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Farm Use of Futures, Options, and Marketing Contracts

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Abstract

Farming can be a risky endeavor. Weather, pests, and disease can diminish the output from a field or herd. Changes in prices can reduce revenues or increase costs. Farmers may manage the risks from market price fluctuations by using agricultural derivatives, such as futures and options contracts, and committing some production to marketing contracts. This study uses data from the 2016 Agricultural Resource Management Survey to describe the use of futures, options, and marketing contracts by producers, with a primary focus on corn and soybeans.

Keywords: risk management, futures contracts, options contracts, marketing contracts, agricultural derivatives

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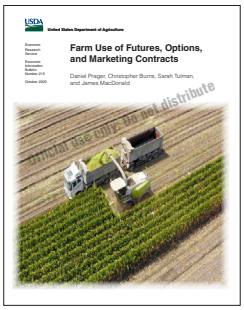


Farm Use of Futures, Options, and Marketing Contracts

Daniel Prager, Christopher Burns, Sarah Tulman, and James MacDonald

What Is the Issue?

Farm producers must contend with forces beyond their control. Weather, including droughts and floods, can diminish the anticipated output from a field or herd, and changes in product or input prices can decrease anticipated revenues or increase anticipated costs. Farmers may use on-farm strategies, such as commodity diversification, to manage such risks, and they may also draw on Federal risk management support programs, including commodity support programs, Federal crop and livestock insurance, and disaster assistance. Market mechanisms are also available to farmers who can use agricultural derivatives—such as futures and options contracts—and marketing contracts to protect against price fluctuations. These tools can help guarantee producers an established price before harvest.

Futures, options, and marketing contracts each have pros and cons. Strategies to manage risk can vary in key ways: with ranges in upfront costs, flexibility of contract terms, risk of default by the other party; and ease of closing out a contract. This study describes these risk management strategies and describes the use of futures, options, and marketing contracts by producers, with a primary focus on corn and soybeans.

What Did the Study Find?

- In 2016, more than 156,000 farms used marketing contracts and over 47,000 farms used futures or options contracts to hedge price risks. Farmers used futures and options contracts across a range of commodities, with corn and soybeans accounting for the bulk of farmer use. These commodities are the primary focus of this report.
- While just over 10 percent of corn and soybean farmers traded in futures contracts, those who did covered a substantial fraction (over 40 percent) of their production. Similarly, while only 20–25 percent of corn and soybean farmers used marketing contracts, those who did covered over 40 percent of their production with marketing contracts.
- However, few of them (6 percent of corn farms and 8 percent of soybean farms that used futures) hedged all their production through the futures market.
- Farmers often use a portfolio of risk management tools. Those who use marketing contracts are much more likely to use futures and options than farmers who do not use marketing contracts. They are also more likely to invest in on-farm storage of their crops, which facilitates their ability to vary marketing volumes over time.

- Agricultural futures and options are used most often by larger corn and soybean farms as a means of hedging against potential fluctuations in price. Farm operator age and education are also associated with futures and options use. Nearly 18 percent of college-educated corn and soybean farmers used futures, as did nearly 25 percent of operators who were 35 or younger. Farms with debt are also more likely to use derivatives than farms without debt: among all farms, only 10 percent used futures as compared with over 15 percent for those with debt.

How Was the Study Conducted?

This study is based primarily on data from the 2016 Agricultural Resource Management Survey (ARMS), a large annual survey of U.S. farms. Conducted by USDA's National Agricultural Statistics Service (NASS) and Economic Research Service (ERS), the survey is representative of the 2 million farms in the 48 contiguous States. The survey elicits information on farm production, farm and farm household attributes and finances, and production and marketing practices. ERS added supplemental questions on risk management practices to the 2016 ARMS questionnaire, including questions on the use of futures and options, and linked responses to these questions to other questions—on the use of marketing contracts, commodity mix, farm size, and operator attributes—that appear in each year of the survey.

Farm Use of Futures, Options, and Marketing Contracts

Introduction

In agriculture, threats to operating a successful enterprise may come from many sources. Crop yields can decline due to pest pressure, weeds, excessive heat or cold, drought, or flooding. Livestock are susceptible to diseases, extreme weather, and other pressures. Prices—for agricultural commodities and for inputs—may rise or fall sharply. The ability of farmers to manage these risks and bring their costs below the revenue they receive allows them to turn a profit on their operations.

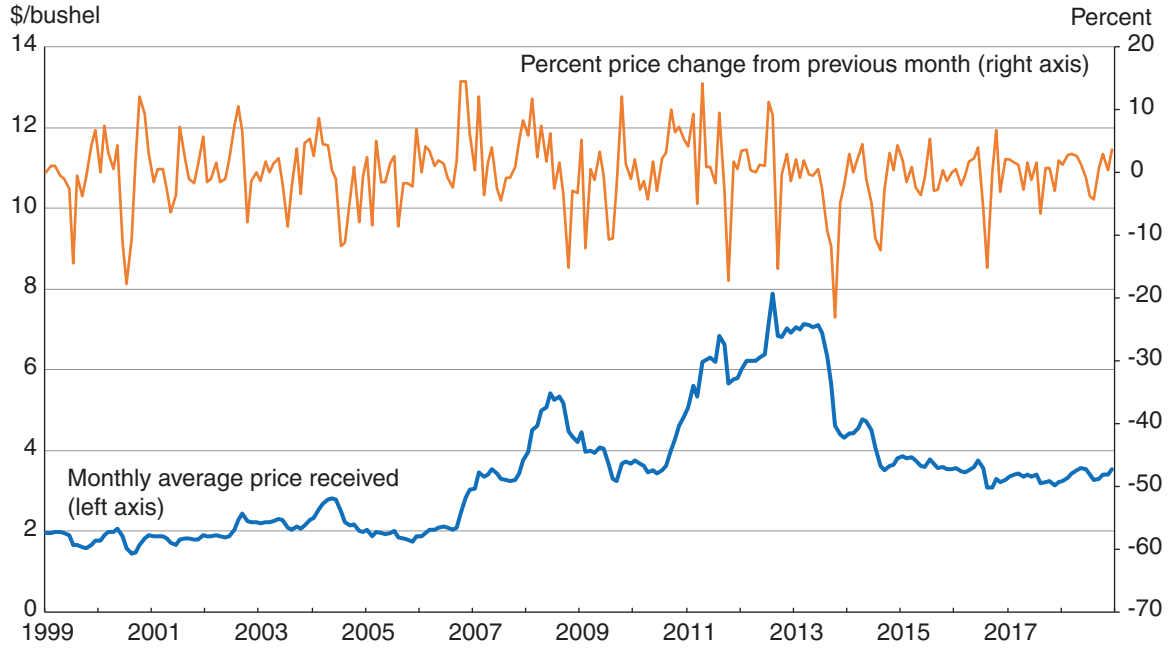
Much of the risk faced by farmers and ranchers can be grouped into six categories:[1]

- Price risk arising from uncertainty about prices received for output (if selling a commodity) or paid for inputs (for example, a livestock operation purchasing feed).
- Production (yield) risk due to the uncertainty of the growth process of crops and livestock, influenced by weather, disease, pests, and other factors that can affect the quantity and quality of agricultural outputs.
- Market risk due to uncertainty about finding a buyer or seller.
- Institutional risk resulting from uncertainty in government policies and programs that affect production and/or the farm or farm household's finances.
- Financial (repayment) risk arising from changes in interest rates, credit availability, or other credit market conditions.
- Human (personal) risk stemming from health or personal relationship issues that can affect the farm business, such as accidents, illness, death, and divorce.

This report focuses on output price risk. Prices for agricultural commodities can fluctuate widely over time. Consider figure 1, which tracks monthly average prices for corn received by Iowa farmers over 20 years (1999–2018). Prices averaged about $2 per bushel from 1999 through late 2005, then rose to $5.40 in early 2007, dropped to $3.40 by late 2009, and rose to a peak of $7.89 in 2012, before dropping to a range of $3.00–$3.40 in 2016–2018.

[1]Adapted from the Risk in Agriculture topic page, accessible from the USDA, Economic Research Service website.

Figure 1
Monthly corn prices in Iowa, 1999–2018



Source: USDA, Economic Research Service using data from National Agricultural Statistics Service, QuickStats database.

The top panel of the chart tracks monthly percentage changes in the price of corn. While the medium-term fluctuations noted above are quite large, the top panel highlights very sharp month-to-month shifts: over the 240 months covered, prices rose or fell by at least 10 percent in 26 of those months and rose or fell by 5–10 percent in another 36 months. Because this series is averaged across days in a month and across farmers in Iowa, these patterns understate the price fluctuations faced by individual farmers.[2]

Farmers may also face input price risks. Livestock producers purchase feed, which follows the movements in grain and oilseed ingredients. Crop producers purchase fertilizers, pesticides, and energy—commodities that can also show sharp month-to-month price fluctuations.

Farmers must make tillage, planting, and pest management decisions well before harvest, and hence well before prices are known. Prices apparent at the time those decisions are made can change sharply by the time crops are harvested and stored, and farmers are unable to make major changes to production decisions between planting and harvest. Because of wide fluctuations in product and input prices, and the inability to adjust production in response to price changes, farmers have a strong interest in methods of managing price and income risks. Farmers can hedge against price risk by locking in a price prior to sale. This can be done through the use of exchange-traded derivatives such as futures and options; through over-the-counter (OTC) instruments that are negotiated directly between counterparties, such as marketing contracts; and through production arrangements that transfer price risk

[2]We focus primarily on decisions made by farmers in 2016 because we were able to add questions on futures and options use to the 2016 Agricultural Resource Management Survey, which elicits information on farm production, farm and operator attributes, and the use of agricultural contracts in every year of the survey. By 2016, prices for major field crops had fallen from their 2011–13 peaks, but remained above pre-2008 levels, and displayed month-to-month volatility in line with other years (figure 1).

to third parties, such as production contracts.[3] In this report, price risk is discussed in the context of the price received for a commodity that the farm produces—for example, corn—or the price paid for a commodity that is used as an input—for example, a livestock farmer purchasing feed.

