Risk Sharing in Agricultural Supply Chains: The Make or Buy / Sell Decision

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Abstract
The objective of this paper is to describe risk-sharing between farmers, producers, and ranchers in agricultural supply chains with first handlers and input suppliers. This paper focuses on the Make or Buy / Sell decision faced by producers when describing risk sharing activities. In particular, the research quantifies the direction over time of vertical coordination activities (the Make / Sell decision) for annual and perennial crops, and animal agriculture in 56 annual and perennial crop, animal agriculture, and input supply industries. Vertical coordination is composed of integration and supply chain alliances such as marketing or production contracting. The magnitudes and direction of integration vs. contracting as a proportion of the overall market size in each industry is estimated using data from the USDA National Agricultural Statistics Service, Economic Research Service, and Rural Business Cooperative Services. The results suggest that the overall market size as measured by volume in each industry has increased due to population increases and changes in per capita consumption. However, the relative share of volume that is vertically integrated through mutual-benefit entities such as farmer-owned cooperatives or investor- benefit entities such as limited liability companies has decreased while use of supply chain alliances such as marketing or production contracts has increased suggesting that producers have chosen to use more contractual type relationships than vertical integration over time which implies greater efficiency and coordination in supply chains.

Key Words: agriculture, agribusiness, contracting, cooperatives, industrial organization, integration, vertical coordination

JEL Classifications: L22, L66, P13, Q13

Risk Sharing in Agricultural Supply Chains: The Make or Buy / Sell Decision

The objective of this paper is to describe risk-sharing between farmers, producers, and ranchers in agricultural supply chains with first handlers and input suppliers.[1] This paper focuses on the Make or Buy / Sell decision faced by producers when describing risk sharing activities. In doing so, a producer considers the boundaries of the production entity with regard to input and output functions. In particular, the research quantifies the direction over time of vertical coordination activities (the Make decision) for annual and perennial crops, and animal agriculture in 56 industries. Vertical coordination is composed of integration and supply chain alliances such as marketing or production contracting. For reasons discussed in the paper, it is not possible to quantify the actual proportion of coordination increasing or decreasing over time, but it is possible to estimate the magnitudes and direction of integration vs. contracting as a proportion of the overall market size in each industry.

The results suggest that, as expected, the overall market size as measured by volume in each industry has increased due to population increases and changes in per capita consumption. However, the relative share of volume that is vertically integrated through mutual-benefit entities such as farmer-owned cooperatives or investor- benefit entities such as limited liability companies (LLC's) has decreased while use of supply chain alliances such as marketing or production contracts has increased.

The paper addresses the topic of risk sharing in agricultural supply chains which is one of the suggested themes for the workshop. The paper begins with a broad overview of risk followed by a description of the Make or Buy / Sell Decision which is a key decision by a producer in deciding to manage risk by sharing it through a Make process with other input suppliers or first handlers through vertical coordinated methods such as integration or supply alliances such as marketing or production contracts or to bear the risk by just Buying or Selling the product. A discussion about supply chains is provided followed by a description about how the measurement of magnitudes and direction of integration and contracting is done in this paper. The results are discussed for the 56 different industries followed by implications for vertically integrated firms and suggestions for future research.

Overview of Risk

The U.S. Department of Agriculture (USDA) Economic Research Service wrote one of the most comprehensive studies on agricultural risk and categorized risk into three broad categories: business, financial, and strategic (Harwood et al., 1999).

An increase in business risk is related to operational risk and short-term profitability with regard to assets and are typically have a low probability of occurrence. Business risk includes: 1) reduction in production; 2) low output prices or high input prices; 3) incidence of fire, theft, or weather on property; 4) failure of equipment or technology; 5) disputes in a relationship with buyer, landlord, lender, or supplier; 6) noncompliance with contracts, regulation, or other laws; and 7) underperforming managers or injury to employees. There are clear and well-utilized methods to manage business risk.

[1] Henceforth, the word producer is used to collectively describe farmers, producers, and ranchers.

An increase in financial risk is similar to business risk but impacts the equity of the farm as opposed to the assets. Financial risk includes: 1) increased use of short-term or long-term debt; 2) increases in fixed or variable interest rates; 3) the increased use of capital lease commitments; 4) reduction in working capital and liquidity; and 5) unfavorable changes in the assumptions of capital budgeting of investments.

Finally, strategic risk is longer term in nature and harder to assess and includes: 1) unfavorable changes in macroeconomic or external factors, 2) having wrong assets or internal capabilities to meet current or future needs; and 3) being positioned poorly given the external factors and internal capabilities.

In this paper, the focus is on business risk with regard to low profitability due to low output prices which are related to a producer's selling something or high input prices which are related to a producer buying something. Risk is considered with regard to the price function, but other considerations are discussed including the relative influence of governance and production attributes such as premiums and discounts for quality, transportation, handling, and similar issues. The vast majority of large agricultural commercial producers are defined by legal structures such as C or S Corporations, various forms of partnerships, limited liability companies or other legal structures defined in state law.[2] Consequently, a producer is really a member of a production entity that has other members that involve other family members or non-family members.[3]

The Make or Buy / Sell Decision

The Make or Buy / Sell Decision considers risk sharing as involving vertical coordination as a binary decision of integration or contracts as shown in Figure 1 which is adapted from classic textbooks on this topic and modified for agricultural producers. The rationale for risk sharing between entities has been articulated by Nobel laureates in Economic Sciences Coase (1937), Hart (2017), Holmström (1979), Ostrom (1990), and Williamson (2005). The volume of agricultural production sold under contracts through the Make or Buy decision has increased significantly in the 21st Century driven by a variety of issues that are described by Martinez (2002) and Whitt, Miller, and Olver (2022). Figure A1 in Appendix A are taken from the USDA and shows the percentage of agricultural production sold under contract for various agricultural commodities and Figure A2 shows the distribution and value of agricultural production. for various agricultural commodities. Note that the USDA does not track the volume of production sold through vertically integrated structures such as cooperatives but appears to combine vertical integration and contracting into one definition.[4]

[2] State corporate farming laws are external to risk sharing and not discussed here. Non-United States (U.S.) investors who physically own land are not considered in this paper.

