts increasingly govern the transfer of farm products, replacing traditional cash transactions on the spot market. This report focuses on the use and impacts of agricultural contracts in evolving supply chains.

The use of agricultural contracts is controversial. Contracts may lead farmers to exchange price risks in the market for unexpected contract risks. Under some circumstances, contracts may allow buyers of agricultural commodities to exploit market power by deterring other buyers from entering a local market or by allowing the buyer to reduce prices paid in related spot markets. On the other hand, contracts frequently provide farmers with important benefits, such as reducing costs associated with uncertain income streams. They can facilitate the spread of new production technologies, including advances in genetics, feed formulations, nutritional services, fertilizers, and pest control. Contracts can lead to reduced processing costs and provide consumers more customized and affordable products.

Contracts are particularly controversial in livestock, where a few meatpackers handle most livestock purchases. In 1999, Congress passed laws requiring mandatory price reporting of livestock transactions in response to the loss of price information because of contracting. Several proposals to regulate livestock contracts were introduced in Congress during debates over the 2002 Farm Bill. In February 2004, a Federal jury in Alabama

concluded that Tyson Foods used contracts to lower cattle prices (with estimated damages to cattle producers of $1.28 billion), a decision later voided by the judge in the case.

This report assesses what we know about agricultural contracting in the United States. It synthesizes existing analyses of its effects on risk, productivity, market power, and price discovery. This synthesis allows us to arrive at conclusions that no single or small set of studies could support. We also suggest areas where new research is needed to answer questions identified by the analysis.

Organizing Agricultural Production and Marketing

Contracts play an increasingly important role in organizing agricultural production (table 1-1). Farmers acquire inputs through a variety of commercial transactions. Assets may be purchased, but they are also frequently rented. Material inputs can be purchased or produced on the farm; for example, livestock producers can buy or grow feed, while crop producers can buy commercial fertilizers or apply livestock manure to fields. Farm operators and their families can provide labor and management, and the operators can hire additional labor. Operators may finance input acquisitions out of business profits or household savings, or they may borrow through loans from a variety of financial intermediaries. Some inputs can be financed through contracts in which the contractor provides inputs in exchange for an eventual product. For example, crop contracts may provide for the provision of seed or plants, fertilizer, and chemical inputs to the farmer, who later transfers the harvested crop to the contractor.

Table 1-1—A farm operator's tasks and decisions

Assembles farm inputs:

What inputs?	How?
Land	Owns, rents, or produces assets; buys materials (individually or through a cooperative venture), produces them on farm, or acquires them through contract; provides or hires labor and management services.
Equipment	
Energy; feed; water	
Chemicals	
Seedstock; genetics	
Labor; management	

Then applies inputs to stages of farm production:

To what stages?	How?
Site preparation	Operator applies directly, purchases through custom service, or obtains contract.
Planting; breeding	
Pest and nutrient management	
Harvest; removal	
Local storage and transportation	

And delivers farm products to downstream users

What users?	How?
Other farms	Sells through spot market, transfers through contract, or transfers between commonly owned units through vertical integration.
Intermediaries	
Processors	
Retailers	
Consumers	

Source: Authors' summary of text discussion.

Farm production has several distinct stages (see table 1-1) and each farmer can handle them differently. The farmer can carry out the tasks of each stage from site preparation through harvest (or slaughter or processing for livestock). He can also hire a custom service provider to take over one or more stages, or he can specialize in some stages, leaving other operators to carry out the remaining ones. Custom crop-service providers often level, till, or seed the soil, apply fertilizers or chemicals to crops, harvest, or provide local transportation. Custom livestock-service providers can be hired for breeding, manure management, feeding, and local transportation. Livestock producers often specialize in breeding stage or in feeding before slaughter. Similarly, floriculture operators can start new plants that are then transferred to others for further growing.

What Are Agricultural Contracts?

Farmers frequently use contracts to assemble inputs, arrange for custom services on the farm, and finance those actions. Contracts are increasingly used to arrange for the transfer of products off the farm to a variety of users. Farmers can transfer products directly to a processor, such as a meatpacker, a cheese manufacturer, or a tomato processor. They may also transfer to intermediaries such as grain elevators, livestock integrators, and produce packers, who classify and aggregate large volumes of farm products for shipment elsewhere. Farmers sometimes link directly to retailers, most commonly for fruits, vegetables, and horticultural products, and sometimes sell directly to consumers. The term "agricultural contracts" refers here to contracts used to arrange for the transfer of agricultural products from farms to downstream users such as processors, elevators, integrators, retailers, or other farms.

Our analysis focuses on the transaction through which a farmer and a downstream user arrange to transfer the farm product. We define four methods of organizing that transaction (table 1-2):

1. *Spot (or cash) markets*, are the traditional means of price transmission in agriculture, which developed around generic or perishable products produced on many farms of similar size but geographically dispersed. Farmers sold to buyers (wholesalers, processors, brokers, and shippers) who aggregated farm commodities, processed them into food products, and distributed the products to customers. Modern spot markets for farm produce are based on many earlier marketing innovations, including grading and weighing technologies, standards to allow aggregation of individual farm products into large volumes, and accounting and payments systems to route compensation back to individual producers after aggregated volumes are sold (Cronon, 1992).

   In spot markets, farmers are paid for their products at the time ownership is transferred off the farm, with prices based on prevailing market prices at the time of sale, under agreements reached at or after harvest. Premiums might be paid for superior quality, based on factors observable at the time of sale. Farm operators control production decisions such as the types of farm inputs to buy, as well as when and how to apply them. Operators also make financing decisions (often in concert with their bankers) and arrange for selling their products, including finding a seller, determining a price, and delivering the product.

Table 1-2—Four ways to govern the exchange of products from farms to buyers

Form of governance	Who controls production decisions?	How is the farm operator paid?
Spot market	Farm operator controls assets and production decisions in agricultural enterprise.	Farm operator receives price for farm output, negotiated at time of sale just prior to delivery.
Marketing contract	Farm operator controls assets and production decisions in agricultural enterprise. Contract may specify output, quantities, and delivery timing.	Farm operator receives a price for farm output, negotiated before or during production of agricultural commodity.
Production contract	Contractor exercises control over some production decisions or farm enterprise assets. Contract specifies products, quantities, and delivery timing.	Farm operator is paid a fee for farming services rendered in the production of the commodity.
Vertical integration	Single firm controls assets and production decisions in adjacent farming and processing stages.	Farm operator-manager is compensated for skills and time.

Source: Authors' summary of text discussion.

Spot market exchanges continue to govern most transactions for farm products. But three alternatives—production contracts, marketing contracts, and vertical integration—govern a growing volume of transactions. We describe these alternatives as they relate to the control of farm production decisions and the manner in which farm operators are paid for farm products.

2. *Production contracts* detail specific farmer and contractor responsibilities for production inputs and practices, as well as a mechanism for determining payment. Under many livestock production contracts, the farmer provides labor, equipment, and housing while the contractor provides feed, veterinary and transportation services, and young animals. Production contracts often specify particular inputs, set production guidelines, and allow for the contractor to give technical advice and make field visits. This leaves the farm operator with less control over input choices. The farmer's payment is based on the costs of farmer-provided inputs, the quantity of production, or both. Contractors, not farmers, often retain ownership of the commodity during the production process. Because the agreement includes the earliest steps of production, these contracts are agreed to before production begins. [See Box 1: What Is in a Production Contract?]

3. *Marketing contracts* specify a price (or pricing mechanism) and an outlet for the commodity, under agreements set before harvest or, for livestock, before removal. The pricing mechanisms often limit a farmer's exposure to wide price fluctuations, and the contracts often specify product quantities and delivery schedules. The farmer owns

Box 1—What Is in a Production Contract?

Some production contracts are quite simple—a few pages—while others are much longer and quite detailed. Common features like compensation rules can take many forms. However, production contracts frequently have the following components:

Assignment of Responsibilities—Production contracts are often quite specific about the roles of participants. Farmers in livestock contracts typically provide labor, housing, utilities, and on-farm structures and equipment. Contractors provide young animals, feed, and medication. The contract specifies responsibility for livestock transportation to or from the farm. In recent years, livestock contracts have included detailed guidelines for manure treatment and disposal. Crop contracts specify the inputs, such as seeds, that the contractor will provide the grower, as well as grower practices to maintain the integrity of the product.

Assignment of Products—Contract feeding produces market-ready animals, but also some dead ones (most processes carry a mortality risk) and animal waste (manure). The contractor usually retains ownership of the animals throughout the process, while growers are responsible for disposal of dead animals. Animal wastes may have economic value as fertilizer, or can be a liability requiring proper disposal, and contracts assign specific responsibilities for waste handling.

Compensation—Rules are rarely simple. Most livestock contracts specify a base pay, on a per animal or space basis. Contracts frequently contain incentive clauses, under which growers earn more if mortality rates are low or if they are relatively efficient in the use of feed or (less often) fuel. Crop contracts specify a base pay, and may contain production risk-control features. Contracts establish standards for product quality and specify penalties for failure to reach the standards.

Contract Length—Many crop-production contracts hold for a growing season. Livestock contracts can range from one flock (less than 2 months) to 10 years, and some livestock contracts are automatically renewed unless cancelled.

Delivered quantities—Most contracts contain estimates of the likely annual production, specify estimates of delivery times and quantities through the year, and set rules for handling departures from those estimates.

the commodity during production and retains substantial control over major management decisions, with limited direction from the contractor. [See Box 2: What Is in a Marketing Contract?]

4. *Vertical integration* combines the farm and the downstream user under single ownership—a firm that produces an input itself is said to be vertically integrated (Carlton and Perloff, 2004). For example, many wineries own and operate vineyards, while citrus processors

Box 2—What Is in a Marketing Contract?

Farmers retain far more control over their production process in marketing contracts, and such contracts are hence often shorter and less prescriptive than production contracts. Key elements include:

Delivered quantities—Marketing contracts contain estimates of the likely annual production under the contract and of delivery times and quantities through the year. Livestock contracts contain greater detail for delivery cycles, dates, and quantities. Some marketing contracts specify the share of the grower's output (often 100 percent) that must be delivered.

Product Specification—Some agreements specify the precise genetics for a product, and also set standards for a grower's production methods and physical equipment.

Compensation and Quality Control—Under some marketing contracts (called marketing pools), groups of farmers commit specific quantities to an intermediary contractor who then negotiates a price with downstream users on their behalf. But most marketing contracts designate a base price or pricing formula, with risk adjustments designed to reduce the variation in contract prices compared with spot market prices. The base price formula can link a price to a spot or futures market price for the commodity, to a price for a related commodity (such as a wholesale price for a food product containing the agricultural commodity), or to a cost formula (such as feed prices for livestock). Contracts for homogeneous products specify minimum acceptable quality standards, while others establish schedules for quality-based price premiums or discount from the base.

may own and operate orange groves and meatpackers may own hog farms or cattle feedlots. Product transfers are made not through contracts or spot market arrangements, but through internal decisions. Farm operators in vertically integrated firms hold employment rights and are compensated like other employees.

Contracts, spot markets, and vertical integration are three ways to organize the *vertical coordination* of products and services through the supply chain. "Coordination" refers to harmonizing the stages of a supply chain, from scientific development and manufacture of new farm inputs through farm input acquisition and production, to processing and retail distribution, to delivery of final products to consumers. "Vertical" refers to the sequential nature of those steps (table 1-1). Vertical integration makes the coordination between stages explicit and dependent upon a set of decisions within the firm, while spot markets achieve coordination implicitly, through prices for products and services. Contracts coordinate through a combination of prices and explicit rules for production decisions, timing, and compensation.

Methods of vertical coordination change over time and vary across commodities. For example, today's farms are often more specialized, and less vertically integrated, than those in the past. Farms that produce their own feed for animals that they raise to slaughter weight are vertically inte-

grated. However, a livestock producer may specialize in raising livestock only, buying feed through a market instead of producing it on the farm, and selling manure instead of applying it as an input to crop production. Crop producers may purchase many custom services, such as harvesting, instead of performing the services themselves. Farmers may do less on-farm processing, and they may buy seedstock or animal genetics (semen) rather than saving seed or keeping a bull for breeding. Each of those choices represents a shift toward reliance on outsourcing through cash or contracts, and a reduction in vertical integration.[1]

[1] There is also some evidence that vertical integration between downstream users and farming is declining. The Census of Agriculture reports on the number of farms owned by nonfamily corporations with more than 10 shareholders, and the value of production on those farms. That measure is a good indicator of farm production by large public corporations such as meatpackers or fruit processors, who source some of their agricultural needs. Such firms owned 1,075 farms in 2002 (0.05 percent of the total), accounting for 1.9 percent of all farm production, down from 3.0 percent of production in 1978.

Chapter 2

The Incidence, Spread, and Terms of Agricultural Contracts

In describing agricultural contracting, we draw primarily on nationwide USDA surveys, which have asked farmers detailed questions about contracting since 1991, and on more limited information from other surveys of specific commodities and earlier periods (appendix table 1). We primarily use data from USDA's Agricultural Resource and Management Survey (ARMS) to summarize contracting in U.S. agriculture, which provides an unusually rich and detailed source of data on agricultural contracts. Each annual ARMS asks farmers whether they use production or marketing contracts and asks for the volume of production, receipts, and unit prices or fees received for each commodity under contract. In some years, the survey contains more detailed questions on contractors, contract terms, and alternatives available to farmers. Further information on the survey can be found at *http://www.ers.usda.gov/Briefing/ARMS/*.

Farms Use Contracts in Many Contexts

Production and marketing contracts governed about 36 percent of the value of U.S. agricultural production in 2001, up from 28 percent in 1991. Because farms in the United States are highly diverse, we use a simple typology of sector organization for showing how contracting has spread and how the use of contracts varies among commodities, regions, and farm types (size of farm and the operator's principal occupation) (table 2-1), as follows:

- *Commercial farms* consist of family-operated farms with gross sales in excess of $250,000 and all nonfamily farms, which can be cooperatives, nonfamily corporations, or family-owned farms operated by a hired manager. Less than 10 percent of farms are commercial, although they accounted for most farm production—72 percent in 2001 by total value (table 2-1).
- *Intermediate farms*, which account for 31 percent of all farms and 22 percent of the value of production, have sales below $250,000 and an operator who reports farming as his or her major occupation. The category excludes limited-resource farms.[1]
- *Rural residence farms*, which include most farms in the United States but account for a very small share of farm production. Most operators of rural residence farms report that they are retired or that their primary occupation is not farming. Ten percent are limited-resource farmers.

U.S. farmers use contracts in many ways. More than a third rented at least some of the land that they farmed in 2001 (table 2-1). Land rental varied sharply across farm sizes, and nearly two-thirds of commercial farms rented some land. In turn, commercial farms contracted for many inputs and services. Most of them (61 percent) hired outside firms to perform stages of farm production, often custom harvesting, planting, or soil preparation, and

[1] Limited-resource farms in 2001 had gross farm sales of less than $100,000, total farm assets below $150,000, and total operator household income below $20,000.

Table 2-1—Contractual arrangements used by U.S. farms, 2001

Item	All farms, 48 States	Rural residence farms	Intermediate farms	Commercial farms
Number of farms	2,149,683	1,286,549	659,962	203,172
Percent of all farms	100.0	59.8	30.7	9.5
Percent of production value	100.0	6.4	21.7	71.8
	Percent of farms in category engaged in practice			
Land rented in:				
Any form	34.9	22.7	48.8	65.4
Cash rent only	24.3	17.8	32.4	38.5
Share rent only	5.6	3.7	8.5	8.1
Cash and share	4.9	1.2	7.9	18.8
	Percent of farms in category engaged in practice			
Contracts for inputs or services:				
Leased equipment	9.2	6.2	10.1	24.6
Contract labor	9.5	6.7	12.6	17.5
Custom work	39.7	31.5	49.0	60.7
Contract shipping of products	7.6	4.1	10.6	19.3
Loans	44.9	37.3	52.1	69.6
Production or marketing contracts	11.0	3.6	16.0	41.7

Source: 2001 USDA Agricultural Resource Management Survey.

25 percent of them leased some equipment. Commercial farms were also far more likely to use production or marketing contracts; over 40 percent had such a contract in 2001, compared with 16 percent of intermediate farms and about 4 percent of rural residence farms.

Contract Use Is Closely Related to Farm Size

In 2001, 36 percent of the value of U.S. agricultural production was produced under a production or marketing contract.[2] Contracting use varied across farm types; contracts governed 42 percent of production value on commercial farms, compared with 24 percent and 13 percent of production values on intermediate and rural residence farms (table 2-2). Larger commercial farms contract more; those with sales in excess of $500,000 are more likely to have a contract, and to have more of their production under contract, than those with sales less than $500,000 (table 2-3).

Large farms, which are handling rapidly growing shares of agricultural production, use contracts much more than other farms (Hoppe and Korb, 2002). Table 2-4 shows how the percentage of large farms grew in the decade between 1991 and 2001.[3] In analyzing farm growth, it is important to adjust for overall inflation, which will increase receipts through price increases even if physical outputs remain unchanged. We accordingly adjusted farm sales for price changes using the Producer Price Index for farm products (which is also the USDA/NASS index of prices received by farmers), and sales values are thus expressed in constant (2001) dollars.

[2] ARMS survey definitions match our contract definitions in section 1, in that marketing contracts are agreements reached prior to harvest or normal marketing of a commodity. Under our definition, agreements after harvest to market commodities in storage are not marketing contracts.

[3] Data from annual Farm Costs and Returns Surveys (FCRS) and ARMS are grouped into several years to ease exposition.

Panel A of table 2-4 reports the distribution of farm numbers by farm sales class, while panel B shows how farm production is distributed. A farm with $1 million in gross sales is a relatively large farm, but it is still a small business by most standards of business size, typically owned and operated by a farm family and providing employment for a few people. While most farms are small, the percentage of very large farms is growing quite rapidly—the

Table 2-2—Production and marketing contracts by farm type, 2001

Farm and production values	All farms, 48 States	Rural residence farms	Intermediate farms	Commercial farms
	Contract share within each category (percent)			
Farms with contracts	11.0	3.6	16.0	41.7
Production value under contract	36.4	13.3	24.2	42.2
	Share of each category in all contracts (percent)			
Farms with contracts	100.0	19.6	44.6	35.8
Production value under contract	100.0	2.3	14.4	83.2

Source: 2001 USDA Agricultural Resource Management Survey.

Table 2-3—Contracting among commercial farms, 2001

Farm size (gross sales)	Farms with contracts	Value of production under contract
	Percent	
Less than $250,000	7.7	19.1
$250,000-$499,999	47.9	31.2
$500,000-$999,999	60.9	45.7
$1,000,000 or more	61.5	46.6

Source: 2001 USDA Agricultural Resource Management Survey.

Table 2-4—Changes in the size distribution of U.S. farms, 1991-2001

Farm size (gross sales)	1991-93	1994-95	1996-97	1998-2000	2001
	A. Percent distribution of farms				
Less than $250,000	94.3	93.8	93.2	92.7	92.7
$250,000-$499,999	3.7	3.7	4.1	4.1	4.0
$500,000-$999,999	1.4	1.5	1.7	2.0	2.2
$1,000,000 or more	0.6	0.9	0.9	1.2	1.2
	B. Distribution of value of production				
Less than $250,000	43.8	40.7	38.4	31.4	28.3
$250,000-$499,999	17.2	16.0	18.1	15.6	14.3
$500,000-$999,999	13.0	13.8	15.2	15.4	15.8
$1,000,000 or more	26.0	29.4	28.3	37.6	41.6
	C. Distribution of value of contract production				
Less than $250,000	22.3	22.4	22.1	13.7	14.9
$250,000-$499,999	16.8	13.5	15.2	12.4	12.0
$500,000-$999,999	17.6	29.5	20.9	19.3	20.1
$1,000,000 or more	43.3	44.6	41.8	54.7	53.0

Source: 1991-2001 USDA Farm Costs and Returns Surveys/Agricultural Resource Management Surveys.

share of those with production of at least $1 million, in 2001 dollars, doubled by the end of the decade. In turn, farms with annual production below $250,000 accounted for a sharply declining share of total production, while those with $1 million or more in sales (2001 dollars) increased their share from 26 percent in 1991-93 to almost 42 percent by 2001. (Since the aggregate number of farms remained fairly stable over time, the percentage growth in the number of large farms matched the growth in their share.) Finally, panel C, reporting on the distribution of contract production, shows that more than half originated on farms with more than $1 million in sales in 2001.

Contracts Cover a Growing Share of Agricultural Production

Figure 2-1 shows the growth of contracting since 1969. Recall that overall, few farms use contracts, and the share of farms using them grew much more slowly than the amount of production under contract, from 6 percent of farms in 1969 to 11 percent in 2001. Contracts covered a growing share of the value of production in agriculture, rising from 12 percent in 1969, to 28 percent in 1991 and 36 percent in 2001. Likewise, Census of Agriculture surveys (fig. 2-2) show that production contract coverage grew from 10 percent of the value of production in 1978 to 16 percent in 2001. The data in figures 2-1 and 2-2 are combined from different surveys, but the trends are consistent within a comparable survey of production contracts, in the *Agricultural Economics and Land Ownership Surveys* (AELOS) of the Census of Agriculture. The AELOS surveys report that contractors' share of the value of production under production contracts grew from 8 percent in 1979 to 11 percent in 1988 and 14 percent in 1999. The contractors' share is measured by subtracting payments to contract growers from the value of production under production contracts. In short, data from several different sources show that contracting has covered a steadily growing share of agricultural production since 1969.

Figure 2-1
Growth in contracting

Sources: U.S Department of Commerce, Agricultural Census, 1979; Farm Finance Survey, 1988; Agricultural Economics Land Ownership Survey, 2001; USDA, Agricultural Resource Management Survey. See appendix, "Data on Agricultural Contracts," for details.