Strategies used by producers to manage price risk include:

- *Futures contracts.* A futures contract is an agreement to buy or sell a commodity or an asset at a predetermined price at a specific date in the future. Futures contracts are traded on organized exchanges and are standardized by quantity, delivery date, and location. Organized futures trading is often used for major agricultural commodities, where traders can opt for futures trading as a way of hedging against price risks for a commodity. Futures also require a deposit—or margin—from both parties to the contract. This can be adjusted daily for losses and gains from price changes. The margin account guards against the risk of a party accumulating losses that it cannot cover when the contract expires, and can guard against defaults on the contract (counterparty risk).[4]

- *Options.* Options offer the right (*but do not carry the obligation)* to purchase or sell an instrument at a set price, regardless of the market price at the time of sale. For agricultural commodities, the option is on a futures contract for a commodity, rather than on the commodity itself.

- *Marketing contracts.* Marketing contracts are agreements to exchange a specified asset for a certain price on a future date. They are neither standardized nor tradeable, as futures and options are, but are customized to the needs of specific buyers and sellers. They often include features such as price adjustments for quality, and they sometimes include commodity-specific features. Marketing contracts also reduce market risk by securing a buyer and a delivery window for the farmer's output.

- *Production contracts.* Production contracts are agreements under which a farmer agrees to raise livestock or crops for a contractor, which may or may not be another farm. The farmer is paid a fee for growing services, while the contractor provides key inputs and markets the product. Most input and output price risks are transferred to the contractor.

These contracts and derivatives form part of an overall risk management strategy employed by farms and farm households. As with other businesses, farms generally cannot eliminate all types of risk that come with running a business. Mitigating against price fluctuations can be an effective way for farm businesses to maintain a profit margin despite an oversupply or an unexpected fall in demand.

[3]Generally, a derivative is a contract between two or more parties that derives its value from the performance on an agreed-upon underlying entity. In agricultural production, the value of the derivative is typically based on a physical commodity, such as corn, wheat, or feeder cattle. Derivatives allow parties to trade specific financial risks to other entities who are more willing or better equipped to take or to manage those risks.

[4]The margin account is adjusted as prices fluctuate, and generally holds, for each party, enough funds to cover potential losses, should the contract be closed out that day.

Agricultural Futures and Options

Farmers looking to secure a price prior to harvest can accomplish this by purchasing an agricultural derivative. In this report, we look at two types of derivatives, futures and options. Both futures and options allow a producer to protect against swings in output prices. Although farms use exchange-traded derivatives such as futures and options less widely than marketing contracts, exchange-traded derivatives are an effective tool for managing price risk and form part of the risk management strategy for some farms, especially those with large grain and oilseed operations.

Futures Contracts

A party to a futures contract can take either a short or a long position. A short position is the obligation to sell the underlying commodity. For hedging purposes, this position is usually taken by a party that intends to sell the commodity in the future. For example, a corn farmer looking to hedge against price risk for that season's crop would take a short position in a corn futures contract. A long position is the obligation to buy the commodity in the future; for example, a feed lot operator looking to hedge the price of feed would take a long position in a corn futures contract. Futures contracts cover standardized volumes; for corn, soybeans, and wheat, a single contract covers 5,000 bushels.[5]

Farmers use futures contracts to secure a price and to protect price risks. For example, a corn producer may decide to sell a corn futures contract in May, after planting is completed, for December delivery. The producer can then hold the short position during the summer and fall and can buy out the futures position as the product is sold in cash markets in late fall. Any gains or losses in cash markets, due to fluctuations in the cash price, will be matched by offsetting gains or losses in the futures markets. This leaves the farmer better positioned to manage risks arising from fluctuations in cash price throughout the growing season.

Clearinghouses act as third parties for futures contracts, splitting the contract and acting as the buyer to the seller and as the seller to the buyer until the contract is settled. In any contract between two parties, there is a risk that one side will fail to uphold its contractual obligations. This is called counterparty risk. By serving as the effective counterparty for each side of the contract, the clearinghouse neutralizes counterparty risk for the contract holders, assuming that risk itself.

In the United States, the major markets for trading futures include the Chicago Mercantile Exchange (CME, including the Chicago Board of Trade), the Minneapolis Grain Exchange, and the Kansas City Board of Trade. While corn, soybeans, and wheat are the most commonly traded commodities, there is also trading in rice, cotton, live cattle, lean hogs, and dairy products.

The clearinghouse's counterparty risk is managed through margin requirements. When a party takes a position, it is required to place a margin deposit (or earnest money) in a brokerage account to cover potential losses. The size of the initial margin depends upon the contract, with the exact percentage determined by the futures exchange. As the futures price changes, the clearinghouse adjusts the value of each margin account (buyers and sellers) to account for losses (or gains) incurred in the futures market on the contract. If the adjusted value of a margin account drops below a threshold called the "maintenance margin," the clearinghouse issues a "margin call," and the holder of that account must transfer additional funds into the account and bring the adjusted value of the margin

[5]There is also futures trading in "mini" corn and soybean contracts, covering volumes of 1,000 bushels per contract.

account back up to the initial margin level. In June 2018, for instance, the margin requirement for a corn futures contract on the Chicago Mercantile Exchange was $792, with a maintenance margin of $720. With corn trading at around $3.60 per bushel in at that time, the margin amounted to 4.4 percent of a 5,000-bushel contract. In this case, whenever the adjusted value of the margin account drops to (or below) $720 because of "paper" losses in the futures market (i.e., losses on the value of the futures contract held), funds must be transferred to the account so that the balance returns to the initial margin level ($792). Because of these margin requirements, futures require that the farmer have either a significant amount of cash or a line of credit that can be accessed quickly should a margin call occur.

A futures contract, with its standardized terms, is interchangeable with other contracts with the same date, commodity, contract size, and other terms. For example, one contract of December 2018 corn trading on a given exchange is identical to another contract of December 2018 corn that trades on that same exchange. For this reason, it is possible to *close out* a contract at any time by taking the opposite position on an identical contract on that exchange, in order to avoid having to deliver the commodity on the contract's settlement date. If a farmer (or any other position holder) has a short position in 20 contracts of December 2018 corn, the position holder can close out the short position by taking a long position in 20 contracts of December 2018 corn. Positions in agricultural futures are almost always closed out in this way rather than with the farmer incurring the costs of physical delivery of the commodity under contract to the exchange.[6]

Worldwide, the use of futures contracts has been growing steadily. In 2017, nearly 4 billion futures contracts were traded, primarily on energy and financial instruments, such as interest rates or equities indices (figure 2). However, agriculture was responsible for a significant share of these contracts, roughly 9.3 percent of total futures trading volume and 8.3 percent of open interest (the total number of contracts that are open—have been traded but not yet liquidated—on an exchange at any given time). Conversely, agricultural options comprise a much smaller proportion of total traded options, equaling roughly 1 percent of that market.

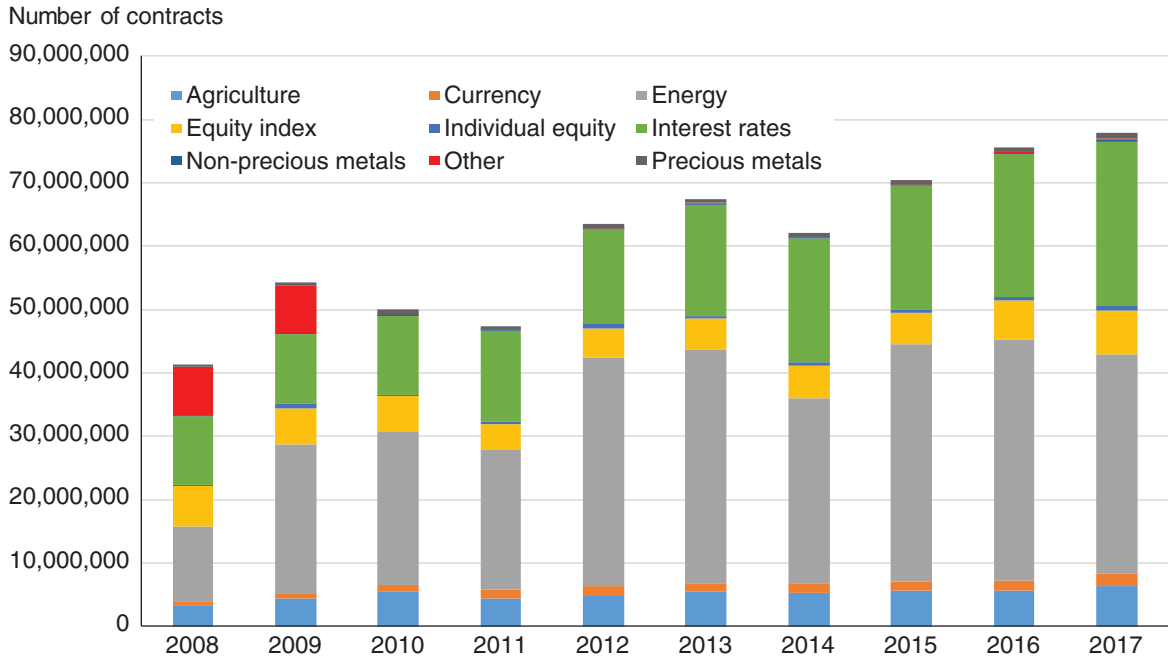
Options Contracts

Options are a contract for the right but not the obligation to buy or sell an underlying asset at a given price at any time before the established expiration date of the option. As with futures, the terms of exchange-traded options are standardized. For agricultural options, however, the underlying asset is not the agricultural commodity itself but rather a futures contract in the agricultural commodity. An agricultural option, therefore, conveys to the buyer the option to establish a short (sell) or long (buy) futures position for an agricultural commodity at a pre-specified "strike price." The cost of purchasing that option is called the "premium," and whether the buyer of the option chooses to exercise the option depends on how the price moves relative to the strike price.

[6]Many participants have no interest in exchanging the corn; the transaction is about hedging price risks. Moreover, delivery of corn adds costs, and it would have to be reshipped from the exchange to another location for use.

Figure 2

Worldwide use of open-ended futures contracts by category, 2008–2017



Source: USDA, Economic Research Service using data from Futures Industry Association.

There are two types of options: calls and puts. Call options give the option holder the right to purchase a futures contract for the underlying commodity at the pre-specified strike price (i.e., establish a long position), at any time before the option's expiration date. A buyer might purchase a call option if they believe that the price of a commodity is likely to increase, and they would like to establish a price ceiling or a cap on the amount that they may have to pay in the future for that commodity. If the futures price of the underlying commodity increases above the strike price specified in the option, the call holder can exercise the option to buy the commodity at the strike price. In that situation, a call option is described as "in the money"—i.e., there is a value to the holder to exercise their option. If the price of the underlying asset stays below the strike price ("out of the money"), the option holder can simply choose to not exercise the option.