[3] Family members are defined broadly and may involve multiple generations whereas non-family members do not include family members. All production entities are investors with their investment considered at risk regardless of whether an individual investor actually works in the production entity.

[4] The evidence for this is this statement is that sugar beet production is shown as being contracted in USDA surveys when it is actual vertical integration since all sugar beet factories are owned by producers through cooperatives (Brester and Boland, 2004). The cooperatives use contracts for the sugar beets, but producers own the plants and are thus, vertically integrated.

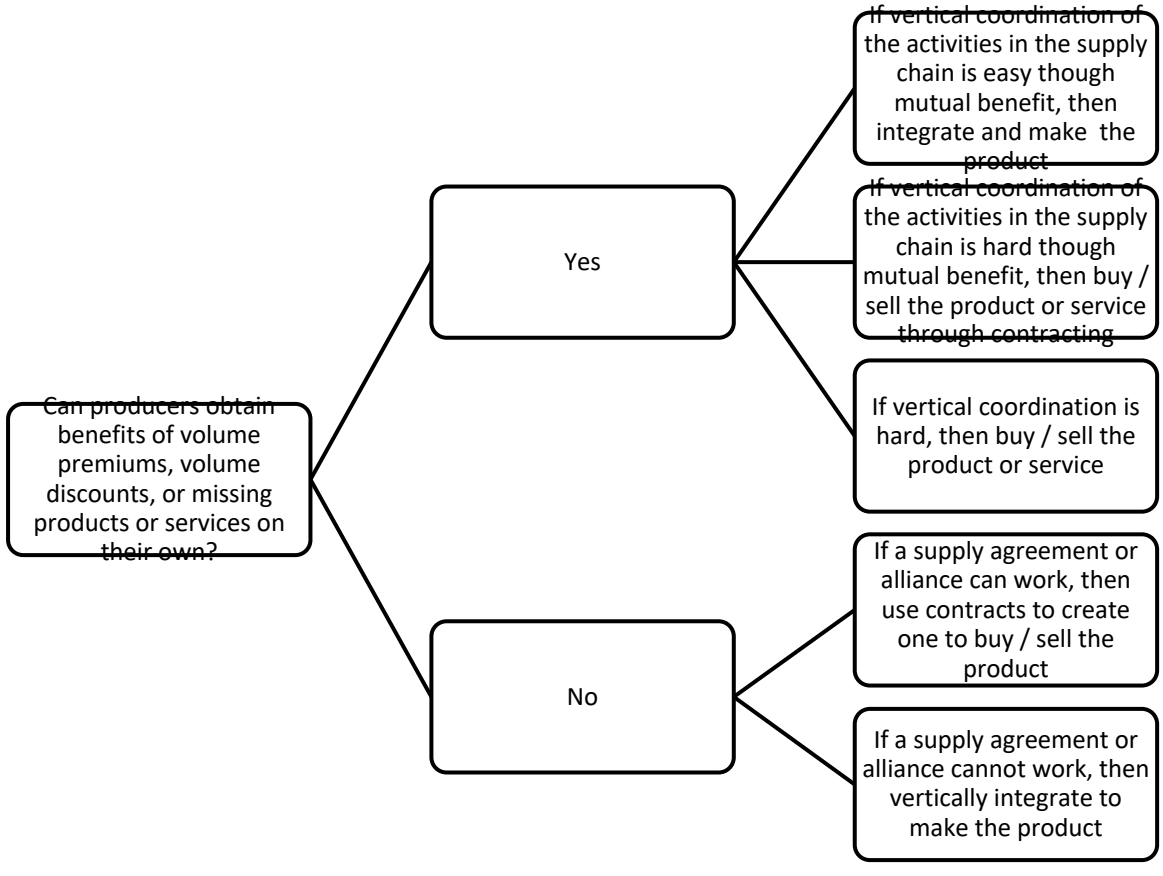


Figure 1. The Make or Buy Decision (adapted from Boland (2017, p.5)

A transaction involving price alone is not considered risk sharing and external to this paper. Integration is considered through a binary decision of cooperatives; S corporations and limited liability companies and contracts are binary decision of marketing or production.[5]

The Boundaries of a Firm in the Make or Buy / Sell Decision

Three terms are commonly used when discussing the motivation of a producer's involvement its existing boundaries.[6] These include marketing or distribution channels, supply chains, and value chains. Warehousing, inventory management, and order fulfillment are considered logistical functions, and these three terms have logistics embedded in them. The nature of a farmer's boundaries with regard to vertical coordination and impact on price involves an understanding of supply chains but because these terms are sometimes used interchangeably, a quick overview is needed to create common understanding.

Marketing Channels

[5] C corporations are tax inefficient and likely not used to integrate as a way of sharing risk.

[6] Much of this discussion is taken from Boland (2018).