Figure 2-2

Growth in production contracting, 1978-2001

Sources: U.S. Department of Commerce, Agricultural Census; 1979; Farm Finance Survey, 1988; Agricultural Economics Land Ownership Survey, 2001; USDA, Agricultural Resource Management Survey. See appendix, "Data on Agricultural Contracts," for details.

Table 2-5 summarizes developments in the percentages of farms using contracts, and the share of the value of production under contract to total production value from 1991 to 2001. In order to focus on trends, we present data for groups of years, drawn from random samples of farms. The share of farms with contracts fluctuates from year to year but shows no apparent trend; we can say that between 2 and 2.5 percent of farms use production contracts, 8-11 percent use marketing contracts, and 10-13 percent use either or both types of contracts.

In contrast, the share of the value of production under contracts shows a pronounced upward trend, from 29 percent of production value in the early 1990s to 36 percent in 2001 (table 2-5). The estimates of contracting's share can vary from year to year because of sampling variability and changes in commodity prices, but the upward trend is clear. The most noticeable trend in the decade occurred in livestock production contracts, which accounted for 11 percent of the value of livestock production in 1991-93 and almost 15 percent in 2001.

The estimated growth rate of contracting's share of the value of production was 3 percent per year, an estimate that was statistically significant at a 95-percent confidence level.[4] Production contracts grew quite rapidly, at 4 percent per year, while marketing contract coverage grew at about 2.2 percent per year. The analysis suggests that the growth in contracting was statistically significant, and the magnitude of the estimated decade-long change (3 percent per year for 10 years) was also substantial.

Our aggregated data show that contracts cover a growing share of agricultural production, and the rate of increase appears to be fairly steady over time. But the aggregated data conceal sharp and dramatic changes in some sectors, such as hog production and tobacco marketing, where contracting rapidly became the primary method of organizing transactions.

[4] Since the data in table 2-5 are drawn from random samples of farms and not from a census of all farms, the shares are estimates. We tested for the statistical significance of the growth in contract coverage over 1991-2001, with the use of a log linear regression, in C=a + b*T, where C is the share of production under contract in each year and T is a time index (1 for 1991, and adding 1 for each successive year).

Table 2-5—Share of farms using contract and share of value of production for selected years

Item	1991-93	1994-95	1996-97	1998-2000	2001
	Percent of farms or value of production				
Share of farms with contracts:					
Any contracts	10.1	13.0	12.1	10.6	11.0
Marketing contracts	8.2	10.8	10.2	8.4	9.1
Crop	6.6	8.0	8.3	6.5	7.2
Livestock	1.6	3.0	2.0	2.0	1.9
Production contracts	2.1	2.4	2.2	2.5	2.4
Crop	0.6	0.7	0.6	0.6	0.5
Livestock	1.6	1.7	1.6	1.9	1.8
Share of production value under contract:					
Any contract	28.9	34.2	32.1	37.3	36.4
Marketing contract	17.0	21.2	21.5	20.4	20.3
Crop	11.0	12.2	12.2	11.3	11.8
Livestock	6.0	8.9	9.2	9.1	8.5
Production contract	11.8	13.0	10.6	16.9	16.0
Crop	0.9	1.0	*1.0	*2.1	*1.4
Livestock	10.9	12.1	9.6	14.7	14.6
Share of farms with production contracts, by farm size:					
$249,999 or less	1.2	1.5	1.2	1.2	0.8
$250,000 to $499,999	15.0	10.7	12.4	12.7	13.9
$500,000 to $999,999	22.5	22.1	19.8	28.1	31.4
$1,000,000 or more	17.6	26.8	23.9	31.3	29.1
Share of production value under production contract, by farm size:					
$249,999 or less	2.8	3.5	2.5	3.1	2.4
$250,000 to $499,999	12.3	9.3	9.6	9.0	10.7
$500,000 to $999,999	19.2	19.0	15.3	24.6	28.4
$1,000,000 or more	23.0	25.5	19.7	28.5	22.5
Share of farms with marketing contracts, by farm size:					
$249,999 or less	6.7	9.0	7.9	6.2	7.0
$250,000 to $499,999	29.1	36.5	39.6	35.3	36.4
$500,000 to $999,999	34.7	42.3	47.5	38.4	32.5
$1,000,000 or more	40.7	38.0	46.0	39.0	38.4
Share of production value under marketing contract, by farm size:					
$249,999 or less	11.9	15.3	15.9	13.1	16.7
$250,000 to $499,999	15.8	19.6	17.4	20.6	19.9
$500,000 to $999,999	20.0	29.3	28.9	22.2	17.8
$1,000,000 or more	25.1	26.3	27.6	25.8	23.9

Source: USDA Farm Costs and Returns Survey/Agricultural Resource Management Survey.

Spot, or cash, auction markets had been the dominant method of marketing tobacco since the 1800s. In 2001, cigarette manufacturers moved to replace auctions with contract marketing, arguing that contracts could better enable them to acquire sufficient quantities of the specific leaf qualities they require. Contracts, which covered only 9 percent of flue-cured tobacco and 28 percent of burley tobacco sales in the 2000 marketing year (ending June 2001), covered 81 percent of flue-cured tobacco in 2001 and nearly two-thirds of burley sales (Capehart, 2002).

In hog production, meatpackers acquired 87 percent of their hogs in spot markets in 1993, with 11 percent acquired through marketing contracts and 2 percent owned by packers (Hayenga, Rhodes, Grimes, and Lawrence, 1996). By 1997, spot market use had fallen by half, and spot markets governed only one-quarter of hog shipments in 2000, when half were sold through marketing contracts and another quarter were packer-owned (Lawrence and Grimes, 2001). Moreover, the shift to marketing contracts coincided with a decided shift toward the use of production contracts, under which integrators—often other hog producers—arranged for the production of market hogs, which were then transferred to slaughter facilities under marketing contracts between integrators and packers.

In each market, the shift to contracts occurred quite rapidly, raising the question of whether there are "tipping points" in marketing systems at which spot markets reach volumes too low to remain feasible. Other earlier examples involve broilers and processing vegetables—in both cases, contract use grew quite quickly and came to almost completely displace spot markets (Reimund et al, 1980). Such rapid shifts suggest that sharp change could occur in other commodities as well.

Contracts and Commodities

Contracts now cover nearly one-half of all livestock production, up from one-third in 1991-93, while they cover just over one-quarter of crop production, with no apparent trend (table 2-6). Marketing contracts are used for both crop and livestock marketing, while production contracts, common in livestock, are rarely used in crops. Contract use varies widely among more narrowly defined commodities; they dominate production and exchange relationships in poultry and eggs (88 percent of the value of production) and accounted for 61 percent of the value of hog production in 2001.[5] Contract use also varies sharply across crops, ranging from 6 percent of wheat production and more than half of fruits and cotton to almost all sugar beet production. Cotton and rice have had strong recent increases in contract incidence.

Marketing contracts are commonly used in both crops and livestock, while production contracts are used primarily in livestock and cover very small shares of crop production (table 2-7). Two livestock commodities—dairy, and poultry and eggs—account for over 40 percent of the total value of production under contract in each period under review, while livestock in total accounted for 64 percent of the value of contract production in 2001 (table 2-8).

[5] Note that spot markets do not govern the rest, since packer vertical integration covers a substantial share, estimated at one-quarter of market hogs in 2000 (Lawrence and Grimes, 2001).

Table 2-6—Share of production under any type of contract, by commodity and year

Commodity	1991-93	1994-95	1996-97	1998-2000	2001
	Percent of production under contract				
All commodities	28.9	34.2	32.1	37.3	36.4
Crops	24.7	25.8	22.9	26.7	26.2
Corn	11.4	13.9	13.0	12.9	12.8
Soybeans	10.1	10.0	13.5	10.3	8.7
Wheat	5.9	6.2	9.1	7.0	5.5
Sugar beets	91.1	83.7	75.1	89.0	95.5
Rice	19.7	25.2	25.8	30.5	38.5
Peanuts	47.5	58.3	34.2	45.1	21.2
Tobacco	0.3	0.6	0.3	1.9	48.6
Cotton	30.4	44.5	33.8	42.9	51.7
Fruit	na	64.2	56.8	65.4	59.0
Vegetables	na	55.0	38.4	39.7	36.9
Other crops	7.9	11.3	17.1	24.0	17.9
Livestock	32.8	42.9	44.8	48.0	46.8
Cattle	na	19.0	17.0	24.3	20.9
Hogs	na	31.1	34.2	55.1	60.6
Poultry and eggs	88.7	84.6	84.0	88.8	88.1
Dairy	36.8	56.7	58.2	53.6	53.1
Other livestock	0.2	9.3	4.9	10.9	9.3

na= not available.

Source: USDA Farm Costs and Returns Survey (1991-95); USDA Agricultural Resource Management Survey (1996-2001).

Table 2-7—Share of production under contract, by contract type, commodity, and year

Commodity	1991-93	1994-95	1996-97	1998-2000	2001
	Percent of production under marketing contracts				
All commodities	17.0	21.2	21.5	20.4	20.3
Crops	22.8	24.0	21.1	22.5	23.4
Corn	10.2	13.8	12.9	12.6	12.7
Soybeans	9.6	9.8	13.2	9.7	8.5
Sugar beets	88.5	83.7	74.6	83.1	93.7
Fruit	na	61.0	54.3	63.3	56.5
Vegetables	na	45.3	32.2	27.3	30.0
Other crops	6.4	10.0	13.4	15.2	12.9
Livestock	11.6	18.2	22.0	18.4	17.2
Cattle	na	4.3	5.9	4.6	3.2
Hogs	na	2.4	2.7	9.1	7.1
Poultry and eggs	5.9	3.4	4.0	3.9	6.8
Other livestock	0.1	6.8	4.9	10.6	1.6
	Percent of production under production contracts				
All commodities	11.8	13.0	10.6	16.9	16.0
Crops	1.9	1.9	1.8	4.2	2.8
Vegetables	na	9.7	6.1	12.3	6.9
Livestock	21.1	24.7	22.9	29.6	29.6
Cattle	na	14.7	11.1	19.7	17.7
Hogs	na	28.7	31.5	46.0	53.4
Poultry and eggs	82.8	81.2	80.0	84.9	81.3

Note: Estimates for marketing contracts for wheat, rice, peanuts, tobacco, cotton, and dairy are within 0.1 of the estimates for all contract types reported in table 2-6.

Source: USDA Farm Costs and Returns Survey (1991-95); USDA Agricultural Resource Management Survey (1996-2001).

Table 2-8—Share of total contract value, by commodity and year

Contract type and commodity	1991-93	1994-95	1996-97	1998-2000	2001
	Percent of all contract value				
All contracts:					
All commodities	100.0	100.0	100.0	100.0	100.0
Crops	41.5	38.5	41.3	36.0	36.4
Corn	3.5	3.9	5.1	3.1	2.8
Soybeans	2.6	2.3	4.0	2.1	1.5
Fruit	11.6	10.8	10.5	10.3	12.9
Vegetables	9.8	10.0	8.0	5.6	5.4
Livestock	58.5	61.5	58.7	64.0	63.6
Cattle	18.6	10.2	7.5	12.3	11.2
Hogs	2.8	5.7	5.0	7.7	9.8
Poultry and eggs	20.4	23.0	21.3	24.1	23.2
Dairy	16.6	22.1	24.6	19.3	19.1
Marketing contracts:					
All commodities	59.1	61.9	66.9	54.8	55.9
Crops	38.3	35.8	38.1	30.3	32.4
Corn	3.1	3.9	5.1	3.0	2.7
Soybeans	2.5	2.3	3.9	2.0	1.5
Fruit	11.2	10.2	10.1	9.9	12.3
Vegetables	8.3	8.2	6.8	3.9	4.4
Livestock	20.8	26.1	28.8	24.5	23.5
Dairy	16.5	22.1	24.5	19.2	18.7
Production contracts:					
All commodities	40.9	38.1	33.1	45.2	44.1
Crops	3.2	2.8	3.2	5.7	3.9
Vegetables	1.5	1.8	1.3	1.8	1.0
Livestock	37.8	35.4	29.9	39.5	40.2
Cattle	16.1	7.9	4.9	10.0	9.5
Hogs	2.4	5.2	4.6	6.4	8.6
Poultry and eggs	19.0	22.1	20.3	23.1	21.4

Source: USDA Farm Costs and Returns Survey (1991-95); USDA Agricultural Resource Management Survey (1996-2001).

Table 2-9 shows recent changes in contracting in hog production. In 1994-95, farms with less than $500,000 in sales accounted for just over half (54 percent) of the value of all hog production, while farms with at least $1,000,000 in sales handled 29 percent. By 2001, these large farms were handling 57 percent of all hog production, while farms with less than $500,000 in sales handled just 22 percent. Diversified farms, those that did not specialize in hog production, accounted for a noticeable share of hog production in the early 1990s (27 percent in 1994-95), but by 2001 the bulk of production was on farms that specialized primarily in hogs.

Contracting Expands Along Distinctive Regional Patterns

ARMS data suggest that contracting initially spreads among producers within a particular region and only then spreads to other regions, a pattern consistent with findings in an earlier ERS study (Reimund, Martin, and

Table 2-9—Contracting and structural change in hog production, 1991-2001

Production category	1991-93	1994-95	1996-97	1998-2000	2001
		Percent distribution of the value of contract hog production, by years			
By farm specialization:					
Hogs	82.5	98.5	90.8	95.1	96.4
Other commodity specialization	*17.5	*1.5	*9.2	4.9	*3.6
By farm size (value of production):					
$Less than $500,000	45.5	*16.7	*15.0	15.3	#8.3
$500,000 to $999,999	*31.5	*15.8	20.9	27.1	*26.5
$1,000,000 or more	*23.0	67.5	64.1	57.6	65.2
By major resource regions:					
Heartland	39.7	*31.0	38.2	58.2	54.8
Eastern Uplands	*21.6	*24.9	*6.3	*3.4	*3.3
Southern Seaboard	*26.6	*37.6	48.7	25.6	26.7
		Distribution of the value of all hog production, by year			
By farm specialization:					
Hogs	na	73.1	75.9	84.3	91.8
Other commodity specialization	na	26.9	24.1	15.7	8.2
By farm size (value of production):					
$499,999 or less	na	54.0	43.5	34.2	21.5
$500,000 to $999,999	na	16.7	16.6	23.3	21.4
$1,000,000 or more	na	29.2	39.9	42.5	57.2
By resource region:					
Heartland	na	60.3	60.7	66.3	54.4
Eastern Uplands	na	*8.9	*3.8	*3.0	*2.8
Southern Seaboard	na	*13.9	18.3	15.2	*16.6

Coefficient of Variation = (Standard Error/Estimate) x 100. * indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is greater than 50 and less than or equal to 75. na indicates value is not available due to no observations, an undefined statistic, or reliability concerns.
Rounded percents may not add precisely to 100.

Source: USDA Farm Costs and Returns Survey/Agricultural Resource Management Survey.

Moore, 1980). Figure 2-4 depicts this process, capturing developments in selected regions in the 1990s (ERS regions are described in figure 2-3). The figure displays four commodities with sharp recent increases in contracting—cotton, rice, tobacco, and hogs.

Beginning with hog production, contracting emerged initially in the Southern Seaboard, particularly in North Carolina during the late 1980s and the 1990s. Figure 2-4 shows the dramatic later spread of hog contracting throughout the Heartland, where contracts covered 60 percent of hog production (by value) in 2001, up from 20 percent only 5 years before.

Note also the rapid spread of contracting in two Mississippi Portal region crops, cotton and rice. There, contracts covered one-half of cotton produc-

Figure 2-3

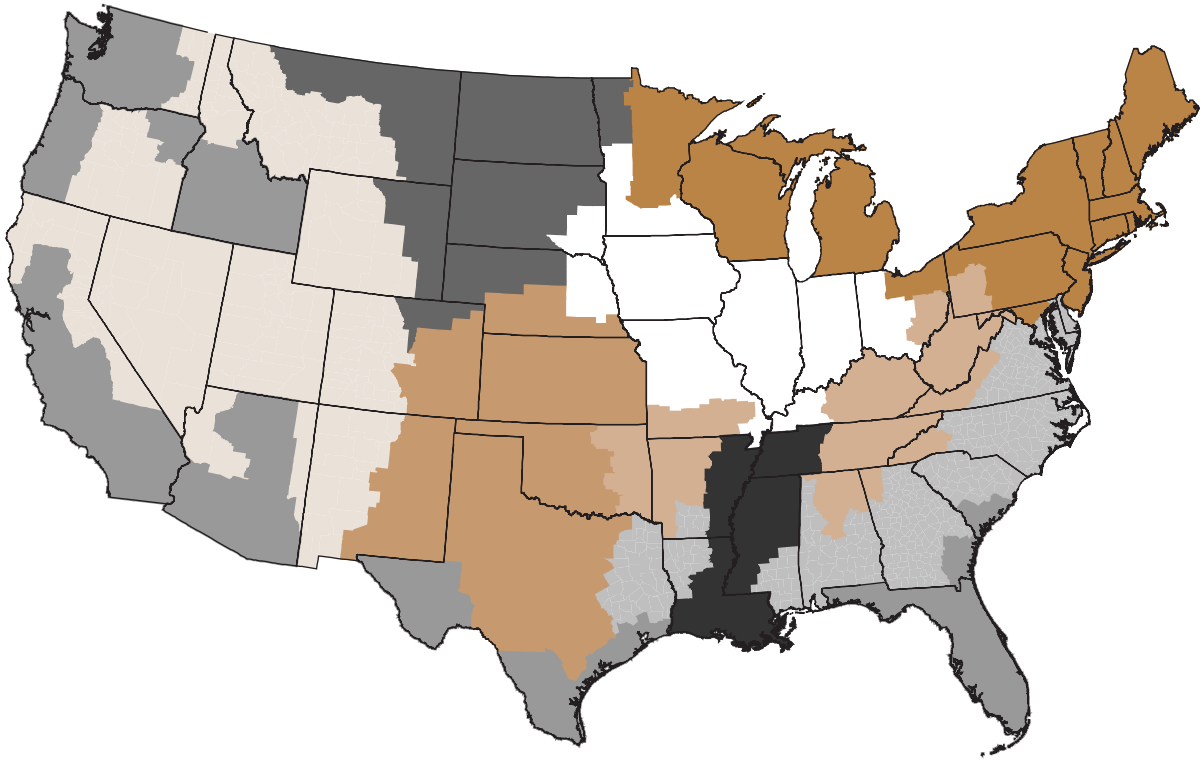
Farm Resource Regions

Basin and Range
- Largest share of nonfamily farms, smallest share of U.S. cropland.
- 4% of farms, 4% of value of production, 4% of cropland.
- Cattle, wheat, and sorghum farms.

Northern Great Plains
- Largest farms and smallest population.
- 5% of farms, 6% of production value, 17% of cropland.
- Wheat, cattle, sheep farms.

Heartland
- Most farms (22%), highest value of production (23%), and most cropland (27%).
- Cash grain and cattle farms.

Northern Crescent
- Most populous region.
- 15% of farms, 15% of value of production, 9% of cropland.
- Dairy, general crop, and cash grain farms.



Fruitful Rim
- Largest share of large and very large family farms and nonfamily farms.
- 10% of farms, 22% of production value, 8% of cropland.
- Fruit, vegetable, nursery, and cotton farms.

Prairie Gateway
- Second in wheat, oat, barley, rice, and cotton production.
- 13% of farms, 12% of production value, 17% of cropland.
- Cattle, wheat, sorghum, cotton, and rice farms.

Mississippi Portal
- Higher proportions of both small and larger farms than elsewhere.
- 5% of farms, 4% of value, 5% of cropland.
- Cotton, rice, poultry, and hog farms.

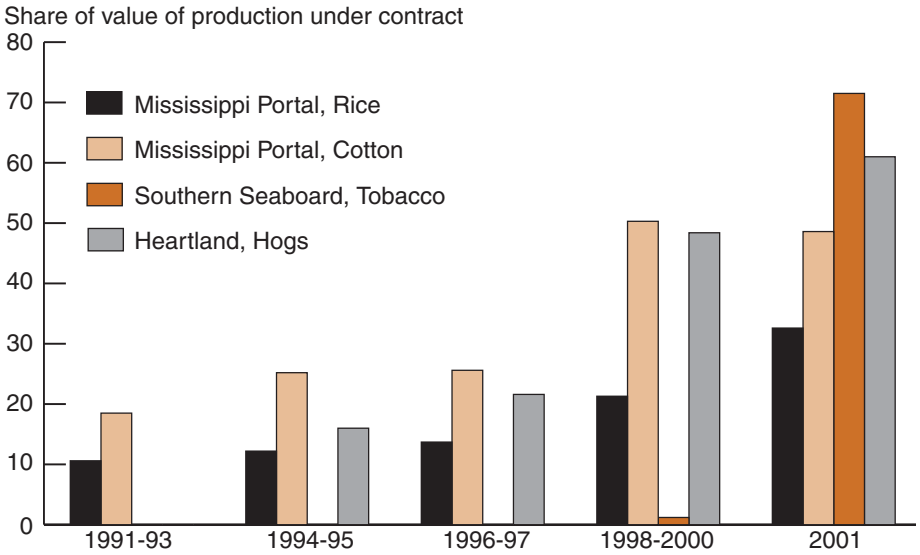
Southern Seaboard
- Mix of small and larger farms.
- 11% of farms, 9% of production value, 6% of cropland.
- Part-time cattle, general field crop, and poultry farms.

Eastern Uplands
- Most small farms of any region.
- 15% of farms, 5% of production value, and 6% of cropland.
- Part-time cattle, tobacco, and poultry farms.

tion and one-third of rice production in 2001, up from one-fifth and one-tenth a decade before. In each instance, contracting spread more rapidly in the Mississippi Portal in the 1990s, catching up to earlier spreads in other regions. Finally, figure 2-4 displays the dramatic recent change in tobacco contracting in the Southern Seaboard. Because of the sharp expansion in contracting for hogs, rice, cotton, and tobacco, contracting as a whole spread more widely in the Heartland, Mississippi Portal, and Southern Seaboard regions than in the rest of the country (fig. 2-5 and table 2-10).