A put option gives the option holder the right to purchase, at any time before the option expires, a futures contract to sell the underlying commodity at the strike price—i.e., establish a short position on a futures contract. If the price of the commodity falls below the strike price, then a put option is "in the money;" the put option holder can exercise their option and sell the asset at the strike price, which is higher than market price. If the price of the commodity remains above the strike price, the put holder can simply let the option expire without exercising it and sell the commodity at the market price. The put option, therefore, allows the producer to establish a price floor for the sale of the commodity.

Advantages and Disadvantages of Futures Use

While the use of futures can be an effective means of hedging against price risk, there are also potential downsides for producers seeking to use them.

Advantages:

1. Contracts can be entered quickly at highly competitive prices.
2. Contract commitments can be changed easily if conditions change.
3. Contracts offer high levels of security.
4. Contract prices are widely reported.

Disadvantages:

1. Margin calls necessitate having cash reserves or a quickly accessible line of credit.
2. Derivatives, though often effective for managing price risk, do not address basis risk or market risk, especially for farmers who are far from delivery points.[7]
3. Contract quantities may be too large for small farmers.

Source: Futures Industry Association (FIA).

[7]Basis risk is the risk that a hedging strategy will not work as expected because of differences between the local cash price for a commodity and the futures price for that commodity. While the two prices generally move together, differences between the two arise because local cash market prices reflect variables such as storage, freight, and product quality, as well as regional differences in supply and demand.

When purchasing an option, the buyer pays a premium to the party that wrote the option (the counterparty). The premium's price is a complex function of the intrinsic value (the difference between the underlying commodity's market price and the specified strike price, if the option is in the money), the time value, and the volatility of the underlying asset's price. For example, on August 15, 2019, a call option to purchase corn at a strike price of $3.80 in December 2019 was priced at $0.14 (the closing price of a December 2019 corn futures contract that day was $3.75). The time until expiration of an option has value, because the longer the time period, the greater the flexibility to the holder; in August 2019, a call option for December 2019 would have a higher premium than an otherwise identical call option that expires in October 2019. The higher the volatility of a commodity's price, the greater the potential for wide price swings in either direction over the period of the option; higher price volatility carries a higher premium for the option.

Advantages and Disadvantages of Options Use

Advantages:

1. Ability to set upper or lower bounds on prices. Unlike with futures contracts, the option holder is protected against price changes in the direction that would be negative for them, but is able to gain from price changes in the opposite direction.
2. Absence of margin calls. Once the premium is paid, no other cash outlay is needed until the option is exercised, *if* the option is exercised.
3. Limits on losses. The farmer's loss on an option is limited to the premium paid, because if the option is out of the money the farmer does not need to exercise it.
4. The benefits of trading on an exchange (competitive pricing, high level of security, price transparency).

Disadvantages:

1. Lower net price, because of the premium cost.
2. Upfront premium cost.
3. Less direct relationship between option premium and cash prices, relative to futures pricing. Option premium pricing is complex and takes into account a number of factors beyond just the price of the underlying commodity.
4. Does not help to hedge against basis risk.

Source: Adapted from Heifner et al., 1993.

Agricultural Contracts

Many farm product transactions are organized through contractual agreements between the farm operation and a processor, wholesaler, retailer, or another intermediary. Since the mid-1990s, between 33 and 40 percent of U.S. agricultural production has been produced under contract (Burns and MacDonald, 2018). Contracts are a substitute for spot market (cash) sales of farm commodities, and for vertical integration between the farm operation and the processor.[8] Farmers often use contracting to secure a certain outlet for the product, manage price risks, and obtain debt financing.

Commodity sales usually feature some kind of contractual agreement; for example, cash sales are contractual agreements between the buyer and the seller—the buyer commits to deliver payments at a specified time in exchange for delivery of a commodity with specified attributes. Farmers sometimes make a sale out of storage, and that sale may feature a contractual arrangement between buyer and seller. However, in the Agricultural Research Management Survey (ARMS), and in this report, we define an agricultural contract as an agreement reached *before* harvest, or before the conclusion of a production cycle for livestock. In ARMS, products that are sold out of storage are defined as cash sales. Though specific contractual designs may vary, the USDA, Economic Research Service uses two major contract classifications: marketing contracts and production contracts.[9]

Marketing Contracts

A marketing contract sets a market outlet, a quantity to be delivered, and a price or a pricing formula for a commodity. The farmer owns the crop, provides most or all inputs, and makes most production decisions. In one type of marketing contract—a forward contract—a specific price is agreed upon in the contract. Other types of marketing contracts specify a pricing arrangement or formula rather than a price; in those cases, the price at delivery will be based upon prices in nearby futures contracts, or on specified price indexes, with adjustments reflecting quality attributes of the delivered product (MacDonald et al., 2004).

Field crop farms (e.g., corn, soybean, wheat) often use marketing contracts, along with traditional cash markets, to market their production. Marketing contracts are particularly important to producers of specialized varieties of certain crops, such as high-oil corn and organic soybeans; with few buyers for specialized varieties, farmers seek buyer commitment via a contract before committing to production. Marketing contracts are arranged prior to harvest or even planting, but usually no more than one marketing year ahead of time. By providing assurance of a buyer and guaranteeing a certain price premium, marketing contracts reduce income (price) risks that arise from fluctuations in commodity prices and assure that a producer can find a market for his or her products, reducing the risk of not finding a suitable buyer. Marketing contracts also allow prices to be more closely tied to product attributes and provide higher returns to farmers able to produce those attributes.

[8]Vertical integration is more common in livestock production than in field crops. For example, broiler processors usually own and operate hatcheries (vertical integration) while contracting with farms to raise chicks after hatching. A cattle feedlot could choose to raise its own feed crops for the lot (vertical integration), but it is far more likely to contract with farmers for the delivery of crops. Some fruit and vegetable operations are vertically integrated; they grow, process, and market their crops (for example, in the form of fruit juice or cut and cleaned carrots).

[9]Survey needs, including questionnaire length and guidance to survey enumerators and staff, drive the ERS classification. A production contract indicates costs that are borne by contractors, an important signal for a survey of farm sector income and expenses. Production and marketing contracts also indicate revenue flows that may differ from the revenue generated in a cash sale.

Marketing contracts are not standardized as futures contracts are. Any quantity can be specified in the contract, and prices can be adjusted to specific product attributes. However, in contrast to future contracts, the quantity specified in a marketing contract is delivered. This introduces some further production risk for the grower, who is committed to delivering the quantity specified in the contract, even if production falls short of that amount. In that case, the grower may have to purchase production in the spot market in order to fulfill the contract. Growers can manage this kind of risk by entering into marketing contracts for only a fraction of their expected production. In some cases, they can write a marketing contract to cover all production from a specified acreage, thus shifting production risk to the contractor.

Marketing contracts allow buyers (such as grain elevators or processors) to efficiently manage the timing of product flows to their facilities, ensure that products meet specified quality attributes, and manage price risks. However, marketing contracts may often retain price risks; for example, prices in many marketing contracts are formulas that link the price to be paid to the farmer at the time of delivery to a base price drawn from a nearby futures contract, plus premia for meeting quality attributes. Because the future prices may fluctuate between the time of agreement and the time of delivery, the buyer still faces some price risk. They often manage that price risk by hedging in future markets.

Production Contracts

Under a production contract, a farmer raises an agricultural commodity for a contractor who owns the commodity, provides some or all production inputs, and pays the farmer a fee for services provided. Production contracts are used primarily in livestock, which accounted for 99 percent of the value of all production contract production in the 2016 Agricultural Resource Management Survey, with poultry, fed cattle, and hogs accounting for almost all of it. In turn, production contracts governed 85 percent of poultry and 66 percent of hog production, with much of the rest occurring under vertical integration, on farms owned by a processor.

Advantages and Disadvantages of Marketing Contracts

Advantages:

1. Can be tailored to specific contract quantities and durations and product attributes; hence to specific needs of contracting parties.
2. Require no upfront deposits for margin calls or premia.
3. Assure an outlet for production of a commodity.
4. Provide assurance of compensation for creating costly product attributes.

Disadvantages:

1. Contracted quantity must be delivered; leaves grower open to costly yield risk.
2. No exchange trading of contracts; creates potential counterparty risk.

Source: Adapted from MacDonald et al., 2004.

Integrators (as contractors are usually called in the broiler and hog industries) provide feed, veterinary services, and young animals to contract growers, and consequently bear the price risks for key inputs. Moreover, growers are paid through contract fees that usually have no link to market prices; as a result, contract producers are largely insulated from input and output price risks (Knoeber and Thurman, 1995; McBride and Key, 2003). However, production contracts do introduce certain new risks for contract growers (MacDonald, et al., 2004).[10]

Production contracts are also used in processing vegetables, in seed production, and sometimes in horticulture. However, they are rarely used in field crops, where marketing contracts and derivatives are widely used. Hence, we'll focus primarily on field crops in the rest of this report, and on marketing contracts rather than on production contracts.

Although futures contracts and marketing contracts are conceptually similar, there are some key differences (table 1). These differences are largely due to the nature of standardized contracts on formal exchanges, the customization of marketing contracts, and to the fact that it is possible to exit from futures positions without delivering or buying the commodity, while delivery or purchase is expected under a marketing contract. Furthermore, farmers typically engage in marketing contracts with cooperatives, grain elevators, or processors, whereas futures contracts can be traded with any entity on the futures exchange (e.g., Chicago Mercantile Exchange).

Table 1
Differences between futures and marketing contracts

Futures contracts	Marketing contracts
• Exchange traded	• Over the counter (OTC)
• Standardized contract size, delivery date	• Customized contracts
• Market-driven pricing	• Pricing could be market based, fixed, or quality-adjusted
• Exchange acts as counterparty for each side	• Counterparty risk
• Margin calls and deposits	• Less cash needed upfront
• Delivery: almost never	• Delivery: expected
• Can close out position easily	• Cannot exit the contract as easily
• Non-agricultural participants are common	• Non-agricultural participants are rare

Source: USDA, Economic Research Service.