A marketing or distribution channel is often viewed from the point of the buyer or customer. In the food system, the customer, from the viewpoint of a Consumer Packaged Goods (CPG) firm, would be a consumer. The same would be true for a restaurant or food service organization. Marketing or distribution channels are narrower than supply chains and consider the five Ps of the marketing mix (that is, packaging, people, price, product, promotion). A direct marketing channel would be one where a producer sells directly to a consumer as in a farmer's market. Stages that may lie in between the producer and consumer include processing, wholesaling or distribution, and retailing. It is useful to think about an example. The food system contains multiple stages with various marketing or distribution channels. For example, consider a marketing channel for breakfast cereals. Consumers desire cereals in a variety of packaging forms (for example, boxed, bagged, single serve, etc.) with certain nutritional needs (for example, use of whole grains, no added sugars, etc.) or product attributes (for example, organic, non-Genetically Modified (GM), no artificial dyes or colors, no corn sweeteners, etc.) which are communicated to the consumer in a variety of methods (for example, in-store promotion, digital coupons, advertising, etc.). A simplified set of stages in the marketing channel would include production, processing, wholesaling, and retailing to consumers. The processor must work with multiple stages in the channel through Make or Buy set of decisions.

Supply Chains

A supply chain is a system of organizations, people, activities, information, and resources involved in moving a product or service from production to consumption. Relative to marketing channels, the goal of supply chain management is to achieve efficient methods of optimizing for low cost and is typically viewed from the viewpoint of decision science or operations management. It involves a broad network of entities within and outside the firm to deliver the product, which has been transformed in some fashion to a finished product suitable for the consumer. For example, a cold chain is a temperature-controlled supply chain used in fruits, meats, and vegetables. A segregated supply chain is created to meet the needs of one or a limited number of buyers. There are many supply chains within a firm. For example, a multinational CPG firm with various consumer brands could likely have dozens of supply chains due to the various ingredients being used. An example of a segregated supply chain would be the production of an organic breakfast cereal, which involves using organic inputs in a manufacturing value chain and making it available and communicated to consumers through an organic marketing channel.

The supply chain for efficiently providing consumers with breakfast cereals might begin with agricultural production crops such as hard white wheat varieties for whole wheat grains or cane sugar as opposed to liquid sweeteners from corn which are sold to handlers who collect the crop and sell it bulk to breakfast cereal manufacturers who use them in a food extrusion technology to create the actual cereal flakes. This manufacturing process is quite complicated involving a number of processes in a Make or Buy decision framework. The cereal is packaged, shipped and stored in a distribution center warehouse, and sold to a wholesaler or directly to a retail grocer or food service distributor who sells to consumers. The breakfast cereal firm uses logistics services to manage this entire process. Inventory management, warehouse replenishment, demand forecasting, and raw material procurement are included in this process. Thus, a supply chain is defined as a coordinated process through which a number of business entities cooperate in an effort to acquire raw materials through product procurement, convert these raw materials into specified finished products, manage standards of quality and deliver these to

retailers. Some of these activities are vertical integrated, some are contractial, and some are just spot market purchases.

Value Chains

A value chain is a set of activities that a firm operating in a specific industry performs in order to produce a product or service (Porter 1980). In this way, supply chains link value chains. The firm's value chain is designed to capture value for all firms by carrying out activities to meet the demand of these consumers who could be an individual retail grocer, food service, or restaurant chain. Consumer demand is the source of the value, and the value added to a product. That value, as viewed from the perspective of a consumer, is obtained through research and development (for example, an almond innovation lab, a private label brand kitchen, etc.), market research on consumer trends (for example, NPD Group, Nielsen, etc.), creation of product and service innovations valued by consumers (for example, internal customer solutions lab for food starches, etc.) and economic conditions underlying consumer income that impact product demand (for example, government reports by Bureau of Labor Statistics, etc.).

One type of CPG manufacturing value chain for breakfast cereal is the process used by an individual manufacturer to create the cereal using research on consumer demand for product attributes such as whole grains, vitamin-fortified, or natural food colors; packaging attributes such as portion size (for example, single-serve, family size, etc.) and cardboard box or plastic packaging; or cereals produced under certain types of production systems such as non-genetically modified ingredients or organic. A company who has a line of business that handles global feed and food grain trading value chain might be the business of delivering grain at a specified grade year-round at certain time intervals and its value comes from the entire process from origination to delivery as opposed to just origination.

Summary

Supply chain management can be thought of as functions that manage product supply flow through the Make or Buy decisions and value chain management can be thought of as functions that manage consumer demand. Ideally, these activities should work together within a firm. An economist might think of this as a firm maximizing consumer demand as measured by value subject to an internal constraint on costs of procuring the ingredients for the product supply. Within a firm, the job descriptions for individual employees reflect these viewpoints and the employees are working towards the same goal. Consumers purchase food products daily directly through a retail grocery or similar store format or through food service or similar format, but a firm is not producing a product in "real-time." It must anticipate the needs of the consumers years in advance and build a system to supply the product inputs and services needed to anticipate consumer demand. Most food value chains and supply chains exist with global reach. Generally speaking, agricultural production and those who firms who supply farmers, producers, and ranchers with inputs is the beginning of such chains with regard to origination and participation by producers in these chains allow for increased opportunities and risk.

Previous research has found that the wholesale and large grocery retailers have integrated functions (Schumacher and Boland, 2004; Volpe and Boland, 2022) and that integration has been occurring between producers and first handlers in food and feed grains with regard to certain commodities such as corn ethanol and soybean crushing (Secor and Boland, 2018). Furthermore, integration has been

increasing as shown by Dorsey and Boland (2009) for reasons other than diversification and that vertical coordination, overall, has been efficiency enhancing (Sexton, 2012).

Measuring Producer Choice in the Make or Buy / Sell Decision

There is no good source of measuring the decision by a producer to participating in Making a product through vertical coordination using integration or a marketing or production contract over time. The three most common forms of vertical integration for purchasing supplies or marketing products would be: 1) producer investment in a mutual benefit type firm such as a cooperative; 2) producer in an investor benefit type firm such as an LLC; or 3) investing in Making assets as a sole proprietor. In order to understand a producer's behavior toward business risk, it would be desirable to know data on the market share of ownership in vertically integrated enterprises for agricultural inputs or marketing outputs over time. If market share was increasing, this would suggest that producers were receiving benefits by Making the product through integration whereas if market share was decreasing this would suggest the opposite effect.