Figure 2-4

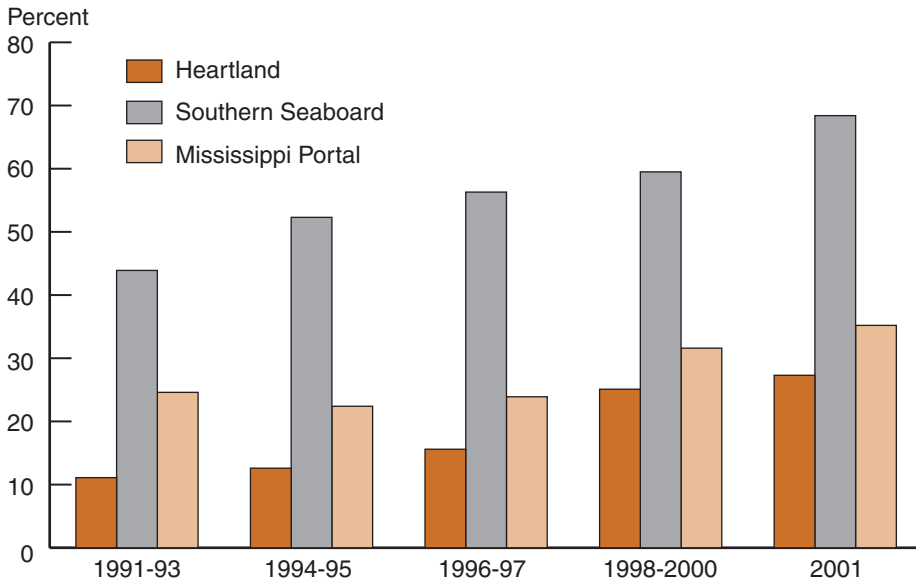
Contracting grew sharply among some regions and commodities in 1991-2001



Source: USDA Farm Costs and Returns Survey/Agricultural Resource Management Survey.

Figure 2-5

Contracting covered a growing share of the value of production in three regions



Source: USDA Farm Costs and Returns Survey/Agricultural Resource Management Survey.

Table 2-10—Share of value of production under contract by resource region for selected years

Contract type and region	1991-93	1994-95	1996-97	1998-2000	2001
			Percent		
Share of production value under any contract, by resource region:					
Heartland	11.1	12.6	15.6	25.1	27.3
Northern Crescent	17.4	34.0	29.5	32.6	32.6
Northern Great Plains	*22.7	14.8	15.7	26.3	*25.1
Prairie Gateway	29.3	33.6	*26.2	36.6	28.9
Eastern Uplands	40.4	57.7	45.6	45.6	46.8
Southern Seaboard	43.9	52.3	56.3	59.5	68.4
Fruitful Rim	49.4	52.7	47.1	47.1	40.5
Basin and Range	28.1	20.0	37.9	*32.2	*30.5
Mississippi Portal	24.6	22.4	23.9	31.6	35.2
Share of production value under production contract, by resource region:					
Heartland	4.7	4.8	6.2	16.6	18.4
Northern Crescent	3.6	3.2	*4.7	6.6	*6.9
Northern Great Plains	#13.1	*1.8	*2.5	*8.9	#13.7
Prairie Gateway	22.3	*20.7	*10.8	22.3	*16.8
Eastern Uplands	31.2	50.3	34.1	34.0	41.7
Southern Seaboard	32.4	39.1	45.1	50.0	52.9
Fruitful Rim	5.0	3.8	3.0	4.7	3.2
Basin and Range	*2.8	*2.1	*1.4	a11.1	a1.9
Mississippi Portal	*14.0	*10.9	*5.7	12.9	*16.2
Share of production value under marketing contract, by resource region:					
Heartland	6.4	7.8	9.5	8.5	9.0
Northern Crescent	13.8	30.8	24.8	26.0	25.7
Northern Great Plains	9.6	13.0	13.2	17.4	#11.3
Prairie Gateway	7.0	12.9	15.4	14.3	12.1
Eastern Uplands	9.3	7.4	*11.6	*11.6	*5.1
Southern Seaboard	11.4	13.2	11.2	9.5	15.6
Fruitful Rim	44.3	48.9	44.1	42.4	37.3
Basin and Range	25.3	17.9	36.5	21.1	*28.5
Mississippi Portal	10.6	11.5	18.2	18.8	19.0

Coefficient of Variation = (Standard Error/Estimate) x 100. *indicates that CV is greater than 25 and less than or equal to 50. # indicates that CV is greater than 50 and less than or equal to 75. a indicates that CV is above 75.

Source: USDA Farm Costs and Returns Survey/Agricultural Resource Management Survey.

Prices and Terms in Marketing and Production Contracts

We use 2001 ARMS data to assess prices and nonprice terms in marketing and production contracts. Marketing contract information is summarized for five selected field crops—corn, cotton, rice, soybeans, and wheat (each had significant volumes produced under both spot markets and contracts, as well as at least 30 observations with useful contract data in ARMS).

Average contract prices, as well as interquartile ranges (a measure of the dispersion of contract prices) are reported in table 2-11. For comparison, we

Table 2-11—Characteristics of marketing contracts for field crops in 2001

Contract characteristics	Corn, for grain	Upland cotton	Rice	Soybeans	Winter wheat
Price and quantity basis	Bu.	Lb.	Bu.	Bu.	Bu.
			Dollars		
Prices:					
USDA/NASS mean, all sales	1.89	0.40	2.30	4.37	2.77
Contract mean	2.13	0.43	2.91	4.82	2.96
Contract 25th percentile	2.00	0.34	1.84	4.25	2.35
Contract 75th percentile	2.25	0.52	3.70	5.00	3.04
			Quantities		
Contract quantities:					
Contract median	9,161	105,000	36,350	5,000	5,000
Contract 25th percentile	5,000	15,840	26,100	2,020	2,200
Contract 75th percentile	21,000	310,949	68,600	10,000	10,000
			Percent		
Contract terms (% of contracts):					
Length 12 months or more	18.0	72.9	70.1	23.8	27.5
Confidentiality clause	16.3	10.2	36.2	17.9	8.0
No open market alternative	7.2	33.9	15.6	7.1	10.9

Source: Data derived from the 2001 ARMS. USDA/NASS average price is weighted average based on USDA/NASS prices received, by State.

also report USDA/NASS marketing-year average prices, which are calculated across all sales (contracts and spot market transactions). One pattern stands out: average contract prices exceed USDA/NASS prices in each commodity, and the differences can be large, ranging from 6.8 percent of the USDA/NASS price (winter wheat) to 26.5 percent (rice).

However, reported contract prices also vary widely, with substantial ranges between relatively low (25th percentile) and relatively high (75th percentile) contract prices. The 25th percentile price is the one at which 25 percent of sample prices are lower and 75 percent are higher; similarly, 75 percent of prices are below the 75th percentile price. In four of the five commodities, the USDA/NASS average price substantially exceeds the 25th percentile contract price. Variations in contract prices likely reflect differences in contract terms that affect costs like delivery, storage, and transportation, differences in precise product characteristics stimulated by the contract; and differences in delivery times. Contracts may also more closely tie prices to commodity attributes, and hence reward producers who can deliver those attributes and penalize those who do not.

Next, note the range of contract quantities in the second panel of table 2-11. Farmers who contract for a crop usually only contract for part of it, but the small quantities covered by many contracts is still quite striking. Twenty-five percent of corn contracts are for 5,000 bushels or less; at yields of 140 bushels an acre (the 2001 U.S. average was 138), that is only 35 acres, while the corn bushels covered at the 75th percentile of contract quantities could require about 150 acres. Contract acreage implied by the quantities in wheat and soybean contracts are somewhat larger—45 to 50 acres at the 25th percentile and 225 to 250 acres at the 75th, while at the 75th percentile

rice and cotton quantities would need 450 to 500 acres, again based on U.S. average yields. Producers of field crops often use contracts as one element in an overall marketing strategy that also includes spot market sales and hedging, and hence contract only a share of their crops.

Finally, we also report on the presence of nonprice terms, in the bottom panel of table 2-11. Contracts in cotton and rice usually specify lengths of a year or more, while contracts in corn, wheat, and soybeans appear to be much shorter. Cotton and rice contract growers appear more likely to report no spot market alternatives for their crops.

Table 2-12 reports on production contracts for broilers and market hogs (each had at least 30 observations on contracts with a common pricing basis). Just as in marketing contracts, production contracts show a wide range of fees paid for the farmer's services. Twenty-five percent of contract broiler producers received fees of at least 26 cents a head, while another 25 percent received fees of no more than 16 cents a head, and contract hog producers received nearly as wide a range of fees. Some of the variation is likely due to differences in producer costs under different contracts. Farmers pay for transportation under some contracts but not others, and some contracts may require significant investments in equipment and structures. Note that most broiler contracts call for some specified investments in equipment or structures, but the precise nature of those investments can vary. Moreover, some broiler contracts may be for larger (roaster) birds, which require a longer growing period and hence more effort by the grower. Finally, many broiler contracts also contain relative performance payment schemes, in which grower fees paid depend in part on a grower's performance in transforming feed into meat, relative to a peer group of growers.

In general, fees paid to contract growers are fractions of estimated livestock market values. According to USDA statistics, the average price for market

Table 2-12—Characteristics of livestock production contracts in 2001

Contract characteristics	Broilers	Market hogs
	$ per head	
Contract fees:		
Mean	0.23	10.71
25th percentile	0.16	9.50
75th percentile	0.26	12.50
	Head (number)	
Contract quantities:		
25th percentile	214,281	1,700
Median	336,000	5,483
75th percentile	516,000	13,000
	Percent of contracts	
Contract terms:		
Length less than 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.

hogs in 2001 was $44.30 per hundredweight, which would imply an average market value of $110.75 for a 250-pound market hog. The average fee reported in table 2-10 was $10.71 a head. Similarly, the average broiler market value in 2001 was $1.99, with an average grower fee of 24 cents. Those statistics, based on farm-level ARMS data, suggest that contract producers' fee payments were 10-12 percent of the value of production. This broadly accords with aggregated data in the Census of Agriculture, where operators with production contracts received payments equal to 16.5 percent of the value of production under all production contracts in 1999.[6] Farmers with production contracts provide labor, energy, and capital, while contractors commonly provide feed, veterinary services, and breeding services. Since feed accounts for a large share of total livestock and poultry production costs, growers typically bear a small share of total costs.

[6] The Census of Agriculture data are from the 1999 Agricultural Economics and Land Ownership Survey (AELOS).

We also report on typical contract quantities in table 2-12. In contrast to producers who use crop marketing contracts, contract livestock growers usually place all of their hogs or broilers under a contract. Median annual production contract quantities are 336,000 broilers and almost 5,500 hogs, with substantial ranges around those values. Finally, table 2-10 reports some striking differences in contract length between hog and broiler contracts. More than half of all contract broiler growers report that their contracts have either a very short length or no specified length at all, in contrast to just one-sixth of hog producers. Growers make similar long-term investments in structures and equipment in each case, and we would expect contracts to cover the expected economic life of the investments.

Contracts Cover a Growing Share of Production

The patterns we have been describing lead to a set of questions about how and why contracting spreads. Few farms use production and marketing contracts, because most farms are very small and large farms are far more likely to use contracts. However, because recent changes in agricultural producion include a shift toward large farms, contracts cover a steadily growing share of agricultural production. Why are large farms more likely to use contracts, and why is production shifting to contracts and to larger farms?

Farm size is not the sole factor determining contract use, which varies widely among different commodities and can vary for the same commodity across regions. Why would commodity or regional characteristics affect contracting, and which characteristics favor contracting?

Contracts and spot markets are not the only alternatives—contract production coexists with vertical integration in some commodities, and vertical integration coexists with spot markets in others. Why would market participants choose one mechanism to access the market over the other?

Shifts to contracting can occur quite suddenly in some commodities. Why do these rapid shifts occur? Finally, prices and associated contract terms can vary widely across contract growers of a particular commodity. What commonalities among commodities lead to contracting?

Chapter 3

Why Use Contracts? The Economics of Contracts

Why would farmers and their buyers shift to contracts from spot markets? Agricultural product prices traditionally were—and for many products still are—determined in open spot markets, either in direct negotiation between individual buyers and sellers or in public auctions (including, these days, satellite and Internet auctions), based on attributes observable in the live animal or harvested product. Transaction terms such as prices, locations, some product attributes, and times of sale and delivery are accessible and easy to record, and information based on them can be easily disseminated to all market participants.

Accurate and widely available market information coordinates supply chains that are based on spot markets. Accurately reported information should cause prices in similar transactions to converge to a common "market price" as buyers avoid paying exceptionally high prices and sellers do not accept exceptionally low ones. Then reliable market price information will provide important signals such as cost and value differences, regional price differences, and quantities available to buyers and sellers. Prices should be flexible, in the sense that they respond quickly and accurately to underlying changes in market conditions, and reported price information should quickly reflect actual price changes.

Effective vertical coordination through spot markets achieves several goals. For consumers, accurate market prices signal the degree of product scarcity, inducing greater consumption of products in oversupply and limiting consumption of scarce products. Accurate prices will also stimulate production of product attributes that consumers prefer. For sellers, accurate market prices provide signals of buyer preferences and will elicit flows of inputs and services. Combined with competition among providers, accurate market prices will give strong profit incentives to firms to find ways to reduce costs and improve productivity through innovation.

How Can Spot Markets Go Wrong?

Traditional spot market pricing systems can become ineffective at providing appropriate signals to producers and consumers. Spot markets will fail to respond to changes in consumer demand if prices do not reflect the attributes of products that consumers prefer. For example, some observers of the beef industry argue that spot market beef pricing systems failed to accurately reflect consumer preferences for taste and tenderness, and hence producers were not rewarded for producing desired products or penalized for producing inferior ones. Since desired products cost more, producers had no price incentives to produce the desired attributes (Purcell, 2002; Ward, 2001). If production is to be driven by product attributes that cannot be accurately priced, a different coordination system is needed, one provided by contracting and vertical integration.

To work well, spot markets also require competition, in the form of many buyers and sellers. An increasing number of agricultural markets are marked by limited competition and relatively few buyers, due to economies of scale in processing (cost advantage to large size), and sometimes because of increased demand for distinctive agricultural products (creating a niche market for the product). Farmers may often be reluctant to commit to investing in land and assets if that investment would leave them dependent on a single buyer.

Why Shift to Contracts?

Two broad approaches dominate economists' thinking on the choice between spot markets and contracts. One, the *risk-sharing* approach, sees contracts as a device used to limit the economic risks faced by farmers. Farmers may face input and output price fluctuations in spot markets, along with the risk of poor production. Such risks may raise farm costs and inhibit production. In contrast, the *transactions* cost approach emphasizes the costs of using spot markets to arrange transactions and sees contracts as a device that can reduce those costs. Parties will rely on contracts when the transactions costs of using contracts fall below the costs of using spot markets. The two approaches are not mutually exclusive, although economic analyses frequently emphasize one or the other.

Contracts Share Risk and Provide Incentives

Income from farming is risky because it depends on prices and output that may fluctuate widely and are difficult to forecast with accuracy. Risks matter for several reasons. First, some farmers may dislike income fluctuations. Second, risk can impose costs: when income is variable and uncertain, farmers may find it difficult to meet recurring financial obligations or to plan production and investment decisions. When farmers as a group try to avert risks by modifying production practices—changing their use of inputs such as pesticides or fertilizer, or altering cropping patterns—they affect prices, incomes, and input usage patterns.[1]

Our analyses focus on two sources of income risk: *yield (or production)* risk and *price* risk. *Yield risks* for crops result from unpredictable events such as drought, frost, hail, and insect infestations, while livestock production risks can arise from disease, feed supply shortages, extreme temperatures, or machinery malfunctions. Yield risks can be common, affecting a large region or group of producers, or *idiosyncratic*, affecting only one or a few farmers.

Price risks arise from unanticipated changes in output or input prices. Agricultural prices often fluctuate widely because of unexpected changes in production or demand in market environments in which supply and demand are insensitive to price movements. Such market insensitivity is frequent in agriculture because agricultural commodity costs form small shares of processed food costs and because farmers have limited ability to adjust to changes in price after they have planted their crops or sunk resources into production.

[1] See Chavas and Holt, 1990; Leathers and Quiggin, 1991; Loehman and Nelson, 1992; Pope and Kramer, 1979; Roberts and Key, 2002.

Farmers who are averse to risks may be willing to pay a price or forego some income in order to reduce their risks. The amount of income they would be willing to give up would measure the degree of their aversion to risk. Risk-sharing explanations for contracts begin with three propositions: (1) farmers are exposed to significant risks; (2) many are risk-averse and are willing to pay, explicitly or implicitly, to reduce risks; and (3) farmers' exposure to risks can often be reduced, thereby creating a market for risk reduction.

Contracts are one technique by which processors can share risk with farmers by shifting risk to the party better able to bear it—in this case, from the farmer to the buyer of the agricultural commodity. Buyers are not necessarily more risk-averse than farmers, but they are frequently less exposed; they may get products from many different regions, and diversifying their supply may reduce their overall risks. Buyers may also produce a variety of products sold in many markets, and product diversification may also limit their exposure to risks. When buyers are large public corporations, their stockholders usually have highly diversified portfolios and are not significantly affected by the actions of the large corporate buyer. In contrast, farmers are usually able to obtain only limited diversification of the farm's business. With most of their wealth tied to the farm, they face greater risk than many buyers and have reason to be more cautious.

Contracts designed solely to limit farmers' risk exposure can remove farmer incentives to undertake good management practices, and can therefore lead to higher total costs. For example, a hog contract may specify that the processor pay the farmer a fixed fee for each hog delivered. Under such a contract, the processor bears all the price risk, and from a risk-sharing perspective this is ideal since the processor may be better positioned to manage risks. Once the contract is signed, will the farmer use the best practices and carefully raise the hogs, producing the quantity and quality of pork that is best for the processor? Possibly, but since the price is set and no longer depends on the farmer's best effort, he or she may decide to cut corners by using fewer or lower quality inputs when raising the hogs. In order to prevent "shirking" by a farmer, contracts will shift some—but not all—of the risk by making the farmer's payment depend in part on effort, thereby retaining incentives for efficiency.

Contracts can be designed to limit farmers' exposure to risks, but contracts will pay for shifting risks to contractors by providing farmers with lower prices. If risk-sharing were the primary reason to use contracts, we would expect farmers using contracts to generally receive lower prices. However, average contract prices reported in the previous section systematically exceed nationwide average prices for the same crops, which suggests that risk-sharing may not be the primary force driving the use of contracts.

Contracts Reduce Transactions Costs in Some Spot Markets

Several types of transactions costs arise in regard to agricultural contracting, and two perspectives are relevant to this discussion. The first relates to the ideas of *asset specificity* and *holdup* (Williamson, 1975; Hart, 1995). The

second relates to the costs of *measuring and monitoring* market transactions (Allen and Lueck, 2003; Barzel, 1982).

Asset Specificity and Holdup

According to Williamson (1985), asset specificity refers to durable investments that are undertaken in support of particular transactions. The specificity arises when assets are much less useful, and hence less valuable, in any use other than the one they were designed for; that is, redeployment is quite costly. For example, specialized broiler houses offer optimal growing conditions and are designed to facilitate feed delivery, regulate temperature through ventilation and cooling systems, and incorporate specific feed and water delivery systems. Costly equipment designed for broiler production is much less valuable when redeployed to another use. Moreover, the equipment may be designed to a particular processor's specifications.

The broiler house example captures two elements of asset specificity—physical asset specificity and site specificity. Physical asset specificity arises because the asset is dedicated to a particular use, such as raising broilers, and is far less valuable in uses like equipment storage. By itself, such specificity may not create problems if there are many potential buyers for broilers, because the physical assets could be redeployed to transactions with other broiler buyers. Site specificity arises because chickens cannot be shipped far before losing value, due to both direct costs of transport and extra feed and indirect costs from the birds losing value due to stress-related weight loss or death during transport, or to aging during additional feeding. Therefore, the asset is most valuable when used in production for nearby buyers. In this case, the two forms of asset specificity, site and physical, tie the farmer to only a few potential buyers.

In another example, sugar beet production requires highly specialized harvesting equipment and extensive investment in seed beds, constituting physical asset specificity. While sugar beets can be transported further than live poultry without losing value, transport costs—and site specificity—are still significant. Sugar in beets starts converting to starch quickly after harvest and the investment is most valuable when committed to a nearby processor.

Once a farmer makes a costly investment specific to transactions with one or a few buyers, there is potential for "holdup." When it is costly to ship agricultural products very far, processing plants will locate in farm regions. If there are also economies of scale in processing (so that larger plants realize lower processing costs), one or a few processing plants will be enough to handle all local production, leaving farmers with just a few buyers.

When the farmer harvests and attempts to sell in a spot market, a processor can attempt to force very low prices on the farmer—the holdup in this case refers to the processor holding up the farmer for a lower price. The sugar beet farmer would have few alternatives because of the costs of distant transport, as would the poultry grower, for whom it is costly to ship the birds very far or to keep them on feed.

However, asset and site specificity also create a risk for the processor in a spot market. In spot markets, farmers may not make the investments in

specific assets that could reduce production expenses and raise quality if those investments leave the farmer dependent on the good will of a single buyer. In that case, spot markets can fail, in that they do not elicit the investments in technology and expertise that will reduce costs and improve product qualities.