[10]Contract growers often make a long-term investment in housing, while obtaining only a short-term contract, thus sometimes leaving themselves exposed to hold-up risks at the time of contract renewal. In poultry, grower compensation is often tied to relative performance—compared to other growers delivering birds in the same time window—creating a composition risk reflecting the attributes of other growers in the comparison group.

Other Risk Management Strategies

In addition to using futures, options, and agricultural contracts to manage price risks, farm operators may use other risk management approaches. Many farmers diversify their production, growing a combination of crops as well as raising livestock. Historically, prices have correlated across agricultural commodities, but they do not necessarily move in tandem. Similarly, on a farm with diversified production, failure of one crop will not wipe out the farm's entire revenue.[11]

Most farm families also diversify off-farm. Within a farm household, the operator or spouse often works off-farm, either full- or part-time. In fact, for a majority of farm households, most household income comes from off-farm sources, though this is not the case for larger, commercial farms (Prager et al., 2018). In addition, the accumulation of savings or access to credit provides a backstop for many farms that experience a negative shock. These risk management strategies are complementary and, compared with other farms, farms that mitigate risk through one strategy are more likely to use other methods as well.

Two risk management tools offered by the Federal Government—commodity programs and crop insurance—are widely used by field crop producers. In turn, two main commodity programs are used to manage price risks—Agriculture Risk Coverage (ARC) and Price Loss Coverage (PLC). ARC provides payments to farmers when revenues fall below 86 percent of a benchmark revenue (calculated for a county average, or for the farm). Payments are capped at 10 percent of benchmark revenue. Given the payments cap and the 86 percent threshold for payments, revenue losses in the range of 76 to 86 percent of benchmark revenue are covered in ARC.

PLC provides payments to farmers when a covered commodity's average national price for a marketing year falls below a specified reference price. Producers with historical base acres of that commodity enrolled in PLC receive the difference between the reference and national average prices, multiplied by 85 percent of base acres and program yield. Farmers must choose between ARC and PLC enrollment, and do not pay premiums for coverage.

Federal crop insurance is available to farmers growing a wide range of commodities. Most policies pay indemnities when realized revenue or yield falls below a percentage of the expected value. The percentage, chosen by the producer, typically ranges from 50 to 85 percent. The programs are supported through premiums, which vary with the type of policy and the coverage level chosen. The Federal Government subsidizes premiums through direct payments to insurance companies, with the Government paying over 60 percent of total premium payments, in addition to supporting coverage of the administrative and operating costs of the system.

In 2017, approximately 300 million acres were enrolled in crop insurance, with approximately two-thirds in corn, soybeans, and wheat. Commodity programs and crop insurance, alone or in combination, limit price and yield risks by providing payments when prices, yields, or revenues fall below established thresholds (Motamed et al., 2018).

[11]Farm production has become more specialized over time (MacDonald, Hoppe, and Newton, 2018). Fewer farms combine livestock with crop production, and the number of different field crops produced on farms has been shrinking.

Sector-wide Use of Futures, Options, and Marketing Contracts

We assess farmer use of futures, options, and marketing contracts in 2016, based on responses to a large and nationally representative USDA survey that queried farmers on the use of each type of contract in that year (see box, Data Sources). We focus initially on all farms, then narrow the focus to farms that grow corn or soybeans (because they account for most futures and options use). Finally, we narrow the focus again to commercial corn and soybean farms, defined as those with sales of at least $350,000 or an operator who reports farming as the primary occupation. Such farms account for 93 percent of corn and soybean production, and almost all use of futures, options, and marketing contracts by corn and soybean producers.

Futures and Options Use

In 2016, over 47,000 farms used futures or options to hedge price risk (table 2—the sum of columns (1) and (2), minus column (3)). While that amounts to just over 2 percent of all U.S. farms, users of futures or options were relatively large, accounting for almost 11 percent of the total value of agricultural commodity production.

Use was spread among the many different commodities with futures and options contracts offered on exchanges, including wheat, cotton, rice, soybeans, and dairy. However, the use of futures and options was concentrated in corn and soybean production. Since the two crops are often grown in rotation, most farms that grew corn also grew soybeans. In 2016, 33,271 farms used corn futures or options, and 31,482 farms—many of them the same—used soybean futures or options (table 2).[12] Of the more than 47,000 farms that used any futures or options contracts, more than 90 percent used them for corn or soybeans. That represents 10.4 percent of all farms that grew corn or soybeans. In contrast, just over 4 percent of cotton or wheat producers used futures contracts, and less than half of 1 percent of cattle and milk producers used futures contracts. Hence, we focus much of this study on corn and soybean contracts.

Futures and options use was also concentrated among larger farms. For example, while only 2 percent of U.S. farms used any futures contracts in 2016, nearly 12 percent of midsize farms (with sales of $350,000 to $999,999) and 17 percent of large farms (sales of $1 million or more) used them (table 3). Among corn and soybean producers, 17 percent of midsize farms and 27 percent of large farms used futures contracts.[13]

[12]Unless specifically noted, all comparisons of survey estimates noted in this section are of statistically significant differences. We forego the common practice of reporting tests of statistical significance because the report is aimed at a broad audience, and because most relevant differences are statistically significant with the large samples drawn from ARMS.

[13]A similar pattern holds when we use acreage. Only 1 percent of farms with less than 50 acres of corn acreage (about one quarter of all corn-soybean farms) used corn futures, while 28 percent of farms with at least 750 acres of corn used futures contracts.

Data Sources

The USDA's Agricultural Resource Management Survey (ARMS) is an annual survey of U.S. farms administered jointly by the USDA, National Agricultural Statistics Service (NASS) and the USDA, Economic Research Service (ERS). The survey unfolds in three phases. Phase I screens farms in June of the reference year for inclusion in later phases. Farms producing selected target field crops are selected for Phase II and are queried about their field practices during the fall. During the following winter, all types of farms, including those in Phase II, are surveyed in Phase III for farm and farm household attributes and financial outcomes. Phase III includes a questionnaire version (version 1) aimed at all types of producers, as well as up to three other questionnaire versions aimed at smaller samples of producers of specific commodities, with some questions aimed specifically at those commodities. All Phase III respondents are queried about their use of marketing and production contracts in each year of the survey. In 2016, version 1 of Phase III also included questions about farmers' use of futures and options. Because the survey collects detailed data about farm finances and the farm operator's household, information on risk management strategies can be tied to information about farm production and resources.

The ARMS Phase III sample includes over 30,000 farms, with over 20,000 useable responses. The survey is designed to accurately represent farms and production in the 48 contiguous United States. Toward that end, the survey sample is stratified according to location, farm size class, and commodity orientation, with separate sampling probabilities for each stratum. Each sample farm has a sample weight reflecting the number of like farms represented by that observation, and the weights allow for expansion to national estimates. All estimates reported in this report are expanded national estimates.

Questions on futures and options use were answered by 15,383 farmers who responded to the version 1 questionnaire of ARMS Phase III, and just over 800 reported using any agricultural derivatives. ARMS is the only national source of farm-level data on agricultural derivatives use, and this information provides a more complete picture of farmers' hedging strategies than has been previously available.

Most respondents who reported using futures or options used them for corn and soybeans. While a number of respondents reported using futures or options for other commodities, there were not enough individual observations to perform meaningful analysis for those specific crops. For our empirical analyses, we report on data for all farm users of futures, options, and marketing contracts, and we also report separately on corn and soybean contracts. Similarly, for comparison purposes, we use samples of all farms and of farms that produce corn and soybeans.

Table 2
Most reported futures and/or options use was for corn and soybeans

Commodity	Futures (1)	Options (2)	Both futures and options (3)	Marketing contracts (4)
	Number of farms with marketing strategy			
Corn	27,766	12,464	6,959	61,043
Cotton	628	617	114	4,059
Rice	76	0	0	2,512
Soybeans	27,343	8,008	3,869	72,754
Wheat	4,862	1,306	485	12,250
Cattle	1,776	2,384	1,034	221
Dairy	179	66	40	18,784
Other	404	171	26	41,624
Corn and soybeans	18,056	6,999	3,541	42,558
Corn or soybeans	37,572	14,176	7,287	91,239
Any commodity	39,843	16,323	8,520	156,395

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey.

Table 3
Larger farms use futures and options

	Futures contract users		Options users	
Gross cash farm income ($)	*Farms*	*Percent*	*Farms*	*Percent*
	All farms			
<350,000	13,886	0.7	3,498	0.2
350,000-999,999	15,174	11.8	7,290	5.7
>999,999	10,784	17.0	5,532	8.7
All	39,843	1.9	16,323	0.8
	Corn or soybean producers only			
<350,000	12,838	4.6	2,346	0.8
350,000-999,999	14,737	17.4	7,061	8.4
>999,999	9,997	27.1	4,769	12.9
All	37,572	10.4	14,176	3.9

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey.

Those corn and soybean farms that used futures or options hedged a substantial share of their production through such instruments. For example, while only 10 percent of all corn producers hedged using futures contracts, those that did hedged 41 percent of their corn production in 2016 (table 4).

Table 4
Relatively few corn- and soybean-producing farms use futures and options, but those that do hedge a substantial percentage of production through them

	Corn	Soybean
Risk management instrument:	Percentage of farms using	
Futures contracts	9.9	9.3
Options contracts	4.4	2.7
Futures or options contracts	11.8	10.7
Marketing contracts	21.7	24.8
Among users of each:	Percentage of production hedged	
Futures contracts	41.1	47.2
Options contracts	30.9	33.0
Futures or options contracts	44.2	42.5
Marketing contracts	42.3	53.3

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey.