One measure of market share would be the proportion of products purchased or sold through vertical integration in the numerator relative to the overall size of the market in the denominator. The market size can be proxied by using data from the USDA on the annual volume of various crops and their inputs used by producers. Some of this is annual data collected by the National Agricultural Statistics Service (NASS) and some is available every five years through the Census of Agriculture. Data on the numerator does not exist and alternative methods must be found.

Because of the difficulty in agricultural producers to own land in multiple countries due to laws on foreign ownership of farmland, it is not likely that one would see vertical integration between input suppliers and first handlers, and producers across countries. Thus, common vertical integration strategies in U.S. producers would involve producer owners of farmland and processing assets or purchasing assets in mutual benefit organizations such as cooperatives or vertically integrated farming operations.

Consequently, it would be useful to know the extent of growth in U.S. consumer demand, and U.S. supply. The residual market share, since the commodity balance sheet must balance, would be imports and exports, and carryover stocks and inventories. Growth rates could be calculated for wholesale disappearance adjusted for U.S. population and U.S. production of that commodity. A positive difference between growth rates in aggregate demand and domestic supply would suggest imports are increasing which are likely to be vertically coordinated but not integrated given the nature of scheduling supply to meet demand needs for orderly marketing given the perishability of agricultural commodities.

Measuring Extent of Producers Use of Mutual-benefit Firms such as Cooperatives to Vertically Integrate

The USDA Rural Development reports annual data on sales of cooperatives and the number of cooperative memberships per state in various industries. This data could be used to calculate information on the relative direction of market share held by farmers in two ways. First, the ratio of number of memberships in cooperatives divided by the number of producers every five years from the USDA NASS Census of Agriculture can be determined by state and aggregated nationally. This is count information rather than weighted by volume. Second, assuming that a cooperative operated using the

same profit margin per customer after accounting for discounts or premiums for quality, transportation, volume or other differences, the U.S. annual sales volume of cooperatives in an industry could be divided by the aggregated U.S. gross producer receipts in that industry which would be a proportion. Using this assumption would provide a proportion based on volume. For certain products, producers use bargaining cooperatives who bargain collectively for a price which is used to contract with processors in certain industries such as peaches, pears, prunes, raisin grapes, and tomatoes.

Measuring Extent of Producers Use of Other Methods to Vertically Integrate

There is no similar data on how producers vertically integrate other than cooperatives. The Census of Agriculture began reporting the legal status of a producer's business which is used for tax purposes. Investor-benefit firms that are publicly traded such as Calavo or Mission Produce publish some data on volumes in reports provide to the U.S. Security and Exchange Commission in their annual 10-k reports. Where possible, this volume can be obtained and used in the numerator to understand directionally the volumes marketed in an industry through a supply alliance such as a marketing or production contract. Standard and Poors Compustat database was used to look at firms in the North American Industrial Classification Systems (NAICS) codes of 11 Agriculture, Forestry, Fishing and Hunting; 311 Food Manufacturing, and 3253 Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing.

Methodology

Measuring Vertical Integration Average Growth Rates through Cooperatives

First, growth rates are calculated for the ratio of cooperative memberships from the USDA Rural Business Cooperative Services (RBCS) report to total producers in each industry using the 1997, 2002, 2007, 2012, 2017, and 2022 Census of Agriculture (Wadsworth and Coleman, 2023). Thus, there are five growth rates (1997 to 2002, 2002 to 2007, 2007 to 2012, 2012 to 2017, 2017 to 2022) and the arithmetic mean of the five growth rates is reported for each industry where there was a cooperative in 2022.[7]

Second, growth rates are calculated for the ratio of sales volume of the agricultural cooperative to overall gross receipts in an industry using the 1997, 2002, 2007, 2012, 2017, and 2022 Census of Agriculture. The arithmetic mean of the five growth rates is reported for each industry where the USDA RBCS reported sales of cooperatives broken out in that industry.

These two sets of average growth rates over time provide some indication of the direction as measured by the sign of the growth rate where a positive sign would suggest that producers managing risk through vertical integration in cooperatives is increasing and a negative sign would mean the opposite. Some idea of the magnitudes would be suggested by the relative size of the average growth rate with a rate close to zero being a small magnitude and a number far from zero being a larger magnitude.

Measuring Vertical Integration Average Growth Rates through Investor-benefit Firms

[7] The USDA RBCS data is annual data, and it is possible to calculate an arithmetic mean of the five years between each Census. That was not done in this paper but if it is accepted for presentation, will be done by November 2025. This will allow some comparison between the data.

A third method is used to measure the average growth rate of investor-benefit firms in the same manner for the Census of Agriculture years from the data in Compustat. Such firms may own some farmland but, in general, rely on supply alliances such as marketing or production contracts.[8] These are calculated annually beginning in the first year data was observed and then an arithmetic mean is calculated.

Measuring Average Growth Rates for U.S. Aggregate Demand and Supply
Data from the USDA Economic Research Service (ERS) Food Availability Per Capita Data System are used to calculate annual growth rates for per capita wholesale disappearance and from the USDA NASS for U.S. agricultural production.

Other information Used
Finally, these results are compared and discussed relative to USDA ERS data on relative shares of contracting over time, the use of a marketing order in that industry as reported by the USDA AMS, and any other observations found when conducting this research.