Contracts can relieve the failure of spot markets. By using a contract to specify a compensation scheme with the processor before making an investment, the farmer can eliminate the risk of holdup. Indeed, in some cases, processors may directly finance farmer investments through the contract. By offering contracts, the processor can obtain investment commitments from farmers and assure the commodity supply needed to support an expensive investment in processing facilities. Contracts limit the incentives, inherent in these spot markets, to forego substantial long- term gains in favor of fleeting short-term advantages.

The concept of asset specificity also encompasses temporal specificity with regard to perishable commodities in cases where a farmer's production loses substantial value if sold earlier or later. For instance, a grower may produce a commodity for a particular shipper, one that meets specific quality standards or requirements. After harvest, a shipper in a spot market transaction may attempt to pay an extremely low price, knowing that the grower has no immediate alternatives. Unless there is another buyer nearby, ready to buy the specific product, the grower may realize a loss. Without a contract, the grower may therefore choose to produce a less-specialized and more widely marketable commodity instead of the specific and differentiated product. In this case, a contract, by shielding the grower from the chance of holdup, may be necessary to elicit grower commitments to produce the product.

Costs of Search, Measurement, and Monitoring

Information costs often arise in market transactions; they include the *search cost* of finding a buyer and a seller in the transaction, the *measurement cost* of determining product quality (Allen and Lueck, 2003), and the *monitoring cost* of ensuring that all terms of a transaction are met (including quality and quantity specifications, delivery terms, and payment). For example, some processors and other handlers face the challenge of securing the required quality and variety of products within precise timeframes to regulate the flow of a product into processing plants. A processor of organic tomatoes might aim to can tomatoes within 8 hours of picking, or a fresh produce shipper could seek to provide lettuce and tomatoes of specific qualities throughout the year to meet retailer requirements. In these instances, buyers aim to carefully track and control the timing of product flows through the system.

Transactions also require accurate information to identify product attributes if farmer compensation is to be linked to attributes. For example, processors of vegetables and fruits and manufacturers of cigarettes require commodities with specific qualities and varieties, which vary by processor. Processors can secure the needed qualities and varieties through spot markets if effective measurement technologies and widely understood metrics exist. For example, the key distinctive attributes in high-protein soybeans, high-protein

wheat, and high-starch corn can all be precisely measured with near-infrared measurement technology. But quality measurement may be quite difficult, especially for perishable products and if a processor requires that the product have unusual attributes.

As a result, most fresh-market lettuce and virtually all processed vegetables are grown under contracts specifying a coordinated production process. These contracts typically specify seed stock, fertilizer and chemical inputs, and product qualities; the contractor may even provide these inputs to the farmer. In addition, the contractor might monitor crop development and production processes through field visits. For lettuce sold under contract, the buying firm typically harvests, packs, and markets the crop, and frequently performs post-harvest laboratory tests on the crop to ensure that specific production practices were followed.

Sellers of specialty meat products often use contracts to ensure consistent quality. For example, a small processor of smoked pork and bacon products controls product flows and quality by contracting for pork bellies from hogs raised to its specifications in Canada and the Upper Midwest (Apple, 2000). The contracts specify precise feed rations and slaughter weights to ensure the desired taste attributes, rather than relying on post-slaughter testing.

Contracts may help firms procure specific attributes by precisely setting forth production, harvest, and/or marketing practices, and providing for onsite monitoring and advice. Initial grower recruitment can be done through farm inspections. Processors then obtain attribute certification through contractual control of practices; in contrast, certification in spot markets relies on post-harvest testing and measurement.

Buyers are increasingly interested in identity-preserved products, such as organically produced commodities or specialty grains, with specific attributes that are kept segregated throughout the marketing chain. Identity preservation requires substantial investments in testing, monitoring, and physical separation. Contracts may reduce those costs by controlling production and harvesting practices and by requiring investments in information and measuring at the stages where they are most effective. Again, attribute certification would be met through contractual control and onsite inspection of practices, rather than through information and warranties from the producer.

Costs of Using Contracts

Contracting provides benefits, but it also carries costs that may often leave spot markets as the best way to organize transactions. That is, market participants may choose among spot markets, contracts, and vertical integration, depending on which is the most effective means of governing any particular set of transactions.

Contracts often limit farmers' control over the farm business with production contracts that prescribe detailed guidelines for inputs and practices imposing the greatest limits. Because many farmers value their autonomy, contractors may have to compensate them for the loss of control implicit in contracting, thereby raising the costs of contract production (Key, 2004).

More generally, contracts are costly to write and to monitor and enforce. It may only make sense for a buyer to use a contract if the buyer is planning to acquire significant volumes of the product—that is, the costs of writing contracts may limit their use among small and dispersed producers (Lambert and Wilson, 2003).

Contracts can introduce a new set of strategic risks for farmers. For example, once a farmer has contracted to produce a crop or livestock variety specific to the needs of a single buyer, the farmer faces risks of failure of the buyer/contractor to purchase the product, with attendant risks to market access and payment. The farmer also faces the risk of harvesting crops or producing animals that fall below contracted quality or quantity requirements—with attendant penalties for noncompliance.

Contracts can be quite complex and are generally written by processors and other first-handlers. They may contain highly complicated incentive schemes that create unknown new risks for producers (Hamilton, 1995). Moreover, farmers may find it difficult to compare prices across contracts, because contract terms may contain language specialized to the farmer or circumstance of production, and—particularly in livestock—terms are not generally publicized. As a result, contract prices may not serve the market clearing and signaling functions that spot market prices serve, particularly if they are not anchored to spot prices.

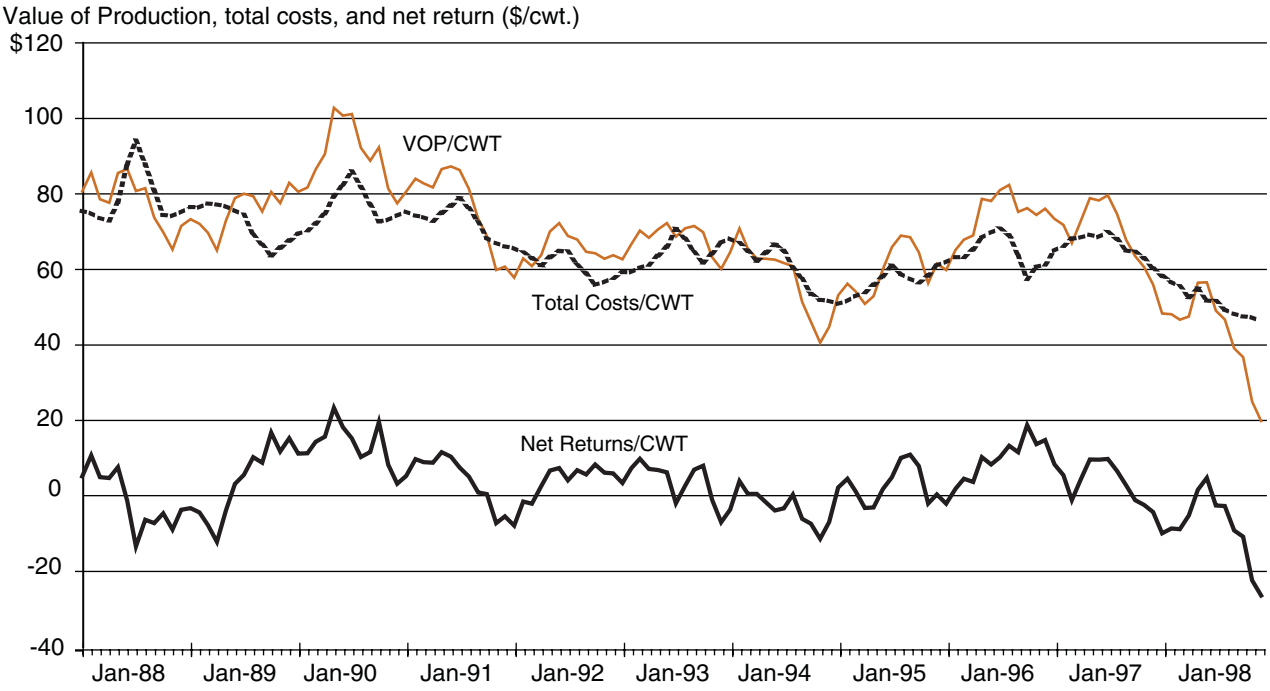
Spot markets still govern nearly 60 percent of agricultural transactions and remain an efficient way to organize the production and distribution of many products. Moreover, technological change has sometimes led to greater use of spot markets. For example, cattle feeding shifted over time from small farmer feedlots to large commercial feedlots that enabled substantial scale economies in feeding. Some commercial feedlots rely on contracted feed, but they also purchase large quantities of feed through spot markets. Farmer feedlots usually fed corn grown on-farm to cattle—that is, they were vertically integrated—so the shift to commercial feedlots also implied a shift to spot market sales of feed (Reimund et al, 1980).

Do Contracts Reduce Income Risk?

We have highlighted two sources of income risk: yield (or production) and price. Yield risks result from unpredictable events (such as drought for crops, or disease for livestock) that affect the quantity of production. That is, favorable weather may lead to unusually large crops, while bad weather may reduce crop yields or livestock weight gains. Price risks arise from unanticipated changes in output or input prices. Contracts can limit the risks faced by farmers by shifting price and (sometimes) yield risks to market participants who are better positioned to bear them, and in some cases, by controlling and reducing risks. In this section, we describe how contracts can be designed to limit risks and summarize the results of the few studies of the actual effect of contracts on risk.

Figure 4-1 provides a striking example of price risks, drawn from hog production. It displays the value of production (VOP), total costs, and net returns per hundredweight (cwt) for a representative independent feeder-to-finish producer from 1988 to 1998. Each series is adjusted for inflation and based on 1998 dollars. Price fluctuations drive almost all variation in the data—feed (corn and soybeans) and feeder pig prices drive costs, while changes in finished hog prices drive VOP fluctuations. The figure shows wide output price variability, from $20 to $100/cwt in 1998 dollars, with

Figure 4-1
Output and input price risk in hog production



Source: Value of production, total costs and net returns in 1998 from USDA ARMS. Estimates for other years computed using USDA NASS monthly price data (see Key, 2002 for details). All values are in 1998 dollars.

sharp short-term fluctuations. Output prices vary more than input prices, and hence are more important drivers of fluctuations in net returns. The income risk associated with independent production is dramatically illustrated in 1998, when a collapse in output prices resulted in net losses of nearly $30/cwt by the end of the year.

Farmers have a variety of ways to reduce or cope with agricultural income risk (Harwood et al, 1999). Risk management strategies include purchasing crop or revenue insurance, using commodity futures markets, accumulating and depleting liquid assets (e.g., through grain storage or saving in financial markets), and borrowing. Producers can also reduce risk by diversifying production—choosing a mix of commodities or income sources (including off-farm employment)—or by altering their production practices (e.g., by irrigating, using more pesticides, or applying more fertilizer earlier in the season).

Contracting can also be a risk management strategy. While several factors likely influence decisions to contract, surveys of contracting farmers indicate that risk reduction plays an important role. For example, over half of contracting producers of grain in 1993-95 surveys rated cash-forward contracts as "effective" or "very effective" in providing price risk protection, while less than a third rated spot market sales as "effective" or "very effective" in doing so (Patrick, Musser, and Eckman, 1998). In their survey of hog producers, Lawrence and Grimes (2001) found that those with production contracts cited reduction in financial risks as a major advantage of contracts, as did those with marketing contracts. Finally, Lawrence, Schroeder, and Hayenga (2001) surveyed cattle and hog packers on the use of marketing contracts. Each group rated reduced price risk as an important contract motivation for producers. Interestingly, each group of packers rated improved and more consistent livestock quality as the most important advantages of contracts for packers.

How Can Contracts Reduce Risk?

As we have seen, marketing contracts can reduce the income risks faced by growers through the terms specified in the contract's pricing mechanism, but farmers must often still manage production risk. Depending on contract terms, production contracts can insulate farmers from most output price risks and many input price and yield risks. Table 4-1 summarizes our conclusions, discussed in more detail below.

Marketing Contracts

Under marketing contracts, producers usually bear all yield risk and frequently all input price risk. Some crop contracts, particularly those used for identity-preserved (IP) varieties, specify an (uncertain) amount grown on a particular area of land. Such "acreage contracts" shift some yield risk to the contractor; the producer still obtains revenue only from the amount delivered, but does not have to make up production shortfalls by buying in the cash market to fulfill contract terms. Some livestock contracts do specify a product price that depends in part on input prices, thereby mitigating some input price risk. Input price risk is particularly important in the livestock

Table 4-1—How much of each source of risk do different types of contracts shift from growers to contractors?

	Sources of risk			
	Price risk		Yield risk	
Contract type	Output	Input	Common	Idiosyncratic
	Amount of risk shifted from growers			
Marketing contracts:				
Flat price - fixed certain price before harvest	Some or all, depending on share of expected output under contract	None	None	None
Basis - fixed difference from uncertain future price	Very little - only "basis" component of price risk	None	None	None
Production contracts:				
Absolute performance - for hogs/poultry, contractor provides almost all inputs except labor and facilities	Almost all	Almost all	Some - depends on contract incentives	Some - depends on contract incentives
Relative performance - same as for absolute performance except that fee is based on performance relative to other growers	Almost all	Almost all	Almost all	Little

Source: Authors' summary of text discussion on effect of contracts on risk.

sector, where feed costs constitute a large portion of the total input cost, and may be one reason why production contracts are more common in livestock production than with field crops.

Marketing contracts specify prices in several ways. For example, forward marketing contracts, frequently used in grain and livestock production, typically establish a base price and provide for the delivery of a given quantity of a good within a specified time. Prices may be modified with premiums and discounts for product attributes, such as moisture or oil content. A “flat price” version of a forward marketing contract sets a predetermined price for a particular quantity of a product before harvest. If growers are certain of their output, the flat price contract can eliminate all output price risk for that production period. On the other hand, if growers face yield risks, then a contract requiring growers to deliver a fixed quantity of a commodity may be risky. Farmers who do not harvest enough to meet contractual obligations may have to purchase the shortfall amount in the spot market. If the market price is higher than the contract price, then growers will lose money. Consequently, growers often find it advantageous to contract only a fraction of their expected output, and to sell any surplus in the cash market.

A "basis" version of a forward marketing contract determines price by applying a difference, or basis, to an uncertain expected price. Spatial differences in grain prices largely reflect transportation costs between production regions and destinations. For example, a farmer may agree to sell in October to a local elevator for 5 cents under the Chicago Board of Trade November futures price. A basis contract does not eliminate output price risk, but secures a market and basis for the grower, who can then hedge the price risk by using a futures contract, which is an agreement to trade a commodity with specified attributes at a specified future time (see Harwood et al, 1999 for a more thorough discussion). For example, by "short" hedging, a farmer sells futures contracts at some point prior to harvest, holds the futures contracts until harvest, then buys back the futures contract when the harvest is sold. In this way the loss (gain) in the value of the crop resulting from an unexpected change in the price is offset by the gain (loss) in the value of the futures contract. By selling a futures contract when entering into a basis contract (a marketing contract based on an uncertain future price), a farmer can eliminate most price risk. However, as with a fixed-price contract, hedging with futures contracts when yield is uncertain can add additional risk. Consequently, hedgers generally sell futures contracts equal to a fraction of the expected harvest.

Sellers of fed cattle or hogs often reach exclusive marketing agreements with a packer, with prices set through a predetermined pricing mechanism. In addition to guaranteeing a buyer for the farmer, the contract may reduce output price risk, depending on the pricing method. Livestock producers may incur risks resulting from their contractual obligations to deliver a predetermined number of animals to the contractor.

Producers of livestock, field crops, and fruits and vegetables sometimes use marketing pools in which groups of farmers commit specific quantities to an intermediary contractor, who then negotiates a price with downstream users on their behalf. Marketing pools can sometimes realize economies through consolidating production into larger lots, and pool operators offer specialized marketing expertise to reduce price risks through the use of marketing contracts, hedging strategies, and storage. Producers continue to bear yield risks if production falls below pool commitments or if pools are unable to market all of a farmer's production.

Production Contracts

Like marketing contracts, production contracts can also shift production and input price risks from growers to contractors. Consider, for example, a production contract to feed, or finish, hogs until they reach slaughter weight. Growers provide labor and facilities and are paid a fee for raising the animals. The fee may have an incentive structure based on animal weight gain, death loss, or feed efficiency. With production contracts to finish hogs, the feed and other inputs supplied by the contractor typically represent over 80 percent of the total costs of production, and almost all input price risk is shifted to the contractor (McBride and Key, 2002). If grower compensation is not tied to the market price of the commodity, contractors also bear output price risks instead of growers.

Floriculture products are often grown under production contracts. A wholesale greenhouse firm, for example, may provide flowers and other nursery products to large retail chains and to independent nurseries (Higgins, 2003). The wholesaler ships seedlings to contract growers, specifies greenhouse design, and provides technical advice and a market outlet. Contracts call for farmers to pay the wholesaler a flat price for seedlings and to receive a flat price for flowers delivered 5 to 8 weeks later. Growers bear yield risk but forego price risk, and the contractor manages the system to time required product flows, which vary from week to week, to the needs of retail clients.

While a production contract can greatly reduce price risks for growers, they may still face varying degrees of production risk, depending on contract terms. If no incentives were included in the contract, and livestock growers were simply paid a fixed fee for raising animals, then the contract would eliminate all of the farmer's production risk. However, because this type of contract could create an incentive for growers to under-apply effort and care in raising the animals, most production contracts require farmers to share some portion of the production risk. Hog and poultry production contracts typically specify a base payment, in addition to bonuses that increase with feed efficiency (pounds of feed per pound of weight gain) and decrease with death losses. Production variation from animal weight gain and death loss would therefore raise or lower the fee the grower receives per head and reintroduce some grower production risk. Other production contracts bar the farmer from growing noncontract hogs, mitigating one incentive problem—that of diverting inputs—while imposing greater risks of asset specificity on the farmer.

How Much Do Contracts Reduce Risk?

Few empirical analyses have estimated the effect of marketing contracts on growers' income risk. Since field crop contracts are almost exclusively marketing rather than production contracts, there is little direct information on risk reduction in crop contracts.

Several studies of livestock production contracts confirm that they can shift price and yield risk from growers to contractors. However, the extent to which they do so and the type of risk shifted depend on the contract terms and the incentive mechanisms. While contracts can reduce income risk, studies also indicate that growers may expect lower returns and may therefore pay a significant premium, in the form of foregone income, for lower risk.

In a study of poultry producers, Knoeber and Thurman (1995) found that price risks, in this case for inputs and output, were by far the most important components of income variability, representing 84 percent of total income variation. Common risks affecting all producers, as when the air temperature becomes very high, and idiosyncratic production risks affecting only a single producer, as when an automatic feeder breaks down, were much less important, each representing about 3 percent of total income variation.[1] Knoeber and Thurman then evaluated the effects of relative performance (or "tournament") contracts on risks and efficiency. As applied in poultry, a grower's fee depends on meat production *relative* to that of other contract growers who harvested at the same time, which in turn depends upon (high)

[1] These factors do not sum to one because the separate components of income risk co-vary.

feed conversion and (low) animal mortality, relative to peers, for a given allocation of young animals. Knoeber and Thurman found that the contracts shifted all price risk and about half of common production risk to the integrator who held the contract.

Four studies analyzed different dimensions of hog production contracts. Martin (1997) examined relative performance contracts using an approach similar to that of Knoeber and Thurman. Contracts again could sharply reduce risks—contract producers in Martin's study faced only 10 percent of the income risk faced by independent producers. As in Knoeber and Thurman's work, price risk was found to be the largest source of income risk by far, explaining 94 percent of the income variability. Moreover, relative performance contracts could shift as much as 94 percent of income risk to the integrator, depending on contract terms.

Johnson and Foster (1994) compared financial returns from independent hog production to those under four alternative contracts, and found that independents earned higher but more variable returns. Their study showed that a broad choice of contract terms allowed hog producers with different degrees of risk aversion to make tradeoffs between risk and returns. Similarly, Parcell and Langemeier (1997) estimated the contract payments that an independent farmer would need in order to accept a contract, depending on attitudes toward risk (level of risk aversion), grower profitability, and contract type. They found that more risk-averse growers were willing to accept lower base payments (a guaranteed fee per head) in contracts than less risk-averse growers (who were paid a base plus an incentive payment). Strongly risk-averse low-profit producers required only $4.50/head to accept a contract, while slightly risk-averse high-profit producers required much more: $28.50/head. The difference in required base payments between a slightly risk-averse and a strongly risk-averse average-profit producer was about $8/head—an estimate of the value of risk reduction for a strongly risk-averse grower.

Many farmers assert that they much prefer the independence and managerial autonomy of operating in spot markets. In a survey by Lawrence and Grimes (2001), hog producers without contracts strongly agreed that they preferred to sell their hogs in spot markets. Key (2004) investigated the tradeoff that hog farmers make between the risk reduction offered by production under contract and the loss of autonomy. He found that a moderately risk-averse farmer would accept lower average prices for market hogs in exchange for lower risk. In his empirical work, Key estimated that the risk reduction offered through a typical production contract was worth about $2.65/cwt to a moderately risk-averse farmer, which is about 5 percent of the historical average price for market hogs during the 1990s. If risk reduction were the only issue, we would expect contract producers to realize lower returns from hog production than independents. But Key found that contract grower returns exceeded returns realized by independent growers by more than $3.68/cwt. He determined that the difference reflected the value of autonomy to producers. An implication of his work is that autonomy was highly valued—a moderately risk-averse producer in his analysis needed to be paid $6.33/cwt, or 11.7 percent of the average market price, to give up autonomy.

Risk Reduction Not the Whole Story

Empirical analyses of the effects of contracts on grower income risks are concentrated on livestock, particularly on hog and broiler production. We have very little evidence on the effects of contracts on income risks in cattle production and virtually none on crop production. The evidence we do have for livestock markets indicates that contracts can substantially reduce income risks associated with price and production variability, and contract terms can be calibrated to tailor the degree of risk reduction offered. Judging by what some producers are willing to pay for risk reduction in terms of lower returns, it appears to be quite valuable to them. Moreover, producers frequently cite risk reduction as a major benefit of production and marketing contracts (Lawrence and Grimes, 2001), and it is likely to be one important reason for contracting.