Farmers have been using agricultural derivatives for many years. Earlier ARMS surveys have asked about futures and/or options use, although not always in a consistent way. The 1996 ARMS asked if farmers "hedge or use futures/options." Eleven percent of farms responded affirmatively, and 25.7 percent of corn or soybean producers responded affirmatively. While that estimate is higher than the estimates reported for 2016, the question in the earlier survey is worded to include (unspecified) hedging other than futures and options. The 1999 ARMS asked whether farmers used "futures hedges" in marketing products; 6.4 percent of corn/soybean producers responded in the affirmative, and 0.7 percent of other operations. More recently, the 2008 ARMS asked respondents if they "… are currently using futures." In that case, 11.5 percent of corn/soybean producers and 0.7 percent of other farms reported using futures. In 2016, we find that 9 percent of corn/soybean producers and 0.3 percent of other farms used futures. The questions asked in the surveys have varied in significant ways, but the responses consistently show that futures use is concentrated among corn and soybean producers. Responses to the 1999, 2008, and 2016 surveys are broadly consistent with one another, and there is no evidence of increasing use in these data.[14]

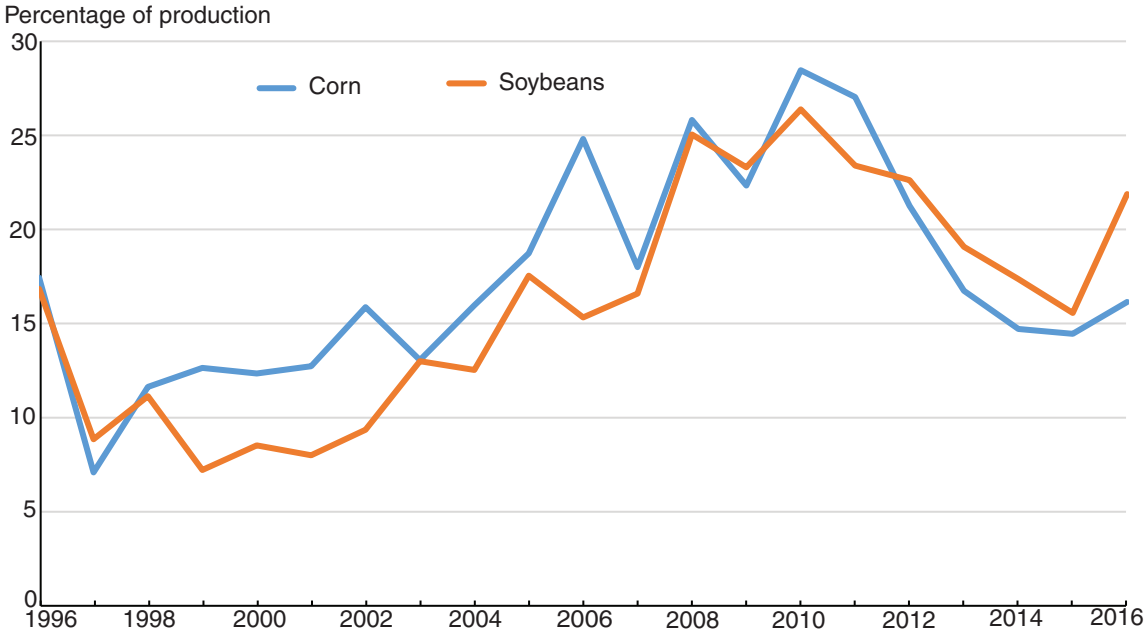
Marketing Contracts

Marketing contracts are used across a variety of farm types. In 2016, marketing contracts covered 19 percent of the total value of agricultural production, though use varied considerably, ranging from roughly 3 to 4 percent of hogs to 54 percent of peanuts. In cash grain crops, 17 percent of corn and 22 percent of soybeans were sold through marketing contracts in 2016. Together, these two commodities accounted for over a quarter of all agricultural production sold through marketing contracts.

[14]We believe that the 2016 data may be more reliable as it was the first survey to ask respondents to record the specific commodity and amount hedged.

Price risk plays an important role in the share of production under marketing contracts. As both the level and volatility of prices for corn and soybeans rose in the mid-2000s, the share of corn and soybean production under marketing contracts rose substantially, peaking in 2010 at more than 25 percent of corn/soybean production (figure 3). However, this share has declined in the last decade as corn and soybean prices have declined, along with the volatility of those prices.

Figure 3
Corn and soybean production under marketing contracts



Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, Agricultural Resource Management Survey, 1996–2016.

Farmers Use a Portfolio of Risk Management Tools

Farms frequently use a combination of futures contracts, options contracts, marketing contracts, cash sales, and other tools in a portfolio of risk management strategies. Consequently, farms may hedge only a fraction of their production with any single tool, but cover a much larger share with the whole portfolio. Many farms, however—most of them small—rely exclusively on cash market sales and do not use risk management tools to manage output risks. We describe the set of choices that farmers make in this section.

The median user of corn marketing contracts covered 10,000 bushels of corn with contracts in 2016, while the median corn futures user covered an average of 20,000 bushels (or four futures contracts), and the median corn options user covered an average of 15,000 bushels (table 5). At a mean nationwide yield of 174.6 bushels per acre in 2016, these contract quantities translate into 103, 115, and 86 acres for marketing contracts, futures, and options, respectively. These are not particularly large acreages—half of the corn farmers in the United States harvested at least 100 acres of corn in 2016. Soybeans quantities covered are typically lower, but the amount of acreage implied by the quantities is similar to that of corn (the mean yield of soybeans in 2016 was 52.1 bushels per acre, about 30 percent that of corn).

Table 5
How much gets hedged under different tools?

Commodity and management tool	25th percentile	Median	75th percentile
Corn			
Marketing contracts			
Quantity (bushels)	5,000	10,000	33,000
Share of production (percent)	19.8	36.8	68.2
Futures			
Quantity (bushels)	5,000	20,000	45,000
Share of production (percent)	17.9	31.7	50.8
Options			
Quantity (bushels)	10,000	15,000	45,600
Share of production (percent)	13.0	23.7	44.6
Soybeans			
Marketing contracts			
Quantity (bushels)	2,600	6,000	15,000
Share of production (percent)	31.4	49.1	76.6
Futures			
Quantity (bushels)	3,000	8,500	19,250
Share of production (percent)	30.0	42.7	70.0
Options			
Quantity (bushels)	5,000	10,000	10,500
Share of production (percent)	17.9	33.1	51.2

Note: Table reports percentiles for quantity hedged and for share of production hedged, among farms that use marketing contracts, futures, or options.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey, Version 1.

We also report the shares of production covered by futures, options, and marketing contracts in table 5. Specifically, we report the median quantity and share of production covered by marketing, futures, and options contracts. At the median, half of users hedge higher quantities (shares) and half hedge less. To give an idea of the range of hedging that farmers undertake, we also report values at the 25th percentile—where 25 percent of users hedge lower quantities (shares) and 75 percent hedge more—and the 75th percentile, where 25 percent hedge more and 75 percent hedge less. The 75th percentile values indicate that some farms hedge large shares of their production with a single risk management tool—25 percent of farms with soybean marketing contracts cover at least 76.6 percent of their production with such contracts. However, most users of futures, options, or marketing contracts cover only part of their production with each tool.

Farms frequently combine marketing contracts with futures, options, and other risk management tools (table 6). For example, farms that use marketing contracts for corn or soybeans are much more

likely to also use futures than farms that do not contract. While options are not widely used among corn and soybean producers, those who use marketing contracts are much more likely to use options than those who do not contract. Farms that use marketing contracts are also more likely to invest in on-farm storage; storage is a risk management tool because it allows farmers to better align the marketing and delivery of their products by placing production in storage during months with low prices and to diversify across sale periods.

Small farms are less likely to use these tools. ERS defines small farms as those with sales of less than $350,000, with midsize farms defined as those with sales of $350,000–$999,000, and large farms as those with sales of $1 million or more (with sales measured by gross cash farm income). While 69 percent of corn and soybean farms are small, over half of corn and soybean farms with marketing contracts are midsize or large operations (figure 4). Most corn and soybean producers do not use marketing contracts, but those who do have noticeably greater acreage and production than those who do not use marketing contracts (table 7). Furthermore, farms that contract for corn or soybeans also tend to use marketing contracts for significant shares of their other crop production, while farms that do not contract for corn and soybeans use very little contracting for any other commodities they produce.

Many corn and soybean farms use none of the risk management tools specified in table 6: no marketing contracts, no futures, and no options, neither directly nor through a cooperative.[15] Those farms are relatively small, though they still account for 36 percent of production and 38 percent of harvested acreage, for corn and for soybeans.

In 2016, the median producer harvested 154 acres of corn and 140 acres of soybeans. But 25 percent of producers harvested 55 acres or less, and 10 percent harvested 20 acres or less (corn or soybeans). Especially in soybeans, production among smaller producers was less than the minimum allowable size of a single futures contract, which might limit producer participation for the purposes of hedging their own production.

Table 6
Use of alternative marketing strategies by U.S. corn and soybean growers

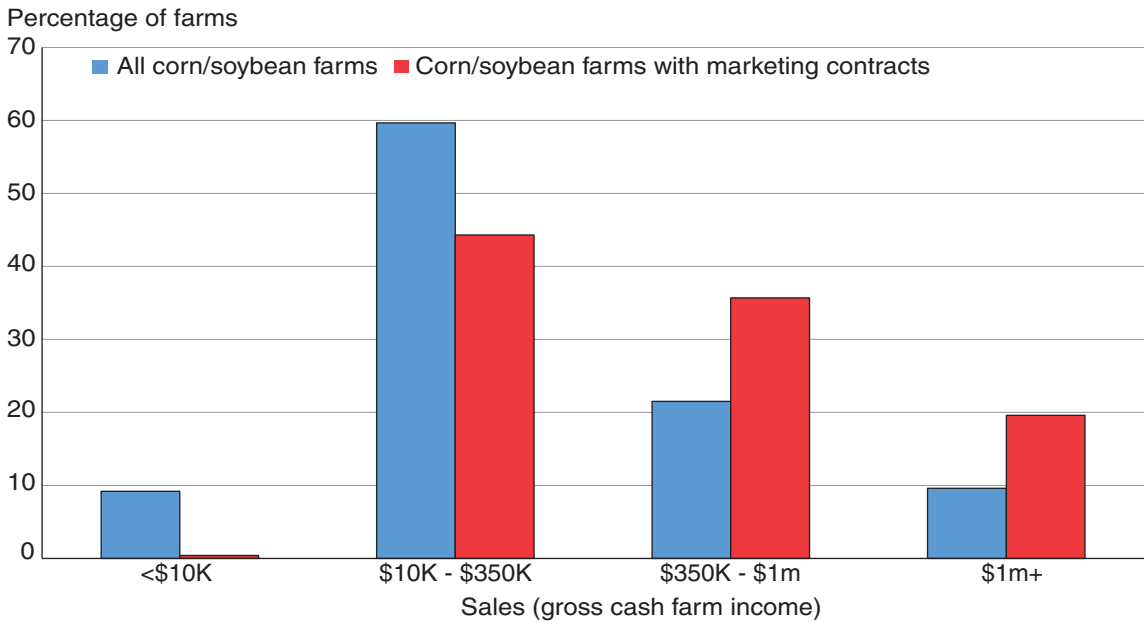
Commodity and contract status	Futures	Options	On-farm storage	Cooperative marketing	Spot market only
	Share (percent) of farms using strategy				
Corn					
Contract	23.7	10.5	58.4	39.5	0
Noncontract	5.8	2.5	45.7	28.2	68.3
Soybeans					
Contract	22.2	5.4	39.7	35.0	0
Noncontract	4.8	1.6	28.3	27.1	69.8

Note: Contract farms are those that use marketing contracts for at least some of their corn or soybean production. "Spot market only" refers to farms that use no contracts, no futures, and no options, and that do not rely on cooperatives to market their production.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey, Version 1.