Data
The extent of agricultural industries with regard to make or Buy / Sell are divided into annual and perennial crops, and animal agriculture. Industries were identified from the Census of Agriculture and correspond to USDA NASS definitions. The industries are grouped into categories. Berries include avocadoes, blackberries, blueberries, cranberries, fresh tomatoes, table grapes, processing grapes (jam or juices), processing tomatoes, raisin grapes, raspberries, and strawberries. Citrus fruits include fresh oranges such as navel, grapefruit, lemons, and processing oranges such as Valencia. Pome fruit includes canning pears, fresh apples, and processed apples for jams or juices. Stone fruit includes apricots, canning peaches, sweet cherries, tart cherries, dates, olives, plums, processing cherries for juice or Maraschino, and prunes. Tree nuts include almonds, hazelnuts, pecans, pistachios, and walnuts. Figs is a separate perennial crop that does not fit into the any of the perennial crop groups.

Annual crops include edible beans, soybeans, corn, grain sorghum, wheat, feed barley, malt barley, cotton, potatoes, oilseed sunflowers, confectionary sunflowers, canning vegetables, peanuts, rice, and sugar beets. Animal agriculture includes beef, chicken, dairy, eggs, lamb, and turkey.

The extent of agricultural industries involved in the Make or Buy / Sell decision of agricultural inputs include crop nutrients, protectants, bovine genetics, energy, and seed. The first two methods used for agricultural outputs such as annual and perennial crops, and animal agriculture are used for these five industries.

[8] For example, Red Gold owns farmland in Indiana to process its own tomatoes in addition to using contracts, the Wonderful Company in California owns farmland to produce pistachios, citrus, and almonds and also contracts with growers; Smithfield Foods owns pork production facilities and contracts pigs; prune growers own Sunsweet Growers and also have a company owned farm and facility in Chile, and there are other such examples.

Results and Discussion

Figures 1 to 3 show the average growth rates for each industry in outputs and Table 4 has inputs. If there is no data in a cell, it means that there was no data to be found. For example, consider the second column of cooperative memberships. **i**ndustries like avocadoes, hazelnuts, processing cherries, and walnuts used to have vertical integration through cooperatives, but these became investor-benefit firms or closely held firms. Pistachios have a producer owned LLC that looks and feels like a cooperative but is not legally organized as one. Similar LLC structures exist in walnuts. Supply agreements in the form of production contracts (for example, use of Haas variety) and marketing contracts (these differ for domestic vs Mexican vs rest of world production) exists in avocadoes. Processing cherries have marketing agreements with a cooperative processor, but it is non-patronage business. Fresh tomatoes are governed through a bargaining cooperative.

Marketing Orders

The Agricultural Marketing Act of 1937 authorized producers to form marketing orders to: 1) conduct research and development to reduce costs, improve crop productivity, undertake distribution improvements, or increase consumer demand; 2) ensure standardization of packaging, labeling, size, weight, product dimension, or similar activities to improve trade; 3) create uniform grading standards to improve trade; 4) create generic advertising programs to stimulate demand including building markets; 5) share data on production and distribution to improve production and marketing decisions; 6) create orderly marketing of products to avoid high or low volumes throughout the marketing year; and 7) maintain uniform standards on imports to ensure that imported products are on same level playing field as domestic production. Marketing orders exist in the following industries in this data: almonds, apricots, avocados, sweet and tart cherries, Florida and Texas citrus, cranberries, dates, grapes, hazelnuts, olives, pears (fresh and processing), pecans, pistachios, prunes, raisins, tomatoes, and walnuts.

Reduction in Cooperative Market Share

Average growth rates were negative in every industry except blueberries, blackberries, olives, and lamb. This may appear puzzling since the formation of marketing cooperatives in the early 20th century saw many producers as members of marketing cooperatives especially in the processed fruit and vegetable industries as these cooperatives sought to add value throughout the marketing year. Aaron Shapiro was a principal proponent of such cooperatives forming pools with as much volume as possible to ensure market share (Larsen and Erdman, 1962). However, such market share has eroded over time as shown in this data. In some industries such as canning vegetables, vertical integration has disappeared as Birds Eye Foods and NORPAC have demutualized or sold their assets with closely held Seneca Foods being the largest firm in this industry. In crop genetics, vertical integration has essentially disappeared with the sale of Cal-West Seeds to Syngenta in 2010 although Land O'Lakes maintains a small alfalfa breeding program. In non-lending financial services industry, vertical integration has disappeared with FCStone's sale to public investors.[9]

[9] Vertical integration in corn-ethanol has eroded but some of this was due to the need for more tax efficient structures such as limited liability partnerships.

With regard to non-cooperative firms who vertically integrated, only 12 firms were found in Compustat that mentioned owning farm land suggesting that contracting or simply Buying / Selling what was needed

Implications for Risk in Agriculture

These results have some implications for risk bearing between producers and input suppliers and first handlers in supply chains.

Private Equity Investments
As demand has increased for fresh berries and other fruits, private capital has entered various industries. In some cases, such as Chelan Fruit or BC Fruits, private equity purchased the assets of cooperatives. In many other cases, private equity has purchased large family-owned farms, many of which were involved in fresh fruits and vegetables and used contracts. An unknown author(s) reported 129 private equity buyouts of farms in the 2018 to 2023 time period. In other cases, they have entered into joint ventures such as Naturipe with cooperatives and other family-owned firms such as MBG marketing (aka Michigan Blueberry Growers). The introduction of private equity rather than producers vertically integrating in such industries suggests the need for new assets in producers linked with research and development and opportunities for value chain activities such as extended shelf life fruit, use of trade policies, or changing trends in the produce aisle including the branding of varieties in fruits and vegetables.