However, risk reduction is not necessarily the main reason for the spread of contracting, even in hog production where we have the most empirical evidence. Key (2004) used ARMS data to argue that the value of risk reduction to farmers is overstated if analyses do not control for the loss of autonomy many farmers experience under contract. Moreover, contracts can serve functions other than risk reduction; they can also improve efficiency in organizing production, easing the adoption of large-scale and specialized techniques and thereby reducing costs or improving product quality (Knoeber, 2000; Lawrence, Schroeder, and Hayenga, 2001; Hueth and Hennessy, 2002). We assess the evidence for that assertion in the next section.

Chapter 5

Can Contracts Improve Production Efficiency in Agriculture?

Contracting may influence productivity by reducing production costs or raising production values. It does so by altering the incentives that market participants face, or by facilitating coordination among stages of production—speeding technology adoption, improving information flows, managing quality, uniformity, and delivery, or enhancing access to credit. Transactions-cost economics helps to explain spot market failure. If investment in specific assets carries risks of holdup, spot market participants may avoid those investments, as well as the resulting reductions in costs or improvements in product attributes. In that case, properly designed contracts may elicit such investments and overcome spot market failure.

Productivity improvements reduce farm costs by decreasing the quantity of inputs needed to produce a given level of output. Improvements in product uniformity, for instance, can allow the use of standardized dedicated equipment by farmers to lower harvesting costs or by processors to lower processing costs. Contracts can also be used to regulate product flows to processing plants, allowing processors to cut costs through more efficient use of plant capacity. Some contracts give farmers access to better seeds or improved livestock strains; these improved inputs lead to greater crop or meat yields from given quantities of other inputs, reducing per unit costs of production. But productivity growth may also result from developments that lead to more valuable outputs for a given level of inputs, providing greater customer satisfaction, such as corn that is more easily digestible as feed or meat with improved taste or tenderness.

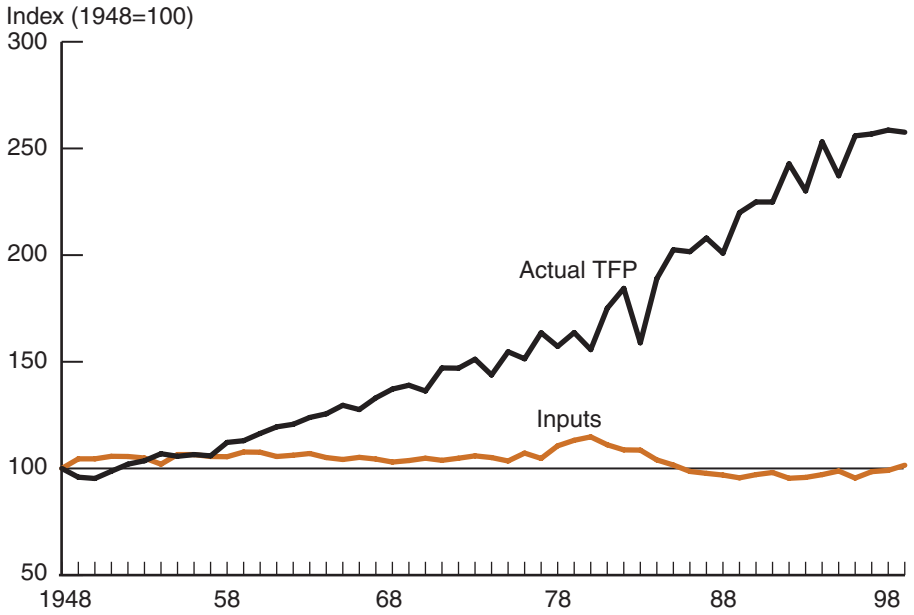
Examples follow from several agricultural sectors to show how contracts can be used to improve productivity. Some measures of productivity growth are called single factor measures, such as increases in crop production per acre or per labor hour, because they relate output growth to a single input. More complete measures are based on total factor productivity (TFP) and relate growth in the volume or value of output to growth in all inputs. TFP measures are preferred because some innovations reduce use of one input by increasing the use of others. Thus focusing on a single input to the exclusion of others may result in misleading inferences about the effects of an innovation on costs. However, because of data limitations, TFP measures are often unavailable; in those cases, single factor measures are used and can be informative if applied with care.

Agricultural Productivity Growth in the Aggregate

Figure 5-1 shows annual nationwide data on agricultural input use and TFP developed by ERS (Ball, 1985; Ball et al, 1997). Between 1948 and 1999, agricultural TFP grew at an annual rate of 1.9 percent per year, much higher

Figure 5-1

U.S. agricultural productivity growth, 1948-98



Source: U.S. Department of Agriculture, Economic Research Service.
(www.ers.usda.gov/Data/AgProductivity/)

than in most sectors of the economy. Much of that growth can be traced to the development and diffusion of improved inputs—mechanical inputs such as faster and more powerful tractors, biological inputs such as new seed types or improved livestock genetics, or chemical inputs such as new or more effective fertilizers and pesticides. Formal private and public investments in research and development often led to the invention and development of input improvements.

Cochrane (1993) argues that a watershed in agricultural production was reached around the early 1980s, leading to greater integration between the stages of production and additional control over the production process. He asserts that productivity increases after 1980 arose not only from new technologies (such as hybrid seed or increased fertilizer use), but also from more controlled and effective use of resources. Cochrane relates this to management innovations that improved efficiency of the production process and sped the adoption of technological innovations. He emphasizes new information technologies, but contracting, by facilitating the adoption of new technologies and improving on the incentives offered by spot markets, may be an important element of these managerial innovations.

Recent ERS research lends some support to Cochrane's position. Ahearn, Yee, and Huffman (2002a) investigated the sources of differences in agricultural productivity growth in the 48 contiguous U.S. States between 1978 and 1996. The authors developed an indicator of contract use: the share of a State's farms that had production contracts. Other indicators of structural change in a State's agricultural sector included measures of entry and exit in farming and changes in size among farms continuing to operate. The measures of structural change and productivity were developed from data in the Census of Agriculture. The measures are not ideal—no information on

marketing contracts or on the share of production under contract was available. Surveys that do have such information only cover recent years. Nevertheless, the structural change measure does seem to match well with what we know about the temporal spread of contracting in general and of the commodities involved.

Ahearn and her colleagues found that a higher incidence of contracts was associated with faster productivity growth and with increases in average farm size. The association was modest—a 10-percentage point increase in the incidence of contracts was associated with a 9-percent increase in productivity—but the estimate was statistically significant. Ahearn's measures of structural change were also associated with productivity growth—faster productivity growth was linked to entry and exit and rapid increases in farm size. (Transactions-cost explanations for contracting argue that technological change that leads to larger operations may also lead to a greater reliance on contracting.)

The connection between contracts and advances in productivity appears to be stronger in 1978-96, in line with the findings of Cochrane; in other work extending over the period from 1948 to 1996, Ahearn, Yee, and Huffman find that the effect of contracts is much smaller and is not statistically significant (2002b). Their analysis suggests that there may be important systemic connections among recent technological changes in agriculture, structural changes in contracting and farm sizes, and productivity growth. However, the highly aggregated data they used were not designed for purposes of these analyses and cannot show precisely how these factors might be linked. For more insight, we turn to studies of particular commodities.

Contracts, Technology Transfer, and Productivity: Farm-Level Studies in Livestock

Contracting in the livestock sector may have led to sharp increases in productivity by facilitating the adoption of new technology. (While not the focus of this report, contracting may also exacerbate environmental risks. See Box 3: Livestock Contracting, Structural Change, and Environmental Effects.) We summarize the evidence below.

Hogs

Contracts that reduce risks may also lower grower productivity. However, the rapid diffusion of contracted production throughout the industry suggests that contracts may offer efficiency advantages over independent production. Key and McBride (2003) pursued this issue with data on nearly 500 hog producers from USDA's 1998 ARMS. Specifically, they compared productivity in production contracts and independent feeder pig-to-finish hog operations. Their econometric analysis controlled for a variety of farm and operator characteristics, including farm and hog enterprise size, location, and operator age, education, and experience.

Because the study focuses on finishing operations that take young pigs (30-80 pounds) and feed them to market weight (200-280 pounds), productivity

Box 3—Livestock Contracting, Structural Change, and Environmental Effects

Structural change in livestock production encompasses several elements. Modern "confined animal feeding operations," or CAFOs, are much larger than livestock operations of the past in order to realize lower production costs from economies of scale. The operations are also quite specialized. They frequently receive livestock feed from an integrator or purchase it themselves, thereby severing the on-farm linkages between crop production and livestock feeding and reducing associated on-farm land requirements. They also commonly specialize in one stage of livestock production. Finally, CAFOs are more likely than other producers to rely on contracts to control genetics, ease financing, and limit the risks of investing in a large enterprise. In that sense, contracts further structural changes toward larger and more specialized livestock feeding operations.

Structural change is occurring because growers realize lower production costs on CAFOs, leading to lower livestock prices for processors and lower meat prices for retailers and consumers. However, because CAFOs concentrate livestock wastes in a limited land area, they may also have a considerable environmental impact on nearby surface and ground water sources (resulting from a concentration, rather than an increase, of wastes). If this change in livestock production leads to lower meat prices, it will increase meat consumption, and therefore animal production and the nationwide volume of animal wastes. That development is offset, however, to the extent that improved feed efficiency, one major source of lower costs, reduces waste production per animal.

Wastes are typically collected in lagoons prior to field application. The lagoons are at risk of leakage and catastrophic breaks that can lead to major pollution in nearby waterways and ground water. One way to manage animal waste is to apply it to fields to help meet crop nutrient needs. However, specialization in livestock means that many CAFOs have limited land devoted to crop production, and individual producers may apply nutrients contained in animal wastes in excess of the amounts that vegetation can utilize. Thus, some large producers may have more interest in disposal than optimal crop production, leaving the excess nutrients to run off to surface water or leach into ground water.

Environmental risks associated with runoff from excess animal wastes vary with the type of animal and the region of the country, and also appear to vary with the type of operation. McBride and Key (2003), analyzing 1998 data on hog producers, found that larger operations generally have far less land per animal than smaller operations and that substantial numbers of large hog operations, particularly in the Southeast, appear to apply nutrients to land at rates in excess of the amounts that crops can use.

Hog and broiler production contracts usually assign the grower with responsibility for handling manure and dead animals, along with liability for damages associated with each. However, recent lawsuits seeking damages from odors from hog and poultry manure have targeted contractors (as in an Alabama suit against Tyson Foods and a Minnesota suit naming Wakefield Farms), as well as their contracted livestock-growing operations. With contractors facing increasing likelihood of regulation and tort liability themselves, some contracts now contain more detailed specifications for the control and application of animal wastes.

indicators measure weight gain per unit of input. Table 5-1 shows that production per dollar of all input expenses averaged 52 percent higher for contract compared with independent (spot market) operations. As is common in analyses of farm data, there is a wide spread of actual performance around the average, and some independent operations are quite efficient. However, the differences are statistically significant and quite large—contracting status has strong effects, on average. Contract operations are usually much larger than independent ones, and larger operations also tend to have higher productivity. However, when Key and McBride controlled for differences in farm size, they found that contract enterprises still had large productivity advantages over independents—output per dollar of input expenses was 23 percent higher in contract enterprises with the same size, location, and operator characteristics as independents.

Why do contract enterprises have higher productivity and lower costs? While contract operations use labor more effectively—production per labor hour was much higher—labor accounts for only a small share (8 percent) of total costs. The driving force in contracting's productivity advantage was feed efficiency. Feed accounted for two-thirds of the cost of raising animals to slaughter weight, and production per pound of feed was 36 percent higher in contract compared with independent operations of similar size and operator characteristics.

The gap in total factor productivity (TFP) between contract and independent growers (23 percent) is less than the single-factor productivity gaps. One reason could be that contract operations pay higher prices for inputs such as feed, possibly because many of the independents are located in the Corn Belt, while many contract operations are outside it. Price differences matter because TFP in this study is a dollar measure—output per dollar of expense—while the single-factor measures reported here are in physical units such as output per pound of feed or per labor hour.

Table 5-1—Productivity and contracting in hog production

Efficiency measure	How measured?	Average increase under contract production	Average increase under contract production, controlling for other factors	Share of input in total costs
			Percent	
Total Factor Productivity (TFP)	Production per dollar of inputs	52	23	na
Feed	Production per pound of feed	61	36	66
Labor	Production per hour of labor	234	44	8

Notes: na = not available. Production is the combined weight of all hogs sold or removed under contract less the combined weight of all hogs purchased or placed under contract, plus the combined weight of inventory change. The column labeled "average increase under contract production" compares means for contract and independent operations. The next column compares means, while controlling for the effects of the size and location of the hog operation and age, education, experience, and primary occupation of the operator.

Source: Key and McBride (2003).

How do contract operations achieve such large gains in feed efficiency? One answer is that contracts can ease a grower's credit needs and access. Many production contracts provide such a large share of production inputs that they sharply reduce overall grower credit needs, and banks may be more willing to advance loans before production because of the more certain revenue flow provided by a contract. Eased credit allows for greater size, which may allow scale efficiencies, and production contracts that cover the provision of inputs reduce both the cost of searching for inputs and the risks associated with input price and the necessary credit arrangements to buy inputs.

Contractors may deliver more effective and appropriate feed mixes than those that independent growers feed to their hogs. Feed efficiency also depends on genetics, and integrators control hog genetics in typical contracts by retaining the exclusive right to supply pigs to the grower.[1] Finally, contracts provide a framework for transferring information and training to growers. Contracts frequently require growers to attend training courses and seminars on hog production and to follow integrator-provided procedures, guidelines, recommendations, and advice.

[1] Examples of hog finishing contracts can be found at the Iowa Attorney General's electronic collection of agricultural contracts. (*http://www.state.ia.us/government/ag/ag_contracts/index.html*)

Changes in hog genetics arising from private and public research, along with related improvements in production practices and feed mixes, are important drivers of industry-wide productivity growth. Key and McBride's research suggests that organizational shifts toward expanded contracting are also important elements in productivity growth, because they provide a means for applying new genetics, feed mixes, and production practices.

Broilers

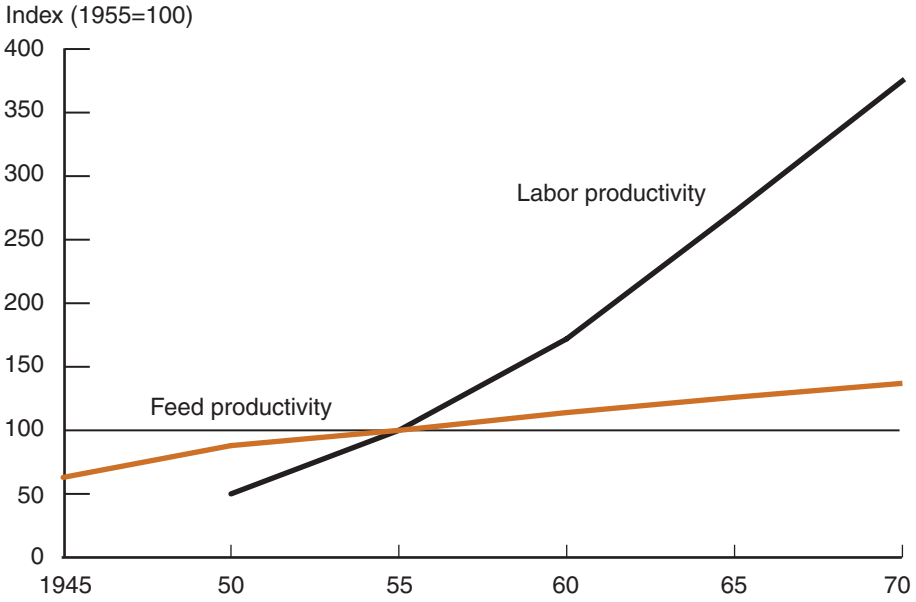
Since contract broiler production dominates the industry, we cannot compare independent and contract broiler producers. However, industry-level analyses suggest that contracting delivers productivity-enhancing technology to the sector.

Research led to a number of basic advances in poultry breeding, nutrition, and disease control in the late 1940s and early 1950s (Reimund, Martin, and Moore, 1980). New fast-growing strains of chickens, bred specifically for meat production, were developed, along with newly formulated rations mixed for specific classes of poultry in different stages of growth. New vaccines and antibiotic feed additives limited the onset and effects of diseases, and mechanical innovations led to improvements in housing, waste removal, and materials handling. Other research allowed better sexing of the chicks and better candling of hatching eggs during incubation, along with examination for clear (unfertilized) eggs or dead embryos.

The innovations led to striking industry-wide productivity improvements, as measured by two single-factor indicators (fig. 5-2). Feed efficiency more than doubled between 1945 and 1970, while labor productivity rose 10.5 percent per year, on average, between 1950 and 1970. Organizational changes, in the form of larger farms and contracting arrangements, were necessary vehicles for spreading the new technologies (Knoeber, 1989; Lasley, 1983; Martinez, 1999; Reimund, Martin, and Moore 1980; Rogers, 1979).

Figure 5-2

Productivity growth in U.S. broiler production, 1945-70



Source: Reimund, Martin, and Moore (1980).

Production contracts reduced both the risks and the financial commitments faced by growers. As with hogs, integrators made the investments to improve broiler genetics, and they also developed and controlled appropriate feed mixes through contracts. They transferred information as well as production and management technology through contract guidelines and requirements.

Knoeber (1989) argues that the particular design of contracts found in broiler production—relative performance contracts—was an important element in diffusing technological advance. Grower payments depend on the grower's relative performance with a given flock of chicks, compared with a control group of growers in the area. Performance is largely driven by the effectiveness with which growers convert feed to poultry meat, which in turn depends on mortality in the flock and on feed efficiency for surviving birds. Knoeber further argues that the contracts played an important role in encouraging the diffusion of new technology for two reasons. First, the high rate of technological change in the industry led to some risk in using a new technique—it may not work. Contracts shifted the risks of developing and introducing new broiler technologies from producers to integrators. After cutting-edge farmers tried a new technology and affirmed its effectiveness, the contracts' performance clauses encouraged adoption and diffusion by growers. Second, the growers who can adapt most effectively to new technologies will likely gain the highest longrun returns under relative performance contracts. Such contracts may serve as tools to attract and retain effective growers.

Contract Design, Incentives, and Institutions for Product Quality in Crops

As noted, production contracts may be vehicles for productivity growth in livestock. Such contracts often contain explicit components governing the

transfer of technology and the farm production process. However, production contracts covered only 2.8 percent of crop output in 2001, while marketing contracts were far more important, covering 23.4 percent of the value of 2001 crop output (table 2.7). Marketing contracts rarely contain detailed rules for input use and production, but instead focus primarily on pricing mechanisms that shift risks, offer greater returns for higher product quality, or ensure market outlets for farmers and steady commodity flows for buyers.

Marketing contract designs can raise productivity if they provide more effective incentives to produce higher valued crop varieties. If compensation is tied to product attributes, either accurate measurement of those product attributes is required or contractual specifications must provide assurance of production practices. Moreover, production of specific attributes can often create limited markets and holdup risks, leading to a reliance on contracts. Complicated contract designs require participants (producers and buyers) to pay close attention to the means of measuring performance, and the setting of payments. We turn to examples from several crops.

Tobacco

All major cigarette companies currently contract for tobacco. Cigarette production requires a particular blend of tobaccos, and contracting provides a way for manufacturers to get varieties with desired qualities. The shift to contracting occurred shortly after the November 1998 agreement between the major cigarette manufacturers and the Attorneys General of several States, under which the companies agreed to pay 46 States about $87 billion to compensate for Medicaid health expenses (Cutler et al, 2000). The payments would be financed through higher cigarette prices. The agreement also restricted certain forms of cigarette promotion.

Tobacco contracts are not standardized across companies, but most include provisions about quality, quantity, ownership, production standards, prices and payment, and enforcement. One key contracting issue is the relationship between price and quality. In general, buyers are willing to pay for higher quality, which generally costs more to produce. Tobacco contracts contain strong incentives to improve tobacco quality, and it is possible that cigarette manufacturers sought to raise quality in order to offset the effects of the Compensation Agreement's price increases and marketing restrictions on cigarette demand.

Growers can affect tobacco quality only to an extent, through their choices of farming, harvesting, curing, and sorting techniques. By paying prices based on quality, contracts can give growers incentives to increase the share of high-quality tobacco and decrease the share of low-quality tobacco in each crop.

A comparison of auction and contract price data indicates that tobacco contract pricing rewards high quality and punishes low quality. Table 5-2 compares auction market and contract prices for quality grades of five standard tobacco products. The products are leaves from different parts of the stalk, with primings at the bottom, cutters in the middle, and tips at the top

Table 5-2—Contracting and product quality in tobacco

Product	Contract grade	Contract price	Auction prices		
			Mean	Minimum	Maximum
		Dollars per pound			
Primings	1	1.66	1.56	1.53	1.59
	2	1.61	1.52	1.34	1.58
	3	1.51	1.46	1.34	1.52
	4	1.14	1.37	1.34	1.40
Lugs	1	1.78	1.67	1.65	1.68
	2	1.71	1.60	1.54	1.65
	3	1.64	1.49	1.37	1.54
	4	1.14	1.43	1.37	1.45
Cutters	1	1.88	1.78	1.76	1.79
	2	1.82	1.71	1.62	1.79
	3	1.75	1.60	1.43	1.66
	4	1.14	1.48	1.43	1.56
Leaf	1	1.96	1.94	1.91	1.94
	2	1.92	1.90	1.80	1.95
	3	1.87	1.79	1.45	1.87
	4	1.83	1.69	1.45	1.89
	5	1.20	1.56	1.09	1.69
Tips	1	1.95	1.92	1.83	1.94
	2	1.91	1.89	1.79	1.94
	3	1.77	1.68	1.29	1.88
	4	1.20	1.49	1.09	1.69

Note: The products are tobacco leaves distinguished by their position on the stalk of the tobacco plant, with primings at the bottom (nearest the soil), followed in order by lugs, cutters, leaf, and tips.