[15]Farmer-owned cooperatives often provide marketing services for members. Some growers rely on their cooperative to market their production, and the cooperative may therefore use futures contracts to hedge on behalf of farmer-members, or may enter into marketing contracts on their behalf. As a result, cooperative membership provides another avenue for risk management.

Figure 4
Larger farms are more likely to use marketing contracts



Note: 60 percent of all corn and soy farms have between $10,000 and $350,000 in sales, while 44 percent of corn and soy farms with marketing contracts fall in that class. In contrast, 10 percent of corn/soy farms have sales of $1 million or more, but 20 percent of corn/soy farms with contracts fall in that class.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey.

Table 7
Contracting farms in corn and soybeans

Commodity and contract status	Farms	Farm value of production	Commodity value of production	Enterprise harvested acres	Contracting share	
					Commodity	Other crops
	Number	Dollars	Dollars	Acres	Percentage	Percentage
Corn						
Contract	61,043	699,400	304,469	487	49.0	46.4
Noncontract	218,189	432,836	141,406	250	0.0	6.5
Soybeans						
Contract	72,754	672,324	226,189	453	67.6	34.1
Noncontract	220,275	393,183	108,668	226	0.0	4.8

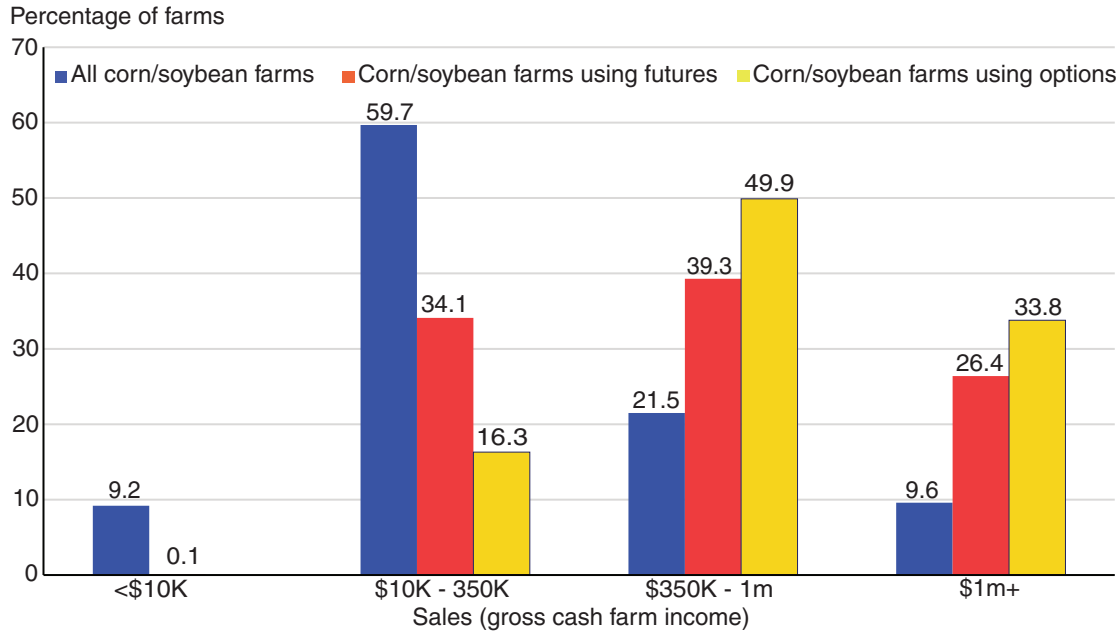
Note: Contract farms use marketing contracts for at least some of their corn or soybean production.
Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey, Version 1.

Which Farmers Use Futures and Options?

This report highlights two attributes of farms where futures and options are used: larger farms are more likely to use futures and options contracts, and producers of corn and soybeans are more likely to use them than producers of other field crops, livestock, or specialty crops.

Small farms, with less than $350,000 in gross cash farm income, are less likely to use futures or options contracts (table 3, figure 5). What's more, many small farms have very little production and a limited attachment to farming.[16] Consequently, we focus our summary on farms with at least $100,000 in gross cash farm income. Farms with less than $100,000 in sales produce less than 5 percent of corn and soybeans and very rarely use future, options, or marketing contracts. For the analyses below, we focus on futures and options use among larger corn and soybean farms.

Figure 5
Larger farms are more likely to use futures and options



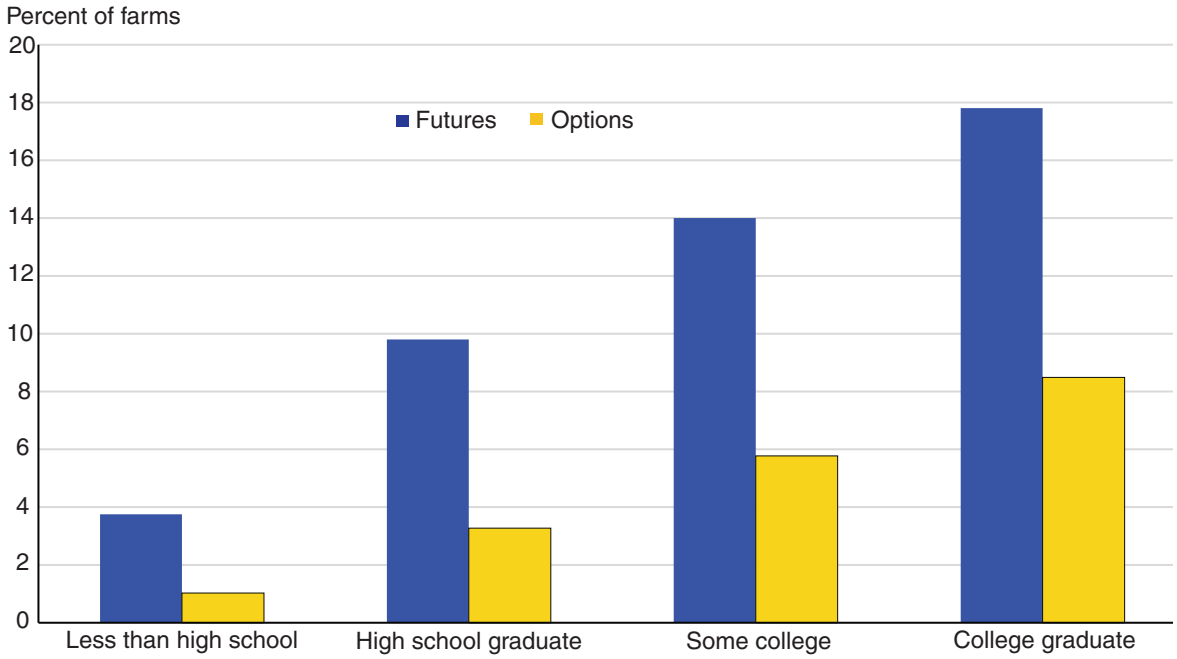
Note: Bars of the same color add to 100 percent.
Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey.

Participating in derivatives markets may require some knowledge of financial markets and an understanding of financial risk management. There is a clear, positive relationship between educational attainment and the use of both futures and options (figure 6). About 18 percent of operators who are college graduates used futures, compared to less than 12 percent of those whose highest level of educational attainment is a high school degree. While options use was lower in general, 6 percent of

[16]In USDA farm surveys, a farm is defined as any place that sells, or normally could sell, $1,000 worth of agricultural commodities. The "normally could sell" element is based on whether the place has land or animal assets that could generate $1,000 in annual sales. While many small farms have substantial agricultural production, the survey definition also encompasses many places with very little sales. Among farms in the 2017 census, 23 percent have sales of less than $1,000.

operators with a college degree used options, compared with just over 4 percent of operators who are high school graduates.[17]

Figure 6
Use of futures or options, by operator education



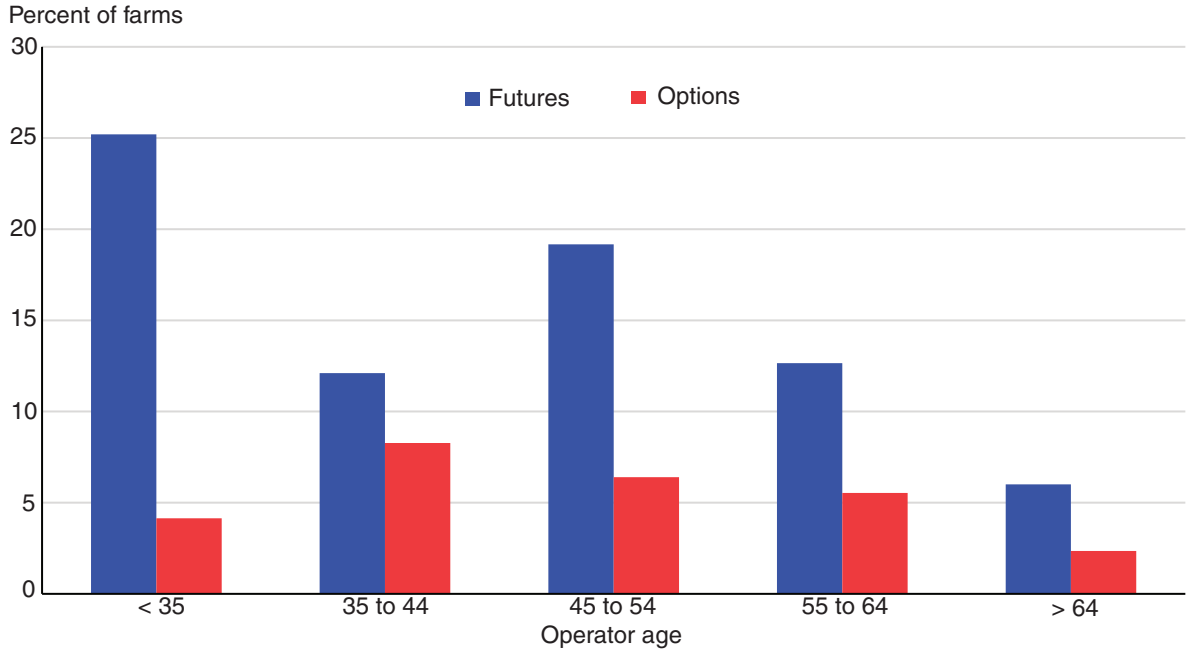
Note: Data shows corn and soybean farms with sales exceeding $100,000, or an operator reporting farming as the primary occupation.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey.