Global Trademarks, Certification Marks, and Geographic Indications
Like the privacy concerns (that is, Right to be Forgotten) and standardized financial accounting reporting between the EU and United States, this particular issue is likely to never be resolved although a "work around solution" appears to be developing. Essentially the issue is whether policies on foods designated as geographic indications are, in fact, nothing more than creating a vertical supply curve, which is how the United States views them or whether the food is actually differentiated and are on the inelastic part of the demand curve which is how the EU views them. It has become important in trade renegotiations because the recent trade agreements between the EU, Canada, and Japan allowed for five cheeses (that is, Asiago, Feta, Fontina, Gorgonzola, and Munster) to be recognized as geographic indications, and the proposed EU-Mercusor has similar language for certain cheeses. Certainly, certification marks and trademarks are important issues. It should be noted that such governance structures are not organized through modern mutual-benefit laws but through ancient legal structures that predate modern laws. Such entities have vertically integrated the entire chain from production through processing and manufacturing and in some cases wholesale functions and allow employees of any of the integrated chains to serve on the governance structure which is difference than cooperative laws that arose globally in the 19th century..

Management of Global Price Risk in a Supply Chain
Firms with global supply chains desire a method to manage global price supply risk. However, this is difficult for many products including dairy, meat and poultry, fruits, and vegetables. Marketing contracts are common, but the price discovery process may depend on publicly reported Buy / Sell prices in thin markets due to limited number of buyers and sellers (Adjemian, Saitone, and Sexton, 2016). The ability

to manage price throughout the supply chain is not readily apparent as evidenced by frequent mentions of the topic in quarterly reports of food economy firms that report to the U.S. Securities and Exchange Commission. Anecdotal evidence suggests that this is especially true in dairy, which is regulated through marketing orders in the United States and the lack of timely and transparent data on current and future demand and supply since milk supply is so elastic regardless of where it is produced.

Have supply chains become more efficient between input suppliers, producers, and first handlers?
Most research would say that this is the case. It is well known that returns to farm assets including land are low based on return on asset ratios relative to other parts of the supply chain from consumer to input suppliers. Thus, vertical integration into actual ownership of farmland by someone in a supply chain is not likely to be in an economically feasible set of investment decisions with exceptions as noted in footnote 8 or possibly food security concerns. The fact that agricultural supply chains have grown longer (at least until maybe recently) with more entities involved globally suggests greater efficiencies. That would suggest that vertical coordination relative to contracting may be more efficient than vertical coordination through integration.

Suggestions for Future Research

The information shown here provides some needs for future research and some questions are shown here.

Does market failure still exist in agriculture?
The issue of why producers have chosen to vertically integrate as part of the Make decision was often linked with market failure considerations (Sexton, 1986a, 1986 b). These results suggests that directionally, market failure may not be such a compelling issue in 2025 as vertical integration has decreased relative to contracting. The issue of why a producer might choose to Make is likely linked with the desire to have less variability in net farm income. This could be researched by using cross sectional, time series data for whole farm budgets broken up by enterprise to compare producers who vertically integrate or contract with producers who do not choose to do so within each enterprise and across the whole farm budget. A minimal effort might begin with the coefficient of variation of net farm income as an initial point of comparison. Such data exists within the Center for Farm Financial Management at the University of Minnesota although it would take an organized effort to determine growers who Make vis-à-vis those who Buy / Sell. It would be a useful dissertation contribution to go beyond a simple measure of risk such as a coefficient of variation.[10]

Do large commercial producers see a need to vertically integrate?
The data used in the numerator of the ratios is not available based on farm size as measured by volume or acreage. No research is available to show whether the bimodal distribution of commercial production is linked with larger production units' ability to make greater use of Make activities such as integration

[10] Anecdotally, this author has taught farm management for a number of years and every student who comes from a commercial farm background reports that their family is involved in over four Sell activities year in and year out suggesting that there are reasons for doing so. For example, in Minnesota there are at least 54 different firms who are involved in the Make decision with producers.

although USDA ERS reports greater use of contracting. Theoretically it is possible to tease out the USDA RBCS data into various sizes of producers by breaking apart the average equity investment by member and its standard deviation with some effort. That would help to provide some more insight as to how larger volume producers view the Make boundary of their farming enterprise.

Has trade liberalism made vertical integration less necessary?
The data used in this study is after the formation of the original NAFTA agreement, the formation of the World Trade Organization, and the 1996 so-called "Freedom to Farm" Farm Bill. A logical hypothesis is that trade liberalization has made it easier for producers to import inputs and export outputs. It is likely that this has led to an increase in contracting relative to integration. Certainly, an examination of industry trends such as the reduction in nitrogen fertilizer production in U.S. relative to imports in the late 1990s until new production was built in the U.S. twenty years later or the development of avocadoes, blueberries, and cranberries as global fruits beyond their North American origin. Many other examples can be found. There is broad economic research that shows that increased trade has led to longer supply chains and supply chains with more contracting relative to integration (Gereffi, Humphrey, and Sturgeon, 2005). However, to the best of this author's knowledge, nothing has been written about the relative reduction of vertical integration relative to contracting in U.S. agriculture since trade liberalization has occurred.

Do vertically integrated brands owned by farmers still have value?
Historically, U.S. brands owned by vertically integrated producers were common in retail grocery stores such as tree nuts including Diamond and Blue Diamond; citrus such as Florida's Natural and Sunkist; pome fruits such as Treetop; grapes such as Sun-Maid and Welch's; dairy such as Cabot, Land O'Lakes, Tillamook, and many others. A list of the world's most valuable brands is done annually by Interbrands in London and an examination of the top brands would find no U.S. brands of vertically integrated producers in those rankings. A USDA RBCS study of such brands in 1990 shows that only 31 percent of the brands still exists in 2025 based on this author's estimates. Meanwhile, brands of firms engaged in contracting can be found on those lists and many of these are true global brands whereas the vertically integrated brands may be found in small areas. A new phenomenon is the development of Fair Trade type supply chains that seek to provide many of the economic benefits of vertical integration to farmers in lower income countries without the need to provide the equity capital to develop and support such brands. No study exists that shows the development of global food brands that compete directly with vertically integrated brands owned by producers, but data exists to do such a study and back into unit counts through production data provided by the USDA NASS and Census of Agriculture.