Source: Dimitri (2003).

(lugs are between primings and cutters, while leaves are between tips and cutters). Lower grades (1, 2) are associated with higher quality. The table reports contract prices, as well as average (mean), minimum, and maximum auction prices. In general, tobacco contracts offered higher price premiums for quality than those in auction markets, and larger price discounts for low-quality tobacco. Contract prices for the highest quality, grade 1, exceed average and maximum auction prices in each product, while contract prices offered for the poorest quality grade (grade 4, and grade 5 in leaf tobacco) are substantially lower than the lowest auction price for primings, lugs, and cutters and well below the average auction price offered for leaf and tips. It appears that spot market pricing systems provided weaker incentives to producers to grow higher quality tobacco than contract pricing structures.

Sugar Beets

Contracting in crop production and marketing is not simply a matter of offering quality incentives. Consider the experience with sugar beets. Contracts cover almost all production; farmers make substantial investments in assets specific to sugar beet production, markets for beet purchase are local, and there are scale economies in processing.

But contract terms vary among buyers, and one type of contract appears to have important effects on beet quality and production value. Recent research documents those effects and explains why only some buyers offer this contract. The contract is based on the facts that sugar beets are valued for the sugar recovered from them and that the amount recovered depends not only on sugar content, but also on the level of impurities present in the beets. Impurities transform sugar into molasses, reducing the sugar actually recoverable. Growers can affect impurities through their agronomic practices, including the timing of planting, fertilizer application, crop rotations, and weed, disease, and insect control.

Balbach (1998) studied the industry's contractual designs and noted that the three processors organized as grower-owned cooperatives used a different contract than the investor-owned processors. Payments in contracts offered by investor-owned firms varied with sugar content, while the "extractable sugar" contracts used by cooperative processors provided additional incentives to reduce impurities as well. The cooperative processor measures the impurities in a random sample of the grower's beets and estimates the percentage of sugar that will be lost due to the molasses created by impurities. The contract terms pay according to beet sugar content minus the percent of loss. Balbach used one cooperative's data to show that average sugar losses to molasses (impurities) fell by 36 percent after introduction of extractable sugar contracts in the 1970s, while actual sugar production per ton of beets rose by 12 percent, representing significant changes in quality and value. In turn, the share of overall production shifted sharply toward the three cooperatives after 1980, as better quality beets reduced their costs of sugar production.

Organizational structure affects contract choice. Extractable sugar contracts require an additional measurement of beet quality—the percentage of sugar loss due to molasses. Balbach argues that processors have an incentive to underreport quality, thereby retaining the higher returns specified in the contract. However, growers form the boards of cooperative processors, holding the right to monitor measurement and reporting processes. If cooperatives themselves underreport quality, the resulting increased cooperative processor returns would still be to growers' benefit as owners. In contrast, investor-owned processors have been unable to assure growers that impurity measures will be accurately and fairly reported, and their growers have avoided extractable contracts. In short, proper contract design also depends on who administers tests for quality, an issue not yet faced in the short-lived experiment with tobacco contracts.

Processing Tomatoes

Almost all U.S. processing tomatoes are grown in California, the vast majority under contracts. There are few participants in the California market—51 processors in the 1990s and about 500 growers, with the 50 largest growers accounting for 40 percent of production (Hueth and Ligon, 2002). Processors usually purchase from nearby growers, substantially limiting the number of potential participants in any transaction, and different processors desire different tomato characteristics for their paste, juice, sauce, ketchup, or soup products. These market characteristics lead to reliance on contracts, with the contract design providing incentives to growers to produce the tomato characteristics desired by buyers.

Hueth and Ligon investigated contract design in a large sample of processing-tomato contracts. Contracts offer premiums and deductions for a variety of tomato characteristics, including weight, the proportion of unripe tomatoes, sugar content, color, and several indicators of damage, including mold, worms, soft spots (rot), and material other than tomatoes (vine parts, dirt, stones, etc.) that may make up part of a load. Actual patterns of contract premiums and deductions vary by processor, year, and grower. Hueth and Ligon found that quality characteristics vary widely across tomato loads and that differences in contract incentives account for a substantial amount of that variation. Moreover, incentives operate in expected directions: increases in premiums associated with specific quality measures are associated with improvements in those measures.

As with sugar beets, product quality must be established by testing random samples of the tomatoes. It appears that, in tomato contracts, effective quality incentives have been achieved by blending contract design with use of an independent quality assurance agency, the Processing Tomato Advisory Board, which is jointly funded by growers and processors and operates grading stations around the State.

Identity-Preserved Corn

Identity-preserved (IP) corn varieties provide specific traits (such as higher oil content) or are produced and marketed in such a way as to retain certain characteristics (for example, by a set of production and marketing techniques like those underlying organic corn). They are IP because they retain identities separate from other grains in the marketing channel, and they include high-oil, nutritionally enhanced, and high-lysine corns primarily used in animal feeds; waxy and high-amylose corns for wet corn milling applications; corn marketed as organic and non-biotech; white and hard endosperm/food grade corns used in dry milling for food products; and seed corn.

IP corns are costlier to produce and market than conventional varieties, both because of the need to preserve identity and because they sometimes have lower yields. Contracts are widely used and cover 75 percent of IP corn production, in contrast to 13 percent of all corn production (table 5-3). Participants use contracts because there often are few nearby buyers, given the specialized nature of IP corn types, and because higher costs expose them to risks of holdup in spot markets. Those with alternative outlets, such as high-oil corn producers who can turn to on-farm feeding, contract less.

Contracts provide an outlet and ensure premiums, usually specified as a per bushel amount above a spot price, to account for costs and yield effects. But contract pricing structures may not accurately capture yield effects, and premiums may not fully offset the yield risks for the fraction of growers (often 10-20 percent) who report substantially lower yields.

As a result, there is great deal of turnover in IP corn production. Thirty percent of producers in 2000 did not return in 2001, and 27 percent of 2001 producers did not return in 2002. Most of those producers are replaced by new entrants, although the U.S. Grains Council, an industry group, reports a declining absolute number of value-enhanced producers in 2001 and 2002.

Table 5-3—Contracting in identity-preserved corn

Identity-preserved corn type	Contract share (percent)		Average premium	Extra costs due to identity preservation	
				Technology fee	All else
	Farms	*Bushels*	*Cents/bu*	*Cents/bu*	*Cents/bu*
Seed	93.4	93.2	233	na	136.9
Waxy	76.9	97.6	17	na	2.7
White	74.1	81.9	26	6.4	9.1
High oil	56.6	73.9	21	7.3	1.3
Hard endosperm/ foodgrade	80.1	52.2	15	9.4	3.0
Marketed as non-biotech	11.9	38.8	14	9.4	3.4
All surveyed IP types	54.7	74.4	-	-	-
All corn	na	12.8	-	-	-

na = not available.

Source: 2001 USDA Agricultural Resource Management Survey (ARMS).

IP corn contracts may need to evolve over time to adjust for the precise nature of yield effects if the problem is not a lower average yield for all, but rather sharply lower yields for some. Future contract designs may need to transfer technological knowledge to reduce yield risks or include provisions to share yield risks. If the risks are idiosyncratic, contracts need to be structured to select those growers that can most effectively produce value-enhanced grains, perhaps using the relative performance features of broiler contracts.

A similar set of issues offsets the spread of contracts in wheat production. Several observers note that spot market wheat prices fail to provide proper incentives to produce wheat qualities that end-users value (Lambert and Wilson, 2003). Yet contracts covered only 5.5 percent of U.S. wheat production in 2001, down from 9.1 percent in 1996-97 (table 2-6). It has proved difficult to design contracts with the right grower incentives and still provide buyers with specific qualities of wheat in substantial volumes.

Contracts Continue To Evolve

The transactions-cost framework for analyzing contracts describes circumstances under which contracts can improve productivity, either through reducing production and processing costs or by improving product quality and value. Crude aggregate evidence suggests that contracting and organizational innovations may have played a role in agricultural productivity growth, and the empirical evidence from broilers and hogs indicates that the effects can be large.

Modern crop-marketing contracts often aim to provide producers with stronger incentives to deliver products with specific characteristics, through payment schemes that provide premiums for meeting quality targets. But our examples suggest that it is not easy to develop contract designs that provide appropriate quality incentives. Contract designs may need to evolve over time to meet new challenges, and contracts may require the presence of other factors, such as independent quality assurance providers, to work well.

Contracting and Market Power

Can buyers of agricultural products use contracts to create or exploit market power? Farmers may frequently have few marketing options, either because of broad industry consolidation or because transportation costs limit the area over which products can be shipped. Options may be further constrained by time of harvest, storability or high storage costs, or local buyer capacities. Livestock producers may have access to only a few packers who might buy their animals. Similarly, a small number of processors dominate purchases of some grain and vegetable crops.

Agricultural contracts often govern transactions between farmers and processors in highly concentrated markets. The contracts may help create the large and steady flow of commodity deliveries that large plants need to operate efficiently and minimize processing costs. Contracts may also limit the income risks faced by farmers and shift risks to the large and diversified processors who may be better situated to bear them. But processors may also be able to exercise market power when they have few competitors, forcing agricultural prices below competitive levels. A key issue is whether contracts can facilitate the exercise of market power. Here we describe the conditions under which buyers could reduce prices paid to farmers in livestock markets. Our discussion focuses on buyer market power (monopsony) rather than seller power (monopoly), because buyer power is usually at issue in agricultural markets.

How Contracts Can Be Structured To Exercise Market Power

A buyer exercises market power by exerting downward pressure on prices and maintaining the lower prices by limiting purchases. In competitive markets, rival buyers expand purchases when one buyer reduces them, so in that case one buyer's actions will have no ultimate effect on total purchases in a market or on price. But a single buyer can exercise market power when rivals do not react to the buyer's reduction in purchases, either because there are no rivals or because actual and potential rivals cannot expand their purchases. A group of buyers can together exercise market power if they can act jointly to reduce purchases and force prices down.

Economic theory identifies three ways in which contracts could extend market power, under certain market conditions (Kwoka and White, 2004). Contract terms may *deter entry* by potential rivals; they may *limit price competition* among existing rivals, thereby allowing single firms to exercise market power; or they may facilitate *discriminatory pricing*. We illustrate the three strategies with examples from cattle markets, which have been the source of much of the policy discussion on market power.

1. *Restricting entry*—Meatpacking has important scale economies (larger plants realize lower per animal slaughter costs), so an entrant

must attract a large flow of animals in a local market area to run a plant efficiently (MacDonald, Ollinger, Nelson, and Handy, 2000). If one packer can use contracts to tie up a substantial portion of the local livestock supply, an entrant packer will have to pay substantially higher prices to attract enough cattle, either by paying for contract liquidations or through bidding for enough cattle on the spot market. Contracts, by raising entrants' costs, may hence deter their entry. The existing contractor could then force spot prices down by limiting spot market cattle purchases.

2. *Limiting price competition*—In principle, a contract could also be structured, by using pricing mechanisms common in other industries, to deter rivals from competing aggressively with one another (Xia and Sexton, 2004). Contracts often specify a base price formula. One approach to determining a base price is to set it at the highest spot market price paid for cattle during a comparison period, a mechanism known in the industry as "top of the market" (TOMP) pricing. Contracts often then specify deviations from the base, related to product quality or other features of the transaction. TOMP clauses can transform bidding strategies in spot markets. If a packer offers an unusually high spot price to a seller, perhaps because that seller has other offers, the packer will also have to pay commensurately higher prices on all its TOMP contract cattle, in addition to the cattle in the specific transaction. Faced with the added costs from aggressive spot market bidding, the packer will be more likely to refrain from aggressive bidding for spot market cattle.

   Another feature of spot market bidding can limit spot prices and also hold contract prices down when contract price formulas are based on spot prices. In some cattle markets, bids are offered only in whole dollar amounts, such as $70/cwt. That is strikingly similar to pricing conventions in NASDAQ stock trades, which were alleged to favor brokers and were the subject of a considerable amount of litigation until the conventions were changed (Christie and Schultz, 1994). A packer considering a competitive bid for a shipment of cattle would have to bid a full dollar per cwt above a rival bid in order to obtain the cattle. If that packer also had contract cattle priced under a TOMP formula, the packer would have to consider the effect of that additional dollar on prices paid for the contracted cattle.

   This may best be described with an example: Suppose a packer usually aimed to acquire 20,000 cattle per week, half through contracts and half through spot market purchases. Assume that the packer bought 9,000 spot market cattle at a price of $70/cwt, but would need to pay $71/cwt (or about $11.50 more per head) to get the extra 1,000 cattle needed. The extra spot market cattle would allow the plant to run near capacity, reducing per head processing costs. Without a TOMP pricing clause in a contract, the packer's additional costs of obtaining the extra cattle, over the existing price of $70/cwt would be $11,500 ($11.50 per head). With a TOMP clause, the packer would be obligated to also pay $71/cwt for all its contract cattle, and the additional costs of getting another 1,000 cattle would be $126,500 (an

extra $11.50 a head on the 10,000 contract cattle as well as the last 1,000 spot market cattle). In this example, the TOMP clause provides a strong incentive to avoid driving spot market prices up in order to obtain additional spot market cattle. If all competing packers use contracts with TOMP clauses, then they may all refrain from aggressively bidding on cattle, and the clauses would facilitate reductions in competition and in spot and contract prices.

Another contract clause can be used to limit price competition among rival buyers. Some contracts contain confidentiality clauses that require farmers to keep contract details secret, usually from other farmers. Since contractors usually write contracts to access more production than any one farmer has, such clauses could provide buyers with strong informational advantages in negotiations. The Farm Security and Rural Investment Act of 2002 limits the use of such clauses in livestock and poultry contracts and specifically allows farmers to discuss the contract with legal and financial advisors or family members.

3. *Discriminatory Pricing*—Finally, consider the practice whereby a buyer pays different prices to sellers for the same product—for example, for cattle of identical quality. Suppose a buyer has some individual market power, exercised by limiting purchases and forcing prices down. The buyer could then increase profits by buying and processing some additional cattle, but only if the higher price paid for them could be paid just for those cattle, without driving up prices on all the cattle that the packer bought. One way to do that would be to offer an exclusive contract for those cattle at a price above the spot price (the contract is exclusive because it is not made available to all sellers and it covers a limited quantity of cattle). In this way, the packer could force spot prices down while still acquiring enough cattle in spot and contract markets to run plants efficiently, realizing higher profits through lower spot prices as well as lower unit processing costs (Love and Burton, 1999).

When Do Contractual Features Create Market Power?

Several distinctive features of agricultural contracts, when combined with spot market practices, could work to limit competition among buyers. However, those features are likely to lead to the creation or extension of market power only under quite specific circumstances, when other important factors are present.

Under what circumstances, for instance, can contracts limit entry by rival buyers? In the example outlined above, several conditions were needed. First, there must be significant scale economies, so that an entrant would be concerned about obtaining large supplies of raw materials. Second, the contract must tie up local supplies for substantial periods of time; otherwise, an entrant need only wait for contracts to lapse to begin acquiring supplies. However, only some contracts tie livestock sellers and packers together for extensive periods. Hog production contracts do so by requiring large investments on the part of growers and by prohibiting grower sales to other

packers from contracted facilities. Some—though not all—hog contracts also clearly specify a contract life of 5 to 10 years. Poultry contracts require large investments on the part of growers while prohibiting grower sales to other buyers during the life of a specific contract, usually for a single flock or group of flocks in a single time period. Thus, poultry contracts frequently commit the contractor to only a single flock—the contracts do not carry long lives to match the long-lived grower investment, and growers can recontract quickly.

Cattle contracts are also not nearly as binding as hog contracts. They typically cover the short period that the cattle are in the feedlots and frequently do not prohibit a feedlot from selling to other buyers. Without long-term contracts linking packers and sellers, entrants can bid contract cattle away from existing packers.

Next, consider pricing terms, such as those included in TOMP contracts. Such contracts are most likely to reduce price competition if all buyers use them. If only one uses a TOMP clause, that buyer becomes a less aggressive bidder. Rivals, however, can continue to bid aggressively for commodities, and the result will be lower production and higher per unit costs for the buyer with a TOMP clause. As a result, such pricing clauses could lead to abuse of market power if they are used by all leading buyers in a concentrated market. In addition, such contracts also require the added factor of entry barriers to be effective. If contracts lead to reduced price and higher profits in a local market, the conditions should attract entry by rivals.

Another complication arises in the broader economics and antitrust literature: Why would sellers agree to contracts that leave them worse off? If contracts allow packers to keep prices below competitive levels, they also force lower long-term prices on sellers as a group (Posner, 2001). Several recent analyses specify conditions under which some sellers would agree to contracts that harm sellers as a group:

- If there are many sellers, each accounting for only a small share of the market, each may believe that its own actions have no effect on longrun market outcomes. In that case, individual sellers will accept contracts that offer premiums above spot market prices and make those sellers better off. As many sellers accept such contracts, entry is deterred, the existing packer can exercise market power by reducing spot prices (as well as contract prices that are based on the spot price), and sellers as a group are made worse off (Rasmusen, Ramseyer, and Wiley, 1991; Aghion and Bolton, 1987; Innes and Sexton, 1994).
- A packer may offer a few sellers contract terms that make them unambiguously better off; if those contracts serve to deter entry, the packer can exercise market power in the spot market, forcing prices down. In this case, the packer shares the profit from market power with a group of contract sellers (Stefanadis, 1998).

Finally, consider the third way that contracts could extend market power: price discrimination. This strategy does not create market power, but rather allows for greater exploitation of existing market power. Even then, it presents a difficult policy challenge because its effects are not unambiguously bad.

Price discrimination may not be easy to identify. Sellers may receive different prices not only because of price discrimination, but also because of differences in product quality, delivery times, reliability, and volume. Thus, efforts to limit price variation may limit the use of prices as quality incentives. Actual price discrimination can also occur as buyers compete with one another—note that TOMP pricing, for example, works as an anticompetitive device only if it eliminates outbreaks of localized price competition. Finally, even if prices are discriminatory (different prices for identical products), they may in some cases improve performance (Levine, 2002). In some markets, revenues may not cover the costs of large capital-intensive facilities without discriminatory prices. The alternative is an industry of smaller facilities with higher processing costs, higher product prices (leading to smaller quantities), and lower farm prices.

Evidence for Exploitation of Market Power Is Weak

Contracts can be structured to create market power for buyers and reduce farm prices. However, the success of such actions depends on the precise contract terms, as well as the structure of the particular markets and the responses of rival buyers. In order to create or extend market power, contracts must either limit entry by potential rivals into concentrated markets, limit the intensity of price competition by existing rivals, or allow for price discrimination by a firm that already has market power. Those terms, even if they are written into contracts, are unlikely to effectively create or extend market power unless the buying side of the market is highly concentrated, with some restraints on the easy entry of new rivals.

Recent research in agricultural economics has begun to highlight methods by which some contractual clauses can be used to exploit market power (see, for example, Xia and Sexton (2004) and Love and Burton (1999)), just as the research literature summarized above indicates that the details of contract design are important in assessing the effects of contracts on productivity. But we have no empirical work that assesses the incidence of monopsony-enhancing contract clauses, or their effects, in agricultural markets. Future research in this area would be needed to precisely identify the effects of specific contract clauses.

Chapter 7

Contracting, Vertical Coordination, and Price Discovery in Livestock Markets

USDA and other price reporting institutions acquire and disseminate large volumes of information on prices, product characteristics, and quantities traded in spot markets. These reports help markets work, because they provide unbiased information to aid market participants in making impending and future production and marketing decisions.

Contract prices are usually not publicly reported, and the effectiveness of spot markets can be eroded as contracting expands. The remaining sales may reflect a nonrepresentative set of transactions, making the reported prices an inaccurate reflection of activity, and market reports based on smaller samples can be less reliable. Further, some participants fear that thinning cash markets may make it easier for markets to be manipulated in favor of insiders. This weakening efficacy can spur further decline in the spot market. Spot market erosion may harm remaining spot sellers, who find it harder (more costly) to get buyers, and it can also harm contract sellers since marketing contract prices are frequently based on spot market prices.

From its earliest days, the USDA has provided agricultural market information to the public. In 1915, the first USDA market news report was issued at Hammond, LA, reporting prices and movement of strawberries. Prices for livestock were reported soon after in various formats, and a voluntary livestock price reporting system was in place at the USDA Agricultural Marketing Service (AMS) by 1946. Structural changes in the livestock industry after that generated concerns about price discovery and the value of voluntary price reporting, especially among feedlots and livestock producers. In particular, many observers believed that the use of contracts and vertical integration in supplying livestock led to poorer public market information because prices of these products were not reported as they moved through the system. In 1999, in response to these and other developments, congressional legislation—The Livestock Mandatory Price Reporting Act—required large meatpackers to report all livestock transaction prices to AMS. This section summarizes the policy issues surrounding livestock price reporting, links the issues to shifts of livestock away from spot markets and towards various forms of contracting, and reviews the 1999 legislation and some unresolved issues.

What Is Price Discovery, and Why Does the Government Provide Market Information?

USDA has frequently taken action to facilitate the functioning of spot markets in agricultural products, to speed up price discovery as well as to improve the reliability of reported prices. Early steps, aimed at improving the reliability of commercial transactions, initiated rules to protect sellers in

public markets from dishonest weighing and from financial insolvency of marketing firms and to ensure fair yardage charges and services.