Operator age also matters, particularly among older operators. In 2016, we found that use of futures was highest among operators under 35 and lowest for operators aged at least 65 (figure 7). Options use was highest among those aged 35 to 44, and lowest among those aged 65 or older. Levels of educational attainment were not lower among operators over 65 than for farmers as a whole, so it may be that these operators have more assets and therefore can withstand a bad crop year without needing to hedge.

[17]Corn and soybean farmers have broadly similar education characteristics to the entire U.S. population, with somewhat higher rates of high school graduation and lower rates of college completion. Over 95 percent of corn and soybean farm operators and 90 percent of the U.S. population have completed high school. Approximately 23 percent of those farmers have a college degree or higher, as compared with 34 percent of all adults aged 25 and older (2016 Agricultural Resource Management Survey; U.S. Department of Commerce, Bureau of the Census, 2017).

Figure 7
Use of futures or options, by operator age



Note: Data shows corn and soybean farms with at least $100,000 in sales, or an operator reporting the primary occupation of farming.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey.

Finally, we examine the relationship between financial leverage, or the use of debt to acquire assets, and the use of futures and options. Derivatives allow producers to hedge against a poor output price. Many farms with significant debt obligations cannot withstand a sharp decrease in revenue (or a loss) because they need to be able to service their debt. Therefore, we might expect that more highly leveraged farms will be more likely to use these derivatives. In addition, farmers who are older are likely to have lower debt levels overall, and therefore tend not to be as leveraged (Ifft, Novini, and Patrick, 2014). On the other hand, farms may take on debt in order to strategically invest or to expand their operations and may use derivatives as part of a robust risk management strategy.

Farms with debt-to-asset ratios of less than 20 percent are least likely to use futures and options, while use varies across other leverage categories (figure 8). The lowest debt-to-asset category includes most operations: with two-thirds of corn and soybean farms, and over 60 percent of production, falling into the lowest-leverage category.[18]

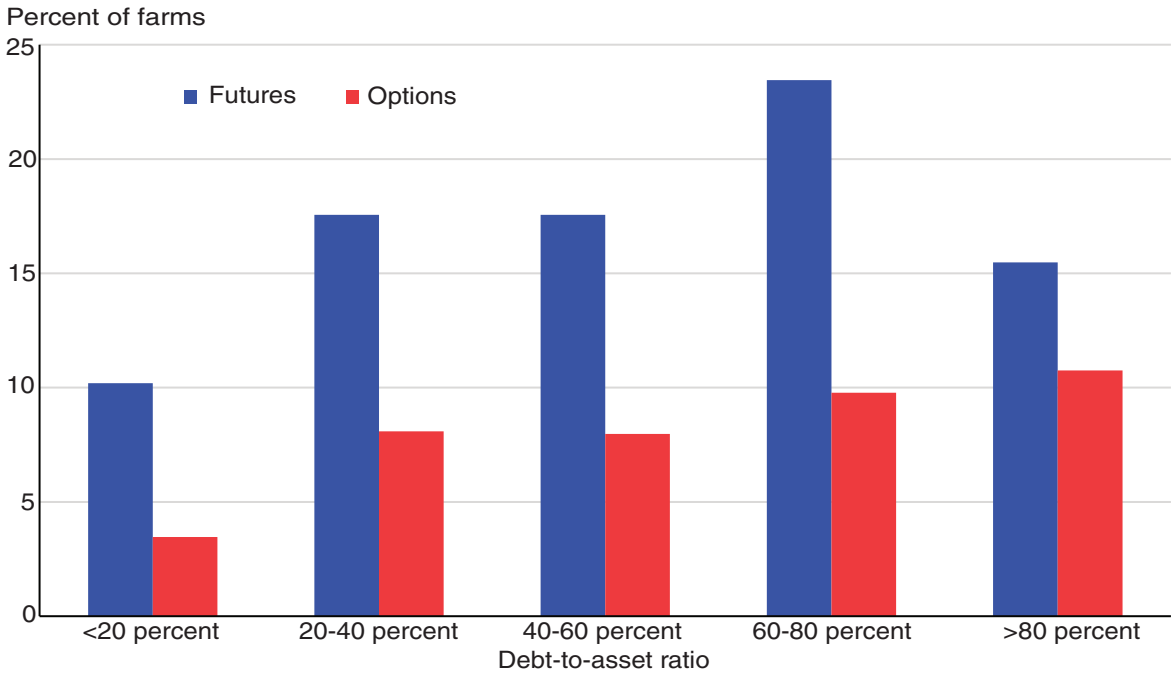
Combining Drivers of Use

Larger farms are more likely to use futures and options, as are farms producing cash grains and oilseeds. Operator attributes seem to matter: farms with younger operators who have graduated from college seem to use futures and options more often than other operators. Finally, marketing contracts

[18]Farrin, Miranda, and O'Donoghue (2016) find that farm household wealth and farm debt affect farm use of crop insurance, with wealthier farms being less likely to purchase insurance, and hence less likely to use their wealth as a substitute for insurance.

appear to be a complementary risk management strategy—farms that use marketing contracts also appear to use futures and options.

Figure 8
Futures and options use, by leverage



Notes: Data shows corn and soybean farms with sales of at least $100,000, or an operator with the primary occupation of farming.

Source: USDA, Agricultural Resource Management Survey, 2016.

We looked at these drivers in combination, in a statistical analysis described in appendix C. Specifically, we looked at the incidence of futures contract use among farms, focusing on futures because they are much more widely used than options. We related futures use to farm size, the commodity orientation of the farm, operator attributes (age and education), and the use of marketing contracts. The analysis covered all farms in the ARMS sample in 2016—that is, farms of all sizes, commodity types, and regions. The statistical analysis has two main purposes: 1) to estimate how much changes in each of the explanatory variables—farm size, commodity mix, reliance on marketing contracts, operator education, and operator age—affect the likelihood of using futures; and 2) to ascertain whether estimated effects continue to hold when we account for the other explanatory variables.

The model generated predicted probabilities of future use for different combinations of farm and operator attributes. In table 8, we report those predicted probabilities for several specified combinations of farm attributes. We start with three different representative farm sizes, measured in terms of gross cash farm income. One is $350,000, the threshold between small and midsize farms in the ERS farm typology. The second is $1 million, the threshold between midsize and large farms in the ERS farm typology, while the third is $2 million.[19]

[19]Small farms, with sales of less than $350,000, accounted for 23 percent of corn and soybean production, while midsize farms with sales of $350,000–$999,999 accounted for 36 percent of production. Farms with at least $2 million in sales accounted for about 17 percent of corn production.

We used the model in appendix C to generate predicted probabilities of futures contract use for a base case farm in each size category. The base case farm had no production of corn, soybeans, wheat, cotton, rice, dairy, or cattle; an operator who was less than 60 years old, with no college degree; and had not previously used marketing contracts. In the base case, futures contract use ranged from a probability of 0.7 percent for the smallest farm to 1.6 percent for the largest farm—indicating low usage rates for farms with this profile and little variation by farm size.

We next adjusted the base case to a case in which the farm produced corn or soybeans. Probabilities of futures use rose sharply, and there was a much more decided impact of farm size, in line with the findings reported earlier—that futures contract use is dominated by corn and soybean producers, and by larger farms in that group (table 8).

Table 8
Likelihood that a farm uses futures contracts in 2016

Farm attributes	Gross cash farm income		
	$350,000	$1,000,000	$2,000,000
	Percent		
Base probability	0.7	1.2	1.6
+ corn/soybean producer	10.4	16.4	20.9
+ operator is college graduate	12.6	19.7	24.8
+ uses marketing contracts	28.8	40.7	48.0
+ operator aged 60 or over	20.4	30.4	37.0

Note: Estimates are predicted probabilities derived from model described in Appendix C. The base case farm is with a principal operator who is less than 60 years old and is not a college graduate; the farm produces no corn, soybeans, wheat, rice, cotton, dairy, or cattle, and uses no marketing contracts.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey.

We then changed the base case to a corn/soybean producer with a college degree. The probability of futures contract use rose again, with an effect that was noticeable but that was not as strong as the effect of commodity orientation. However, when we changed the base to a corn/soybean producer with a college degree, who also used marketing contracts, estimated probabilities of futures use jumped sharply, and farm size had a larger impact. In particular, compare the second and fourth rows of estimates in table 8: the base case corn and soybean producer with $350,000 in sales had a 10.5 percent probability of using futures contracts, and that jumped to 28.8 percent among corn/soybean producers who were college graduates and also used marketing contracts. For large farms with $2 million in sales, the probability of futures use rose from about 1 in 5 (20.9 percent) to nearly 1 in 2 (48 percent). Marketing contracts are strongly associated with the use of futures contracts.

In the bottom row of table 8, we entered an age adjustment, specifying a farm with an operator who was 60 years old or older. Operator age had a noticeable negative association with the use of futures contracts, even controlling for farm size, commodity orientation, and the use of marketing contracts.

The empirical analysis highlights several key points. First, farms use a combination of risk management strategies. This analysis emphasizes the joint use of marketing and futures contracts. Marketing contracts provide an assured outlet for production, at a specified time of year, and they offer payments that may be tied to quality. However, few farms place all their production

under marketing contracts because variability in yields creates uncertainty concerning production outcomes. Futures contracts provide a way to hedge the price risks in cash sales, thus providing a complementary tool for marketing contracts. Second, farm size matters in that larger farms are more likely to use futures contracts, but the effect of size varies with the farm's commodity orientation and appears to be large only among corn and soybean producers.