Has U.S. tax policy led to more vertical integration?
In 2004, Congress passed the Domestic Production Activities Deduction (Section 199) which originated out of the American Jobs Creation Act of 2004 and created an income tax deduction for domestic manufacturing and production activities (Ohrn, 2018). The Section 199 deduction applied to agricultural producers who were vertically integrated through cooperatives as they were manufacturing agricultural products. Agricultural cooperatives could also structure their payments for commodities such that the cooperative was considered as having collectively manufactured the products on behalf of the members. In that case, the cooperative could take the deduction at the cooperative level or pass all or part of it to the members. Because the Section 199 deduction was limited to 50% of W-2 wages

associated with the agricultural production, it was typically more advantageous for the cooperative to take the deduction and then pass on all or a portion of the deduction to their members. The 2017 The Tax Cuts and Jobs Act and the resulting "Grain Glitch Fix" in 2018 reduced the marginal tax rates for most corporations from a top rate of 35% to 21% which was a 40% reduction.[11] However, the deduction (Section 199A) stayed in place for cooperatives owned by farmers. This deduction has made it advantageous for larger farmers to consider integrating into value-added activities, but no research has been done to show whether they have in fact done so. Researchers who are able to work with large data sets from tax authorities through cooperative agreements could use North American Industrial Classification codes to identify data of large producers to examine depreciation and investment decisions as Ohrn (2018) and Zwick and Mahon (2017) have done.

Summary

This paper looks at the Make or Buy / Sell decision faced by producers when describing risk sharing activities. In doing so, a producer considers the boundaries of the production entity with regard to input and output functions. In particular, the research quantifies the direction over time of vertical coordination activities (the Make decision) for annual and perennial crops, and animal agriculture in 56 industries. The results suggest that, as expected, the overall market size as measured by volume in each industry has increased due to population increases and changes in per capita consumption. However, the relative share of volume that is vertically integrated through mutual-benefit entities such as farmer-owned cooperatives or investor- benefit entities such as limited liability companies (LLC's) has decreased while use of supply chain alliances such as marketing or production contracts has increased.

References

Adjemian, M. K., T.L. Saitone, and R.J. Sexton. 2016. "A Framework to Analyze the Performance of Thinly Traded Agricultural Commodity Markets." *American Journal of Agricultural Economics*, vol. 98, np. 2, pp. 581–596.

Boland, M.A. (2018). The Business Merit of Trade. *Federal Reserve Bank of Kansas City Economic Review*. 103(Special Issue), 27-54.

Boland, M. A. (2017). *Introduction to Cooperatives and Mutuals*. University of Minnesota Libraries, https://conservancy.umn.edu/handle/11299/191871

Brester, G. and M.A. Boland. "The Rocky Mountain Sugar Growers Cooperative: Sweet or Sugar-Coated Visions of the Future." *Review of Agricultural Economics* 26, 2(summer 2004): 287-302.

Coase, R. 1937. "The Nature of the Firm." *Economica*, vol. 4, no. 16, pp.386-405.

Dorsey, S. and M.A. Boland. "Vertical Integration in the U.S. Food Economy." *Journal of Agricultural and Applied Economics* 41, 3(December 2009):585–598.

[11] The Agricultural and Applied Economics Association recognized a group of extension economists who wrote and disseminated information about this topic with its group extension award.

Gereffi, G., J. Humphrey, and T. Sturgeon. 2005. "The Governance of Global Value Chains." *Review of International Political Economy*, vol. 12, no. 1, pp.78-104.

Hart, Oliver. 2017. "Incomplete Contracts and Control." *American Economic Review*, vol. 107, no. 7, pp.1731-1752.

Harwood, J., R. Heifner, K. Coble, J. Perry, and A. Somawaru. 1999. *Managing Risk in Farming: Concepts, Research, and Analysis*. Market and Trade Economics Division and Resource Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 774.

Holmström, B. 1979. "Moral Hazard and Observability." *The Bell Journal of Economics*, vol. 10, no. 1, pp.74-91.

Kinsey, Jean D. 2001. "The New Food Economy: Consumers, Farms, Pharms, and Science." *American Journal of Agricultural Economics*, vol. 83, no. 5, pp.1113–1130.

Larsen, G.H. and H.E. Erdman. 1962. "Aaron Sapiro: Genius of Farm Co-operative Promotion." *The Mississippi Valley Historical Review*, Vol. 49, No. 2, pp. 242-268.

Martinez, S. 2002. *Vertical Coordination of Marketing Systems: Lessons from the Poultry, Egg and Pork Industries*. Agricultural Economic Report No. (AER-807).

Ohrn, E. 2018. "The effect of Corporate Taxation on Investment and Financial Policy: Evidence from the DPAD." *American Economic Journal: Economic Policy* 10,2:272-301.

Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge University Press.

Porter, M.E. 1980. *Competitive Strategy*. New York: The Free Press.

Schumacher, S. and M.A. Boland. "Persistence in Profitability in Food and Agribusiness Firms." *American Journal of Agricultural Economics* 87, 1(February 2005):103-115.

Secor, W. and M.A. Boland. (2017). Entry and Exit Patterns in Corn-ethanol Plants. *American Journal of Agricultural Economics*. 99(2), 524-531.

Sexton, R.J. (1986a), 'The Formation of Cooperatives: A Game Theoretic Approach with Implications for Cooperative Finance, Decision Making and Stability', *American Journal of Agricultural Economics*, 68(2):214-225.

Sexton, R.J. (1986b), 'Cooperatives and the Forces Shaping Agricultural Marketing', *American Journal of Agricultural Economics*, 68(5):1167-1172.

Sexton, R.J. 2000. “Industrialization and Consolidation in the U.S. Food Sector: Implications for Competition and Welfare.” *American Journal of Agricultural Economics*, 82(5): 1087-1104.