Collection and dissemination of prices and other market information from many commodity and whole market areas facilitates price discovery. Under the Agricultural Marketing Act of 1946, AMS drew on voluntary price reports from market participants to publish "Market News," providing reports of price, quantities, and transaction characteristics for many commodities.

USDA also attempted to improve incentives in traditional spot market systems by introducing systems of quality and yield grade standards. Quality grades were first introduced in 1916 in support of more disaggregated and accurate price reporting, but were soon used independently to support public and private procurement specifications. Quality grades for livestock were introduced in 1923. They have been revised frequently, most recently in 1997, as USDA has tried to make them more precise indicators of carcass quality on which to base price. Yield grades provide a numerical five-point scale for evaluating yields of beef from a carcass, based on measurements of the thickness of fat at different points on the carcass. The quality and yield grade systems were developed in consultation with the industry, and USDA provides in-plant grading services, financed by a system of user fees paid by processors. Each system was designed to tie prices more closely to observable livestock characteristics, to provide more reliable indicators of market price movements, and to bolster producers' incentives to meet consumer demands.

What Went Wrong With the Traditional System?

Traditional livestock pricing systems became less effective at providing signals to producers, and in response some producer groups, packers, and retailers began to look for alternatives. As larger volumes of livestock began to move through alternative marketing channels, traditional systems also became less effective at orchestrating reliable price discovery—the process of assembling a series of prices in distinct transactions into useful market prices.

Demand for red meat began to slow and even decline in the mid-1970s, with corresponding declines in prices, in response to consumer changes in diet. This was in sharp contrast to the growing demand for marbled beef and the emphasis on family meals that had characterized the 1960s and early 1970s. Beef and pork producers did not quickly respond to the changes in consumer preferences, and demand strongly shifted toward poultry and fish (Purcell, 2002).

Ward (2001) asserts that the reason spot markets failed to respond to the changes in consumer demand, beginning in the 1970s, was that the markets did not provide accurate price signals to producers to develop products that consumers increasingly sought. He (along with others, such as Purcell) further argues that this failure drove processors and other intermediaries to develop alternative means of coordinating market supplies of livestock, such as vertical integration, alliances, grids, partnerships, producer-owned cooperatives, and contracts. Processors began addressing consumer concerns about fat in meat by trimming fat from carcasses, but they did so in the

absence of price incentives for farmers to produce lean carcasses. Without premiums and discounts for raising lean meat animals, producers had limited incentives to improve the quality of cattle delivered to market. There were similar issues with hogs, though not as pronounced as for beef, partly because live fat ("lard-type") hogs could more easily be visually identified from "lean-type" hogs.

Spot market livestock volumes appear to have continued to decline in recent years, although the available data are limited. We have already noted the dramatic shifts of market hogs out of spot markets and into contracts during the 1990s—spot markets handled only 17 percent of market hog transactions by 2000, down from 62 percent just 7 years earlier (Lawrence and Grimes, 2001). ERS estimates that 70 percent of hogs are currently sold under contracts (Martinez, 2002).

Several data sources also suggest that fed cattle sales shifted out of spot markets and into other marketing channels with less reliable public price reporting. USDA reports showed that "captive" supplies accounted for between 20 and 25 percent of steer and heifer slaughter, with no noticeable trend since 1979. Spot market volumes appeared to be holding steady. USDA defines "captive supplies" of cattle to be packer-fed cattle (those owned by the packer more than 14 days before delivery) and those committed to a packer under a forward contract or marketing agreement at least 14 days before slaughter. Complaints from producers that packers were manipulating the market have resurfaced recently. Some State legislatures responded by banning "captive" supplies and by regulating packer ownership of animals.

When USDA's Grain Inspection, Packers and Stockyards Administration (GIPSA) audited the 1999 captive reporting statistics from the four largest packers, the audit revealed that captive supplies had been underreported because of errors, misunderstandings, and inconsistencies in the way packers had reported the data (U.S. Department of Agriculture, 2002). Amended data showed that captive supplies accounted for 32 percent of cattle acquired by the four largest packers in 1999, and not 25 percent as originally reported. Moreover, when the improved process was repeated the following year, captive supplies jumped to 38 percent of the four largest packers' cattle acquisitions in 2000.

Thus, spot market volumes (those not reported as captive supplies) appeared to be considerably smaller than the prior unaudited data suggested, and they appeared to be declining sharply. The pattern reported in GIPSA statistics of recent sharp erosion in cash markets for fed cattle accords with results from a survey of cattle feeders reported by Schroeder, Lawrence, Ward, and Feuz (2002). Respondents moved 90 percent of their cattle through cash markets in 1996, but that fell sharply to 55 percent in 2001, and feeders expected to move only 36 percent of their cattle, on average, through cash markets in 2006.

Other analyses suggest a substantial decline in spot market fed cattle volumes in the 1990s, with a concomitant increase in cattle moving under alternative marketing arrangements. For example, Schroeder, Grunewald, and Ward (2002) reviewed trends in "additional movement" cattle in weekly reports by USDA's Agricultural Marketing Service (AMS)—representing cattle moving to packers that were not sold during the week on a negotiated

basis and hence were not captured in AMS pricing reports. The volume of such cattle rose sharply between 1995 and 2001, from 17.2 percent of all fed cattle marketings in the major feedlot States of Colorado, Kansas, Nebraska, and Texas in 1995 to 46 percent in 2001 (fig. 7-1). Those shifts suggest that, consistent with the revised GIPSA data, a large and increasing share of cattle is moving outside traditional spot market channels.

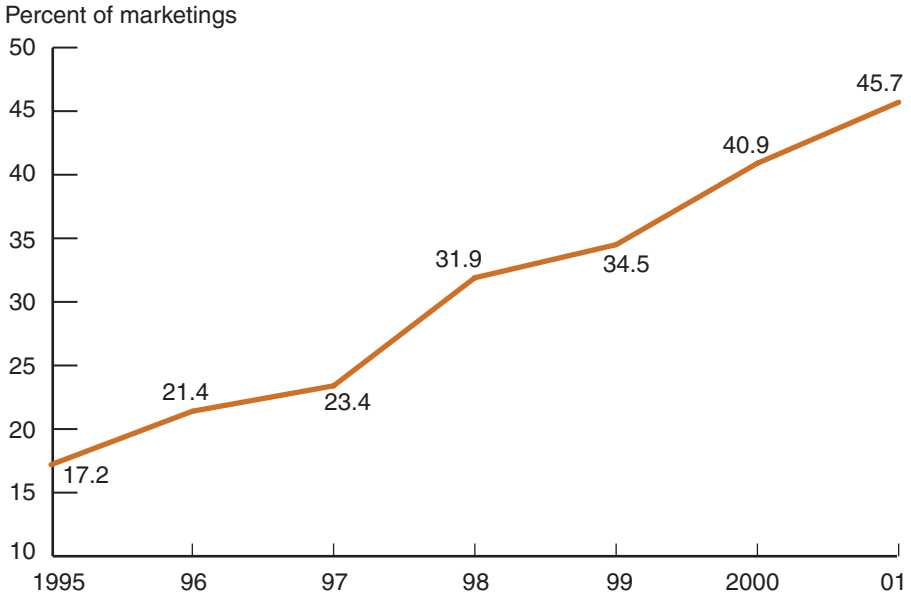
As contracts and vertical integration accounted for larger shares of livestock sales, fewer producers sold livestock through spot markets, and spot market volumes became substantially thinner. Schroeder, Grunewald, and Ward provide information here as well, summarized in figure 7-2. AMS releases daily reports from locations around the country summarizing prices and volumes of livestock transactions.[1] During the 1990s, their reports became far less likely to quote a price for fed cattle. In the early 1990s about 10 percent of daily local fed cattle cash market prices for Kansas and Texas were not reported because of insufficient trading volume—that is, not enough trades were reported for AMS to report a market price. By 2000, daily cash trades had thinned so much that AMS was not reporting prices in 60 percent of daily reports from those States.

As the transactions underlying price reports became fewer, two distinct reporting problems ensued, reliability and bias. Because reported prices were based on fewer and fewer transactions, they became less reliable indicators of the central tendencies of actual transactions prices. Next, to the extent that there were systematic differences in quality between livestock priced in spot markets and those moving through alternative marketing arrangements, spot market price reports were a biased representation of typical prices in actual transactions. Koontz (1999) compared transactions prices on over 108,000 pens of cattle marketed between June 1986 and June 1993 with voluntary AMS reports, and found that voluntary price reporting appeared to be inefficient

[1] See *http://www.ams.usda.gov/marketnews.htm* for all the AMS Market News reports.

Figure 7-1

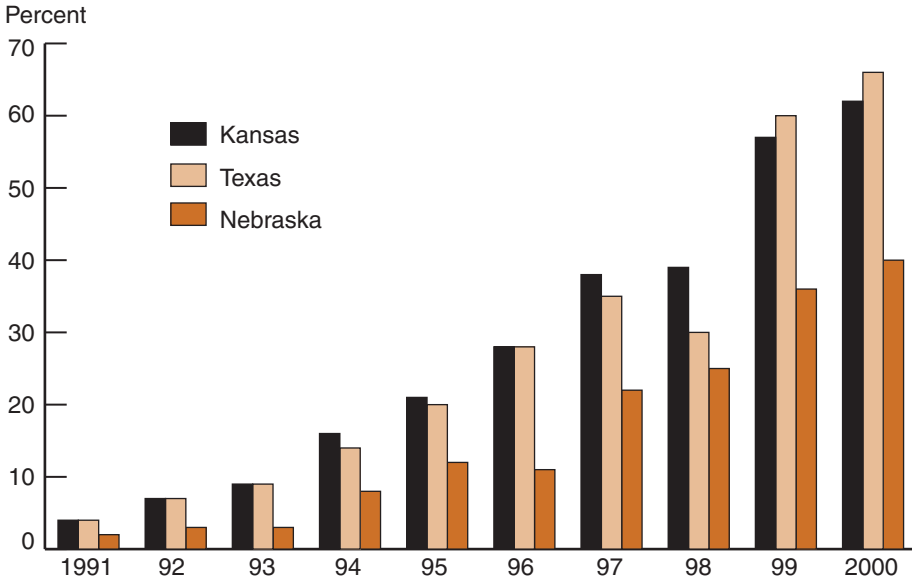
"Additional movement" fed cattle marketings in Colorado, Kansas, Nebraska, and Texas



Source: Schroeder, Grunewald, and Ward (2002).

Figure 7-2

Percent of business days fed cattle cash price was not reported, 1991-2000



Source: Schroeder, Grunewald, and Ward (2002).

during times when prices were changing substantially. In particular, the price range reported by AMS lagged behind actual transactions prices when prices were rising, and also reacted too slowly when prices were falling appreciably. Koontz concluded that packers and feedlots were reporting prices selectively when prices were moving against them, biasing voluntary price reports.

The Start of Mandatory Price Reporting

Price reporting for most commodities remains voluntary. However, in response to producer concerns, the Livestock Mandatory Price Reporting Act of 1999 (LMPR), published in the Federal Register on December 1, 2000 (65 FR 75464), requires the posting of prices paid to producers for their animals and for meat under certain circumstances. The Act aimed to "make the reporting on market information mandatory, (in order to) facilitate price discovery, make the market open, and provide all market participants with market information that can be easily understood." Dan Glickman, Secretary of Agriculture at the time of passage, noted as he announced the program:

> We need to ensure that small farmers and ranchers have a full and fair opportunity to compete in an increasingly concentrated agricultural economy. This new mandatory price reporting program will help producers by making the market more transparent, giving them better information about what's happening in the marketplace.

The LMPR established a mandatory program of reporting information regarding the marketing of cattle, swine, lambs, and products of these animals. As implemented, packers who annually slaughter an average of 125,000 cattle or 100,000 swine, or slaughter or process an average of 75,000 lambs, are required to report selected details of all transactions

involving purchases of livestock to AMS. All transactions involving domestic and export sales of boxed beef cuts are included, along with applicable branded products, sales of boxed lamb cuts, including applicable branded products, and all sales of lamb carcasses. Importers are required to report the sales of all imported boxed lamb cuts, and voluntary reporting continues for smaller entities. This program is intended to provide information on pricing, contracting for purchase, and supply and demand conditions for livestock, livestock production, and livestock products that can be readily understood by producers, packers, and other market participants. The LMPR preempted similar prior legislation in five States—Iowa, Minnesota, Missouri, Nebraska, and South Dakota. State legislation brought on intense debate, amid concerns that the legislation would disadvantage firms within affected states by raising their costs and putting them at a bidding disadvantage compared with firms in States that did not have to report prices (Wachenheim and DeVuyst, 2001; Wilson, Dahl, and Johnson, 1999).

Mandatory price reporting for livestock was designed to improve information available to producers to facilitate the price discovery process. After passage of the LMPR, AMS added a large number of new reports and increased the information in the reports, resulting in a great deal of new price reporting information. Confidentiality concerns complicated the production of early AMS reports.[2] Upon initiating the LMPR program in April 2001, USDA aimed to preserve confidentiality by following a "3/60" reporting guideline. Data would only be published if at least three reporting entities had supplied it, with no single entity responsible for 60 percent or more of the data underlying a statistic. The rules resulted in substantial withholding of data from the public. According to Schroeder, Grunewald, and Ward, between April 2, 2001 and August 17, 2001, before the confidentiality rules were modified, 81 percent of regional and national daily afternoon direct-slaughter negotiated purchase prices were not reported because of confidentiality restrictions.

[2] See *http://www.ams.usda.gov/lsmn-pubs/mpr/rule.htm* for more information about AMS implementation of the mandatory price reporting rule.

AMS responded by developing new "3/70/20" confidentiality guidelines. These specified that for the 60 days prior to a report, at least three entities needed to provide data at least half of the time, no single entity could provide more than 70 percent of the data for a report, and no single entity could be the sole reporting source for an individual report more than 20 percent of the time. With the modified confidentiality guidelines, all reports of regional and national daily direct-negotiated purchases were made without confidentiality breaches. Before modification of the guidelines, only 24 percent of regional fed cattle morning reports were released; reporting frequency for the morning reports rose to 77 percent after modification (Schroeder, Grunewald, and Ward).

Confidentiality guidelines present a difficult challenge for USDA. Note that LMPR imposes the reporting requirement on packers. Cattle slaughter is so concentrated—in many regions, only three or four packers may be active—that confidentiality guidelines designed to protect the information of individual reporting entities may often apply, restricting the release of market news. The issue is of less concern in hog slaughter, where the four largest packers handled 57 percent of hog purchases in 2000. We should note that confidentiality restrictions do not solely protect information providers, even

when that is the primary intent. Market information systems that detail actual individual transactions prices can abet collusive agreements, especially in concentrated industries. For example, suppose that cattle buyers agreed among themselves to refrain from competing aggressively and aimed to set artificially low prices for cattle. A system that reported extremely detailed price information would then ensure that any colluder attempting to secretly renege on the agreement would be found out, and the information system would thereby support the collusive agreement restricting competition.[3]

[3] See Posner (2001) for a general description of the issue, and Wachenheim and DeVuyst (2001) for an application to mandatory price reporting.

We have only limited information on the effects of livestock mandatory price reporting, which was initiated in 2001. Effective implementation took several more months while USDA tailored the confidentiality restrictions and adjusted processes to compile reported prices into accurate and useful price reports.

AMS daily and weekly reports now specify price ranges for a wide variety of transactions. Based on early data, it appears that spot market livestock sales may have stabilized after a long period of decline. Data from AMS reports indicate that negotiated (spot market) live and carcass sales have remained relatively stable and well above 50 percent of the market through the summer of 2003. While spot market hog sales fell steadily through the 1990s to 17 percent of sales in 2001, the decline ended and the spot market maintained its market share in 2002.

Schroeder, Lawrence, Ward, and Feuz (2002) surveyed cattle feeders' views of LMPR. Few producer respondents felt that mandatory price reporting had enhanced their ability to negotiate better prices with buyers, and there was clearly no consensus on whether LMPR had benefited the beef industry—opinions on that issue varied widely. A large majority of respondents strongly agreed with the statement that LMPR had not been as beneficial as they expected. Specifically, respondents were given a scale for answers, with 1 corresponding to "strongly disagree" and 9 corresponding to "strongly agree." Thirty-eight percent of respondents chose 9, while 37 percent picked 7 or 8, also indicating strong agreement.

It is important to place the responses in context. Prior to passage of LMPR, many producers argued that cash market prices were systematically lower than prices offered for captive supplies, although academic research had found only modest differences. Producers may have expected LMPR to show a large gap between cash and contract prices, and to lead to a narrowing of that gap. But data collected under LMPR does not reveal differences in prices received between contracts and negotiated (spot market) transactions. If price discrimination was not occurring in cattle markets, LMPR could hardly be expected to correct it.

Spot prices in competitive markets are relevant only to the extent that they provide information about the value of products moving through the whole system. LMPR addresses facets of the issue of the range and reliability of reported transactions prices as vehicles for discovering market prices. That may not be the most important element in the decline of spot markets for livestock. If spot market pricing systems do not provide producers with useful quality signals, then we are likely to see a continuing shift to more explicit forms of vertical coordination— through contracts and packer ownership—to ensure more consistent livestock and meat qualities.

Chapter 8

Findings and Research Gaps

In previous sections, we used USDA data to describe the broad contours of agricultural contracting in the United States and relied on existing data and research to assess what we know about the causes and effects of contracting. Here, we summarize what we have found and identify some major research gaps and the contracting topics where the existing evidence is weak. We organize our discussion around three themes: the growth of contracting, who contracts and why, and government policy towards contracting.

The Growth of Contracting

Production and marketing contracts cover a large and increasing share of U.S. agricultural production. Contracts governed 36 percent of the value of production in 2001, up from 28 percent in 1991 and 12 percent in 1969. While overall data for agriculture provide an impression of a steady expansion in the use of contracts, data for specific commodities show that dramatic shifts can occur quite quickly. Tobacco and hogs each shifted rapidly to widespread use of contracts in just a few years, and producers expect a sharp expansion of contracting in fed cattle.

The shifts in some commodities are quite striking and raise several important questions. Specifically, do spot markets require certain volumes of trade to be effective and viable institutions? Are there "tipping points" in the use of spot markets—can spot markets become thin enough to lead remaining spot market users to shift rapidly to contracts?

Food companies face increasing pressure to document where and how their products were produced and distributed through the food system, from farms to processors to consumers. Such traceability facilitates food safety and pollution control, as well as the identification of differentiated products with valuable but subtle quality characteristics. Because contracting provides one way to achieve traceability, we expect contracting's share of agricultural production to continue to grow over the next decade. There are still a number of important unanswered questions. How important will traceability be, and will contracts be the primary means of assuring it? Will contracting to ensure traceability lead to sharp downward shifts in the use of spot markets?

Who Contracts, and Why?

Our data provide considerable detail on who uses contracts. Contracts and vertical integration now govern the production and marketing of most poultry, a majority of hogs, and a large share of fed cattle. Among crops, contracts dominate the exchange of tobacco and are important for producers of cotton, rice, and sugar beets. But spot markets still dominate the exchange of major grain and oilseed crops like corn, wheat, and soybeans and show no evidence of decline for these commodities. Within broad

commodity groupings, contracts are far more likely to be used by larger producers for more-differentiated products.

The more challenging question is why market participants rely on contracts, a question that may yield different answers for contractors and producers. Many producers cite reduced price risks from contracts, and we find that contracts clearly can be designed to greatly reduce such risks. But risk reduction is not a strong explanation for the growth in contracting; producers can use a variety of other methods to reduce price risks. Furthermore, if the primary effect of contracting was to reduce grower risks, then we would expect to see contract farmers receiving lower prices, on average, because risk reduction comes at a price. However, we find that contract prices frequently exceed average market prices for some commodities, and some producers may contract more to secure higher prices than to reduce price risks.

Higher prices are likely paid for supplying buyers with commodities of uniform or special attributes, often with a higher cost of production, or for guaranteeing a specified quantity of a product at a specified time. Buyers can ensure that they acquire the attributes they seek by using production contracts that govern inputs and production methods. Or they can use marketing contracts that offer price premiums for products that consistently meet attribute requirements. For example, contracts allow buyers to purchase meat from animals raised on organic feed, or from cattle with a certain type of genetic stock such as Black Angus. Similarly, buyers of processing tomatoes may seek different qualities needed for different processed products, while some corn or soybean buyers seek nonstandard products with specific attributes, such as corn high in oil content or high-oleic soybeans.

Producers of such differentiated products have good reason to seek the protection of a contract. Differentiation often requires producers to make new investments to achieve the desired attributes, and it also leaves the producer dependent on one or a few buyers of the product. To avoid the potential use of market power, producers may seek contracts that provide assurances of compensation for their investments.

Our research gaps lie in many of the details of contract incentives and design, which can be grouped into four topics. First, contract lengths can vary widely, even for producers of the same product. On average, hog contracts specify lengths of several years, although that can vary considerably. Most broiler contracts cover a single flock, although some do cover longer periods. Growers make long-term investments in each case, so additional research is needed to determine why short-term contracts are used. The issue is an important one in the broader economics literature on contracting (Masten, 1996), and it is an important missing element in our knowledge.

Second, contracts often specify widely different methods for determining prices and fees, even for growers of the same commodity. For example, many (although not all) broiler production contracts are designed as relative performance contracts, with base compensation on a grower's performance relative to a control group of other contract growers. Hog production contracts also may base compensation on relative performance, but it is

most commonly based on a formula, not relative to performance of a control group. Production contracts in horticulture frequently are designed as flat-fee contracts, in which growers bear no price risks but have substantial yield risks. Moreover, contract compensation structures appear to vary widely over time—there is a great deal of experimentation in them. We know very little about why different compensation arrangements are chosen and only a limited amount about how different contract designs affect grower performance.