Conclusion

Farming is an inherently risky business. Producers must contend with numerous forces outside their control, including weather, pest infestations, and disease, as well as changes in prices. Each of these factors can cause variability in revenues, potentially hurting profits or increasing costs. Agricultural derivatives and marketing contracts are risk management strategies that can help farmers mitigate the risks arising from price fluctuations by guaranteeing a price before harvest. Data from the 2016 ARMS provide new insight into farmers' use of these risk management strategies, especially for corn and soybean producers.

The report focused on corn and soybean producers because future and options trading is far more prevalent among them—we estimate that 94 percent of futures trading by farmers, and 87 percent of options trading, was on corn and soybean contracts. That's partly because there is far more corn and soybean production, and there are far more corn and soybean farmers; over 300,000 farms grew corn or soybeans in 2016 (and most of them grew both), compared to about 95,000 that grew wheat, about 15,000 that grew cotton, and about 5,500 that grew rice. But the incidence of futures and options use is also much higher among corn and soybean producers: for example, about 12 percent of corn and soybean producers used futures contracts, as compared to 5 percent of wheat growers, 4 percent of cotton producers, and 1 percent of rice growers. As a risk management tool for farmers, futures and options trading is largely about corn and soybean producers. Large and midsize corn and soybean operations frequently make use of futures, options, and marketing contracts, with larger operations making greater use of them. Farms that use them typically cover a fraction of their corn and soybean production with each type of instrument. Moreover, farms that use these instruments typically combine them in a portfolio of risk management strategies, covering hedging through futures and options, marketing contracts, and on-farm storage. Corn and soybean farmers also rely on Federal crop insurance and commodity programs such as Price Loss Coverage and Agriculture Risk Coverage to further hedge against variations in prices and revenues.

Operators of smaller farms are much less likely to use futures, options, or marketing contracts. Futures and options contracts cover a specified quantity—5,000 bushels—that may represent an unacceptably large share of production for small operations. While marketing contracts could be designed to cover any quantity, most cover quantities that are similar to the quantities covered in futures and options contracts. Though some smaller operations may rely on their cooperatives for marketing services (and the cooperative then may use marketing contracts, or may hedge through futures and options), many small operations still rely completely on cash markets for marketing their corn and soybeans.

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Appendix A—Distribution of Futures and Options Use by Farm Type, 2016

Table A1
Distribution of futures use by farm type, 2016

Farm type	Corn futures	Soybean futures	Both	Either	Neither
	Percentage of farms				
Cash grain	18	20	22	18	14
Wheat	1	0	0	1	0
Corn	52	37	54	40	32
Soybean	17	25	14	24	23
Other crops	2	6	2	5	4
Fruit/Vegetable	0	1	0	0	1
Cattle	4	4	3	4	11
Hogs	3	4	4	3	2
Poultry	2	1	0	2	2
Dairy	1	1	1	1	7
Other Livestock	0	1	0	1	4
Total	100	100	100	100	100

Note: Farm types in the Agricultural Resource Management Survey (ARMS) are defined according to the commodity that accounts for the preponderance of sales.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey.

Table A2
Distribution of options use by farm type, 2016

Farm type	Corn futures	Soybean futures	Both	Either	Neither
	Percentage of farms				
Cash grain	16	14	13	16	14
Wheat	2	0	0	2	0
Corn	59	64	67	57	31
Soybean	11	14	12	11	24
Other crops	1	1	1	1	4
Fruit/Vegetable	0	1	0	0	1
Cattle	2	1	1	2	12
Hogs	4	5	4	5	2
Poultry	4	0	0	4	2
Dairy	0	1	1	1	8
Other livestock	0	0	0	0	1
Total	100	100	100	100	100

Note: Farm types in the Agricultural Resource Management Survey (ARMS) are defined according to the commodity that accounts for the preponderance of sales.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey.

Appendix B—Survey Questions

8. Producers may follow a variety of strategies to manage commodity price risks. In 2016, did you, or anyone acting on your behalf (such as a cooperative or marketing pool) use **futures** or **options markets** to hedge commodities?

2369 1 ☐ **Yes -** *Complete Table* 3 ☐ **No -** *Go to Item 9*

Commodity	Futures Markets: What quantity of the 2016 production was hedged using **futures** markets?			Options Markets: What quantity of the 2016 production was hedged using **options** markets?		
Corn	2310		Bu.	2214		Bu.
Cotton	2216		Lbs.	2218		Lbs.
Rice	2220		Cwt.	2222		Cwt.
Soybeans	2224		Bu.	2318		Bu.
Wheat	2228		Bu.	2230		Bu.
Cattle	2232		Lbs.	2323		Lbs.
Dairy	2236		Lbs.	2238		Lbs.
Other:	2365			2366		
Other:	2367			2229		

9. In 2016, did you use a cooperative to market any part of the following commodities? *(Please check all that apply)*

2311 ☐ Corn 2316 ☐ Rice 2364 ☐ Wheat 2368 ☐ Dairy 2237 ☐ None

2313 ☐ Cotton 2319 ☐ Soybeans 2328 ☐ Cattle 2235 ☐ Other:

Appendix C—Analyzing the Use of Futures Contracts Among U.S. Farms

Larger farms are more likely to use futures and options contracts, and so are farms with corn and soybean production (as corn and soybeans have the most actively traded futures contracts). Farmer attributes seem to matter: farmers with a college degree are more likely to use futures and options, and older farmers are less likely. While farmers can use futures, options, and marketing contracts to hedge price risks, they do not appear to use only one instrument or to use them interchangeably, rather they seem to use each instrument as part of a portfolio of risk management tools.

We jointly evaluated the drivers of futures contract use to assess how much of an impact each factor had, and to determine if the impact of any one factor remained when we controlled for other factors. Our dataset consists of all farms in Version 1 of the 2016 ARMS Phase III, representing all types of farms in the 48 contiguous states.

We focused on futures contracts because they were far more common than options use. To do so, we analyzed whether farmers used any futures contracts—that is, we created a variable (FUTURES) equal to 1 if the farm reported the use of futures contracts in 2016, and 0 otherwise. This variable became the dependent variable in a logit regression model of futures contract choice.

We account for farm size in the model with sales (measured as gross cash farm income). We entered the logarithm of sales and its square to account for a nonlinear relationship between size and futures contract use. We took account of the commodity mix of the farm by entering a series of dichotomous variables, taking on values of 1 if the farm produced corn, soybeans, cotton, wheat, rice, cattle, or dairy. There is active futures market trading available for these commodities (although there is nothing to prevent a farm that produces other commodities from trading in these commodities).

We aimed to take account of farm operator attributes with two more dichotomous variables. One took the value of 1 if the farm's principal operator had a college degree, and zero otherwise. The second took on a value of 1 if the principal operator was at least 60 years old, and 0 otherwise.

Finally, we added a variable indicating whether the farm operation used any marketing contracts.

Results of the estimation are reported in appendix table C-1. We relate futures contract use to farm size only in equation (1), then add operator attributes in equation (2), commodity mix in equation (3), and the use of marketing contracts in equation (4). Farm size has a strong relationship with the use of futures contracts, but the effect of increases in size begins to diminish at very large farm sizes, and it disappears at sizes above $4.45 million in sales.

Given farm size, farms with operators who have college degrees are more likely to use futures contracts, and farms with older operators are less likely. Each effect is highly significant, with relatively small estimated standard errors. The commodity mix variables are all statistically significant and are large in some cases; in particular, corn and soybean farms are far more likely to use futures contracts—and cattle, dairy, rice, and cotton farms are less likely—than the base case farm of the same size. Additionally, controlling for commodity mix makes the impact of operator education greater. Finally, farms that use marketing contracts are substantially more likely to also use futures contracts, even while controlling for farm size, commodity mix, and operator attributes.

Because logit models are nonlinear, the coefficient values do not have transparent implications. Specifically, the impact of a change in an explanatory variable in the likelihood of futures contract use depends on the values of other variables in the model. Predicted values from logit models are the logarithm of the odds ratio (p/1-p), where p is the probability of using futures. We estimated predicted values for various combinations of explanatory variables and then derived the predicted probability p. In table 8 of the text, we report those predicted futures use probabilities for different values of the explanatory variables, and in that way show how a change in an explanatory variable affects the probability of futures contract use.

The results tell a useful story. Farms that do not produce corn or soybeans are unlikely to use futures contracts, and increases in farm size have small impacts on whether those farms will use futures. However, farm size has a large impact among corn and soybean farms. Conditional on the farm producing corn or soybeans, operator attributes and the use of marketing contracts are also strongly associated with futures use.

Appendix table C1

Estimating the drivers of futures contract use

	(1)	(2)	(3)	(4)
	Coefficients and standard errors			
Intercept	-37.7205 (0.3589)	-37.4400 (0.3602)	-20.0097 (0.3498)	-18.9947 (0.3476)
Log sales	4.7393 (0.0556)	4.7338 (0.0557)	1.7600 (0.0558)	1.6548 (0.0557)
(Log sales)^2	-0.1548 (0.0021)	-0.1550 (0.0022)	-0.0436 (0.0022)	-0.0433 (0.0022)
Production of commodity (0-1)				
Corn/soybeans			2.9910 (0.0229)	2.7700 (0.0231)
Wheat			0.0398 (0.0126)	0.0307 (0.0128)
Cotton			-0.1815 (0.0355)	-0.2465 (0.0360)
Rice			-1.9890 (0.0900)	-2.0930 (0.0904)
Dairy			-0.9804 (0.0900)	-0.8420 (0.0359)
Cattle			-0.2539 (0.0123)	-0.1254 (0.0126)
Operator attributes				
Operator is college graduate		0.0653 (0.0115)	0.2304 (0.0121)	0.2197 (.0123)
Operator age > 60		-0.5084 (0.0113)	-0.4813 (0.0117)	-0.4552 (0.0119)
Farm uses marketing contracts				1.0324 (0.01178)
McFadden's pseudo-R^2	0.283	0.288	0.391	0.409

Note: Data includes from 15,383 observations.

Source: USDA, Economic Research Service (ERS) using data derived from responses to ERS and USDA, National Agricultural Statistics Service, 2016 Agricultural Resource Management Survey, Version 1, Phase III.