Third, our discussion has generally been framed as a choice between contracts and spot markets, with little reference to a third alternative, vertical integration, which combines agricultural production and food processing under a single firm. One of the distinctive aspects of industrialized agriculture is that it is still carried out primarily by family-operated farms that are not very large businesses in terms of assets, employment, or sales. In turn, large processing and distribution corporations source their agricultural products through contracts with many small businesses, instead of operating the farms themselves.

We know from the 2002 Census data that farms owned by nonfamily corporations with more than 10 stockholders account for less than 2 percent of all agricultural sales, and that more than 98 percent of sales is accounted for by farms organized as sole proprietorships, partnerships, family corporations, and closely held nonfamily corporations. Anecdotal evidence suggests that small shares of fed cattle, broiler, turkey, and hog production are carried out on processor-owned farms. Vertical integration is not common in grains and oilseeds, and limited evidence suggests that it is declining in favor of contracting in fruit and vegetable markets.

We know very little about the tradeoffs of using vertical integration instead of spot markets or contracting. In particular, we know little about why some livestock processors choose to vertically integrate for some—but not all—of their supplies, and about whether vertically integrated farms perform more efficiently than independent contract operations. Consequently, we know very little about the circumstances in which vertical integration might be an efficient way to organize production.

Finally, while we know contracts can be designed to remove much price risk, and while surveys of growers cite risk reduction as one reason for contracting, we have only limited evidence on the actual effects of contracting on risk reduction, as well as the effectiveness of contracting vs. that of other methods in controlling price and output risks. In particular, we know very little about how changes in government policy, such as offering commodity programs or subsidized crop insurance, affect the use of contracting as a device to control risks.

Contracting and Government Policy

Contracts are part of the continuing shift to a more industrialized agriculture, and their growth causes controversy. Some of the controversy arises when contract producers realize lower costs or provide products that better meet consumer demand, taking business away from spot market participants. However, the controversy also reflects concern over buyer market power.

Contracts are often used in concentrated markets with few buyers, and we have shown that certain contract terms may, under the right market conditions, allow buyers to impose lower prices on producers in those markets—making the exercise of market power an issue of real concern in contract markets. But because contracts can lead to enhanced productivity and responsiveness to consumer demand, broad actions to ban or limit their use run the risk of raising production costs and reducing demand for farm products. Thus, it is important to distinguish those contract terms that extend market power without offsetting efficiency. Here we have considerable theoretical literature (such the articles referenced in Kwoka and White, or the specific agricultural analyses in Xia and Sexton or Love and Burton), but very limited empirical evidence from contract markets. In particular, we have little evidence on the extent to which rival firms use pricing clauses that create incentives to limit competition among themselves in the spot or contract markets.

In many livestock markets, particularly those governed by production contracts, processors and integrators contract with growers for services, not for animals. That is, the contractors provide growers with animals and many inputs, and growers provide labor, energy, and capital. In those cases, quite common in poultry and hog production, market power (or monopsony) in the market for animals is not the issue; rather, the important question of competition revolves around monopsony in the labor market for growers and whether growers have alternative outlets for work. While we understand where the competitive issue lies in these markets, we have virtually no empirical evidence on the extent of contractor monopsony in markets for contract growers.

Contracting provides a continuing challenge for government policy and for market performance in the area of information. We reviewed the effects of contracting's growth on the USDA voluntary price reporting program for livestock, as well as the early impacts of the statutory and regulatory response (mandatory reporting of contract and cash transactions). Thinning cash markets present a broad challenge, since many contract-pricing formulas use cash market prices as a base. We face several research challenges in this case. For example, do we observe poorer market performance when price reports are based on thin volumes of trade? Are there feasible alternatives to cash prices, such as input prices or retail/wholesale product prices, to serve as bases for contract prices? To what extent do market participants need market information on product attributes, in addition to base cash prices?

The expanded use of contracts to control food safety, food attributes, and production attributes through the food chain provides two sets of policy challenges. First, regulatory agencies will need to assess whether contractual arrangements provide incentives that benefit growers as well as buyers. Also, they will need to evaluate the placement of monitoring agents (perhaps third parties such as insurance companies or outside certifiers) who can ensure that contractual terms are carried out.

Second, spot markets can be used to deliver desired levels of food safety and product attributes when those characteristics are easy to measure at time of sale; buyers turn to contracts when measurement technologies are inef-

fective. The traditional advantage of spot markets—providing signals that can lead to efficient production—is still advantageous for the marketing of many farm products. Public and private investments have supported spot markets in the past by designing market institutions, providing market pricing and supply information, identifying marketable attributes, developing attribute measurements, and linking prices with those attributes. The extent of spot markets in the future will depend, in part, on the degree to which pricing systems can keep up with changes in product attributes and consumer demand. That, in turn, will depend on the public and private development of production and measurement technologies to bring those products' attributes to the market.

References

Aghion, P., and P. Bolton. "Contracts as a Barrier to Entry," *American Economic Review* 77 (June, 1987):388-401.

Ahearn, Mary, Jet Yee, and Wallace Huffman. "The Effect of Contracting and Consolidation on Farm Productivity." Paper prepared for University of Maryland Workshop on Economics of Contracting in Agriculture, Annapolis, MD, July 21, 2002a.

Ahearn, Mary, Jet Yee, and Wallace Huffman. "The Impact of Government Policies on Agricultural Productivity and Structure: Preliminary Results." Paper presented at the annual meeting of the American Agricultural Economics Association, Long Beach, CA, August, 2002b.

Allen, Douglas W., and Dean Lueck. *The Nature of the Farm: Contracts, Risk, and Organization in Agriculture.* Cambridge, MA: The MIT Press. 2003.

Apple, R.W., Jr. "The Smoky Trail to a Great Bacon," *The New York Times*, February 16, 2000.

Balbach, Jeanine K. "The Effect of Ownership on Contract Structure, Costs, and Quality: The Case of the U.S. Beet Sugar Industry," in Jeffrey S. Royer and Richard T. Rogers, eds., *The Industrialization of Agriculture: Vertical Coordination in the U.S. Food System.* Aldershot, UK: Ashgate Publishing. 1998.

Ball, V. Eldon. "Output, Input, and Productivity Measurement in U.S. Agriculture, 1948-79," *American Journal of Agricultural Economics* 67 (August, 1985):475-86.

Ball, V. Eldon, John-Christophe Bureau, Richard Nehring, and Agapi Somwaru. "Agricultural Productivity Revisited," *American Journal of Agricultural Economics* 79 (November, 1997):475-86.

Barzel, Y. "Measurement Costs and the Organization of Markets," *Journal of Law and Economics*, 17 (April, 1982):27-48.

Capehart, Thomas. "Tobacco Industry Downsizing, Restructuring," *Agricultural Outlook*. US Department of Agriculture, Economic Research Service. AGO-288. January-February, 2002:8-11.

Carlton, Dennis W., and Jeffrey M. Perloff. *Modern Industrial Organization*. London: Pearson Education, 4th ed., 2004.

Chavas, J., and M.T. Holt. "Acreage Decisions under Risk: The Case of Corn and Soybeans," *American Journal of Agricultural Economics* 72 (1990):529-38.

Cochrane, Willard W. *The Development of American Agriculture: A Historical Analysis.* Minneapolis, MN: University of Minnesota Press, 2nd ed.,1993.

Christie, William G., and Paul H. Schultz. "Why Do NASDAQ Market Makers Avoid Odd-Eighth Quotes?" *Journal of Finance* 49 (December, 1994):1813-40.

Cronon, William. *Nature's Metropolis: Chicago and the Great West.* New York: W.W. Norton and Company, 1992.

Cutler, David M., Jonathan Gruber, Raymond S. Hartman, Mary Beth Landrum, Joseph P. Newhouse, and Meredith B. Rosenthal. "The Economic Effects of the Tobacco Settlement," Washington: National Bureau of Economic Research, Discussion Paper No. 7760, May 2000.

Dimitri, Carolyn. *Contracting in Tobacco? Contracts Revisited.* Washington: U. S. Department of Agriculture, Economic Research Service, TBS 254-01. June 2003.

Hamilton, Neil. *A Farmer's Legal Guide to Production Contracts.* Farm Journal, Inc., January 1995.

Harris, Marshall, and Dean T. Massey. *Vertical Coordination Via Contract Farming.* U.S. Department of Agriculture, Economic Research Service, MP-1073, 1968.

Hart, Oliver. *Firms, Contracts, and Financial Structure.* Oxford, UK: Clarendon Press, 1995.

Harwood, Joy, Richard Heifner, Keith Coble, Janet Perry, and Agapi Somwaru. *Managing Risk in Farming: Concepts, Research, and Analysis.* U.S. Department of Agriculture, Economic Research Service, Agricultural Economics Report No. 774, March, 1999.

Hayenga, Marvin, V., James Rhodes, Glenn Grimes, and John Lawrence. *Vertical Coordination in Hog Production.* U.S. Department of Agriculture, GIPSA-RR-96-5, May, 1996.

Hoppe, Robert A., and Penni Korb. "Farm Numbers: Largest Growing Fastest," *Agricultural Outlook* 295 (October, 2002):24-27. *http://www.ers.usda.gov/publications/AgOutlook/Oct2002/*

Higgins, Adrian. "On Eastern Shore Farm, A Future With Flowers," *The Washington Post*, June 22, 2003.

Hueth, Brent, and Ethan Ligon, "On the Efficacy of Contractual Provisions for Processing Tomatoes." Paper prepared for University of Maryland Workshop on Economics of Contracting in Agriculture, Annapolis, MD, July, 2002.

Hueth, Brent, and David A. Hennessy, "Contracts and Risk in Agriculture: Conceptual and Empirical Foundations." In Richard E. Just and Rulon D. Pope, eds., *A Comprehensive Assessment of Risk in U.S. Agriculture.* Boston, MA: Kluwer Academic Publishers, 2002.

Innes, Robert, and Richard J. Sexton. "Strategic Buyers and Exclusionary Contracts," *American Economic Review* 84 (June, 1994):566-84.

Johnson, C. Scott, and Kenneth A. Foster. "Risk Preferences and Contracting in the U.S. Hog Industry," *Journal of Agricultural and Applied Economics* 26 (December, 1994):393-405.

Key, Nigel. "How Much Do Farmers Value Their Independence? Estimating the Risk and Autonomy Premia Associated with Production Contracts," *Journal of Agricultural Economics*, forthcoming, 2004.

Key, Nigel, and William McBride."Production Contracts and Productivity in the U.S. Hog Sector," *American Journal of Agricultural Economics*, 85 (2003):121-33.

Knoeber, Charles R. "A Real Game of Chicken: Contracts, Tournaments, and the Production of Broilers," *Journal of Law, Economics, and Organization* 5(2), Fall 1989.

Knoeber, Charles. "Land and Livestock Contracting in Agriculture: A Principal Agent Perspective." In Bouckaert and de Geest, eds., *Encyclopedia of Law and Economic*., UK: Edwin Elgar Publishers, 2000.

Knoeber, Charles R., and Walter N. Thurman. "'Don't Count Your Chickens….': Risk and Risk Shifting in the Broiler Industry," *American Journal of Agricultural Economics* 77 (August 1995):486-96.

Koontz, Stephen R. "Accuracy of USDA Fed Cattle Price Reporting: Is Mandatory Price Reporting Needed?" Proceedings of the NCR-134 Conference on Applied Price Analysis, Forecasting, and Market Risk Management, Chicago, IL, April 1999, pp. 53-68.

Kwoka, John E., and Lawrence J. White. *The Antitrust Revolution: Economics, Competition and Policy.* Oxford, UK: Oxford University Press, 4th ed., 2004.

Lambert, David K., and William W. Wilson. "Valuing Varieties with Imperfect Output Quality Measurement," *American Journal of Agricultural Economics*, 85 (2003):95-107.

Lasley, Floyd A., William L. Henson, and Harold B. Jones. *The U.S. Poultry Industry: Changing Economics and Structure.* U.S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 502, February, 1983.

Lawrence, John D., and Glenn Grimes. *Production and Marketing Characteristics of U.S. Pork Producers, 2000.* Ames, IA: Iowa State University Staff Paper No. 343, August, 2001.

Lawrence, John D., Ted C. Schroeder, and Marvin Hayenga. "Evolving Producer-Packer-Customer Linkages in the Beef and Pork Industries," *Review of Agricultural Economics* 23 (Fall/Winter, 2001):370-85.

Leathers, H.D., and J.C. Quiggin. "Interactions between Agricultural and Resource Policy: The Importance of Attitudes toward Risk," *American Journal of Agricultural Economics*, 73 (1991):757-64.

Levine, Michael E. "Price Discrimination Without Market Power," *Yale Journal on Regulation* 19 (Winter 2002):1-36.

Loehman, E., and C. Nelson. "Optimal Risk Management, Risk Aversion, and Production Function Properties," *Journal of Agricultural and Resource Economics* 17 (1992):219-31.

Love, H. Alan, and D.M. Burton. "A Strategic Rationale for Captive Supplies," *Journal of Agricultural and Resource Economics* 24 (January, 1999):1-18.

MacDonald, James M., Michael E. Ollinger, Kenneth E. Nelson, and Charles R. Handy. *Consolidation in U. S. Meatpacking.* U.S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 785, February, 2000.

Manchester, Alden. *Rearranging the Economic Landscape: The Food Marketing Revolution.* U.S. Department of Agriculture, Economic Research Service, Agricultural Economics Report No. 660, April, 1992.

Martin, Laura A. "Production Contracts, Risk Shifting, and Relative Performance Contracts in the Pork Industry," *Journal of Agricultural and Applied Economics* 29 (December, 1997):267-78.

Martinez, Steve W. *Vertical Coordination in the Pork and Broiler Industries: Implications for Pork and Chicken Products.* U.S. Department of Agriculture, Economic Research Service, Agricultural Economics Report No. 777, April, 1999.

Martinez, Steve W. *Vertical Coordination of Marketing Systems: Lessons From the Poultry, Egg and Pork Industries.* Washington: U.S. Department of Agriculture, Economic Research Service, Agricultural Economics Report No. 807, May, 2002.

Masten, Scott E., ed. *Case Studies in Contracting and Organization.* New York: Oxford University Press, 1996.

McBride, William, and Nigel Key. *Economic and Structural Relationships in U.S. Hog Production.* U.S. Department of Agriculture, Economic Research Service, Agricultural Economics Report No. 818, February, 2003.

Parcell, Joseph, and Michael Langemeier, "Feeder-pig Producers and Finishers: Who Should Contract?" *Canadian Journal of Agricultural Economics* 45 (1997):317-27.

Patrick, George F., Wesley N. Musser, and David T. Eckman. "Forward Marketing Practices and Attitudes of Large-Scale Midwestern Grain Producers," *Review of Agricultural Economics* 20 (Spring/Summer, 1998):38-53.

Posner, Richard. *Antitrust Law*. Chicago, IL: University of Chicago Press, 2nd ed. 2001.

Pope, R., and R. Kramer. "Production Uncertainty and Factor Demands for the Competitive Firm," *Southern Economic Journal* 46(1979):489-501.

Purcell, Wayne. "Demand for Meat: Past, Present and A Look Ahead," Virginia Polytechnic and State University, Research Institute on Livestock Pricing. Prepared for presentation at the Meat Importers Council of America, Inc., New Orleans, LA, October 25, 2002.

Rasmusen, Eric B., J. Mark Ramseyer, and John S. Wiley, Jr. "Naked Exclusion," *American Economic Review* 81 (September, 1991):1137-45.

Reimund, Donn A., Martin J.R., and Moore, C.V. *Structural Change in Agriculture: The Experience for Broilers, Fed Cattle, and Processing Vegetables.* U.S. Department of Agriculture, Economics and Statistics Service, Technical Bulletin No. 1648, 1980.

Rogers, George B. "Poultry and Eggs." In Lyle B. Schertz, ed., *Another Revolution in U.S. Farming?* U.S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 441, April, 1979.

Schroeder, Ted C., Sarah Grunewald, and Clement E. Ward. "Mandatory Price Reporting in Fed Cattle Markets: Motivations and Implications." Paper presented at Council on Food Agriculture and Resource Economics Annual Symposium, Washington, DC, November 2002.

Schroeder, Ted C., John Lawrence, Clement E. Ward, and Dillon M. Feuz. *Fed Cattle Marketing Trends and Concerns: Cattle Feeder Survey Results.* Manhattan, KS: Kansas State University Agricultural Experiment Station and Cooperative Extension Service, June 2002.

Stefanadis, Christodoulos. "Selective Contracts, Foreclosure, and the Chicago School View," *Journal of Law and Economics* 41 (October, 1998):429-50.

U.S. Department of Agriculture, Grain Inspection, Packers and Stockyards Administration (GIPSA). *Captive Supply of Cattle and GIPSA's Reporting of Captive Supply.* January 11, 2002.

U.S. Department of Agriculture, National Agricultural Statistics Service (NASS), *Agricultural Economics and Land Ownership Survey (1999),* in *Census of Agriculture, 1998*, Volume III, Special Studies, Part IV. AC87-RS-2, July, 2001.

U.S. Department of Commerce. *1960 Sample Survey of Agriculture,* in *Census of Agriculture*, 1959, Volume V, Special Reports, Part 5. 1962.

U.S. Department of Commerce. *1979 Farm Finance Survey,* in *Census of Agriculture, 1978*, Volume V, Special Reports, Part 6. AC78-SR-6, July, 1982.

U.S. Department of Commerce. *Agricultural Economics and Land Ownership Survey (1988)*, in *Census of Agriculture, 1987*, Volume III, Related Surveys, Part 2. AC87-RS-2, July, 1990.

Wachenheim, Cheryl, and Erik DeVuyst. "Strategic Response to Mandatory Reporting Legislation in the U.S. Livestock and Meat Industries: Are Collusive Opportunities Enhanced?" *Agribusiness* 17 (Spring 2001):177-95.

Ward, Clement. *Beef Industry Alliances and Vertical Arrangements.* Stillwater, OK: Oklahoma State University Extension Facts, WF-563, December 2001.

Williamson, Oliver. *The Economic Institutions of Capitalism.* New York: The Free Press, 1985.

Xia, Tian, and Richard Sexton. "The Competitive Implications of Top of the Market Pricing and Related Contract-Pricing Clauses," *American Journal of Agricultural Economics* 86 (February, 2004):124-39.

Appendix: Data on Agricultural Contracts

Comprehensive attempts to survey agricultural contracts began in 1959 when the Census Bureau collected information about contracts in a sample survey following the 1959 Census of Agriculture (U.S. Department of Commerce, 1962). That survey found that approximately 147,000 farms (less than 5 percent of all farms) had contracts for producing or marketing 14 specific commodities. Answers to questions on the timing and terms of the contract, input provision, payment determination, and contract origins showed that contracting was already a well-developed farm production and management tool.

The bureau collected contract information in later follow-on surveys to the Agricultural Census, starting with a 1969 survey that distinguished between marketing and production contracts on farms with sales of $2,500 or more (U.S. Department of Commerce, 1973). Production contracts were found on 84,000 farms, mostly dairy, poultry, and vegetable farms. Among farms that reported contracts for specific commodities, the 1969 value of production of those commodities came to $5.4 billion, nearly 12 percent of that year's total value of all production across all farms. A 1977 follow-on survey also provided specific data on contract terms, but was limited to eight commodities in some regions.

The Census Bureau conducted a third survey in 1979, the Farm Finance Survey, to measure the use of production (but not marketing) contracts on U.S. farms in 1978 (U.S. Department of Commerce, 1982). Results indicated that 43,665 farms (1.9 percent of all farms) used production contracts, covering $12.8 billion of farm production, or just over 10 percent of the total value of production in that year. In 1989, the bureau queried U.S. farmers in the Agricultural Economics and Land Ownership Survey (AELOS) about 1988 production contracts. The results showed modest growth since 1979—the value of commodities produced totaled about $17.9 billion, 13 percent of the total value of production (U.S. Department of Commerce, 1990).

USDA's National Agricultural Statistics Service (NASS) conducted the 1997 Census and the 1999 AELOS. Production contracts in the 1999 AELOS covered about $33 billion, 17 percent of the total value of 1999 production (U.S. Department of Agriculture, 2001).

The U.S. Department of Agriculture has collected annual data on contracting by commodity and type of contract (production and marketing) for U.S. farms in the 48 contiguous States (excluding Alaska and Hawaii) in the annual Farm Costs and Returns Survey (FCRS) during 1988-1995, and since 1996 in its successor, the Agricultural Resource Management Surveys (ARMS). The FCRS did not cover the entire farm population of the 48 contiguous States prior to 1991 (most but not all of the undercoverage was on farms with sales less than $40,000). In 1991, the FCRS design was modified to provide complete coverage of the farm population and to better adjust for nonresponse. Our presentation draws on some supporting information from Census data, but relies primarily on ARMS and FCRS records.

Appendix table 1—Data on contracting from the U.S. Census of Agriculture

Year	Census or follow-on survey?	State-level data	Farms covered	Dollar value of production for contract?	Contract categories[1]
1960	Survey	No	All	No	C
1964	Census	Yes	All	No	P
1965	Survey	No	All	No	P
1969	Census	Yes	Sales > $2,500	No[2]	PMC
1974	Census	Yes	Sales > $2,500	No[3]	PMC
1977	Survey	Yes	Sales > $2,500	No	PMC
1979	Survey	Yes	All	Yes	P
1988	Survey	Yes	All	Yes	P
1999	Survey	Yes	All	Yes	P

[1] C: report combines production and marketing contracts; P: reports production contracts; M: reports marketing contracts.
[2] Value of commodity production reported for commodities on farms with contracts for those commodities. Overstates value of contract production by the amount of cash (non-contract sales) on those farms.
[3] Surveys farms contacted in 1974 Census, for eight commodities, in limited regions.

Source: Agricultural Census, U.S. Department of Commerce, Bureau of the Census, and follow-on surveys, 1960-1988; 1999 Agricultural Census, U.S. Department of Agriculture, National Agricultural Statistics Service.