Sexton, R.J. 2012. “Market Power, Misconceptions, and Modern Agricultural Markets.” *American Journal of Agricultural Economics* 95(2): 209-219.

Unnamed Author. 2025. “Betting the Farm: Private Equity Buyouts in U.S. Agriculture.” Accessed online 25 July 2025 at https://pestakeholder.org/reports/betting-the-farm-private-equity-buyouts-in-us-agriculture/

Volpe, R. and M.A. Boland. (2022). The Economic Impact of Wal-Mart Supercenters. *Annual Reviews of Resource Economics*. 14(1), 43-62.

Wadsworth, J. and C. Coleman (2023). “Agricultural Cooperative Statistics.” USDA Rd Rural Business Cooperative Services Report 87.

Whitt, C., N. Miller, and R. Olver. (2022). “America’s Farms and Ranches at a Glance.” USDA Economic Research Service, Economic Information Bulletin Number 247.

Williamson, O.E. 2005. “The Economics of Governance.” *The American Economic Review*, vol. 95, no. 2, pp.1-18.

Zwick, E. and J. Mahon. 2017. “Tax Policy and Heterogeneous Investment Behavior.” *American* Economic *Review* 107,1:217-248.

Other References

The author identified 47 case studies of vertically integrated firms owned by producers or firms that contract with producers published in the American Journal of Agricultural Economics, Review of Agricultural Economics, or International Food and Agribusiness Management Association Review. The author has prepared a staff paper with a review of them as background for this paper.

Table 1. Arithmetic Mean of Average Growth Rates for Annual Crops

	Average Growth Rates for Vertical Integration, every five years			Average Growth Rates, annual	
	Membership in Cooperatives	Volume of Investor-benefit firms	Market Share of Cooperatives	Per Capital Annual Wholesale Disappearance	Total Supply
Canning vegetables		-2.1		-2.1	-1.8
Confectionary sunflowers	0.05		0.08	1.1	1.9
Corn	-0.8		1.1	0.08	1.1
Edible Beans	-1.1			0.06	0.09
Feed barley					
Grain sorghum					
Malt barley					
Oilseed sunflowers	-1.1		1.5	1.8	2.1
Peanuts	-12.1		-0.08	-0.05	0.01
Rice	-3.8		0.07	0.09	-0.04
Soybeans	-1.6		1.1	1.3	3.2
Sugarbeets	-2.1		0.07	-0.03	-0.07
Wheat	-1.7				

Table 2. Arithmetic Mean of Average Growth Rates for Perennial Crops

	Average Growth Rates for Vertical Integration, every five years			Average Growth Rates, annual	
	Membership in Cooperatives	Volume of Investor-benefit firms	Market Share of Cooperatives	Per Capital Annual Wholesale Disappearance	Total Supply
Berries					
Avocadoes		5.6		7.1	-4.5
Blackberries	2.6		1.9	4.3	3.1
Blueberries	3.2	3.1	2.7	5.1	4.6
Cranberries	-0.8		-0.09	1.4	1.9
Processing grapes	-2.7		-1.7	-0.09	1
Processing tomatoes	-1.1		-3.2	0.08	1.3
Raisin grapes	-4.2		-1.3	0.02	-1.1
Raspberries	-3.2		-0.09	4.1	2.4
Strawberries	-4.1		-2.3	3.7	2
Citrus Fruits					
Fresh orange	-2.7		-1.2	1.7	2.1
Lemons	-2.7		-1.2	2.4	1.9
Processing oranges	-8.5		-5.4	-1.7	-4.1
Pome Fruits					
Canning pears	-12.1		-2	-1.8	-2
Processed apples	-4.6		-2.3	-0.07	-1.3
Stone Fruit					
Apricot	-3.8		-1.1	-0.01	-1.1
Canning peaches	-1.6	-2.1	-1.8	-0.09	-1.3
Sweet Cherries	-2.1		-1.4	1.8	1.1
Tart cherries	-1.7		-1.2	1.4	2.2
Dates	-5.2		-7.3	0.08	1
Olives	2.1		1.6	2.4	4.2
Plums					
Processing cherries					
Prunes	-11.3		-4.3	-1.1	-3.2
Tree Nuts					
Almonds	-3.6		-6.1	3.4	4.1
Hazelnuts				1.5	2.9
Pecans	-1.8		-2.5	0.05	1.1
Pistachios				2.7	4.1
Walnuts		-1.9	-4.5	3.1	2.3
Other					
Figs	-3.2		-8.1	0.01	-2.2

Table 3. Arithmetic Mean of Average Growth Rates for Animal Agriculture Products

	Vertical Coordination				
	Average Growth Rates for Vertical Integration, every five years			Average Growth Rates, annual	
	Membership in Cooperati	Volume of Investor-benefit f	Market Share	Per Capital Annual Wholesale	Total Supply
Lamb	0.09		0.02	0.03	0.02
Beef	-0.02	2.1	0.01	-1.1	-0.08
Pork	-0.05	1.9	-0.02	1.8	2.1
Chickens					
Turkeys		0.6		2.4	3.1
Eggs				3.2	2.7
Milk	-3.1		1.8	2.1	1.8

Table 4. Arithmetic Mean of Average Growth Rates for Farm Supply Inputs

	owth Rates for Vertical Integration, ever			verage Growth Rates, annu	
	Membership	Volume of Inv	Market Share	Per Capital A	Total Supply
Animal nutrition	-0.07		1.1		2.3
Crop protectants	-1.2		0.8		3.1
Crop nutrients	-1.8		1.1		2.9
Energy	-1.7		1.3		1.1
Seed	-2.3		-0.02		1.3
Animal genetics	-2.9		0.09		1.1

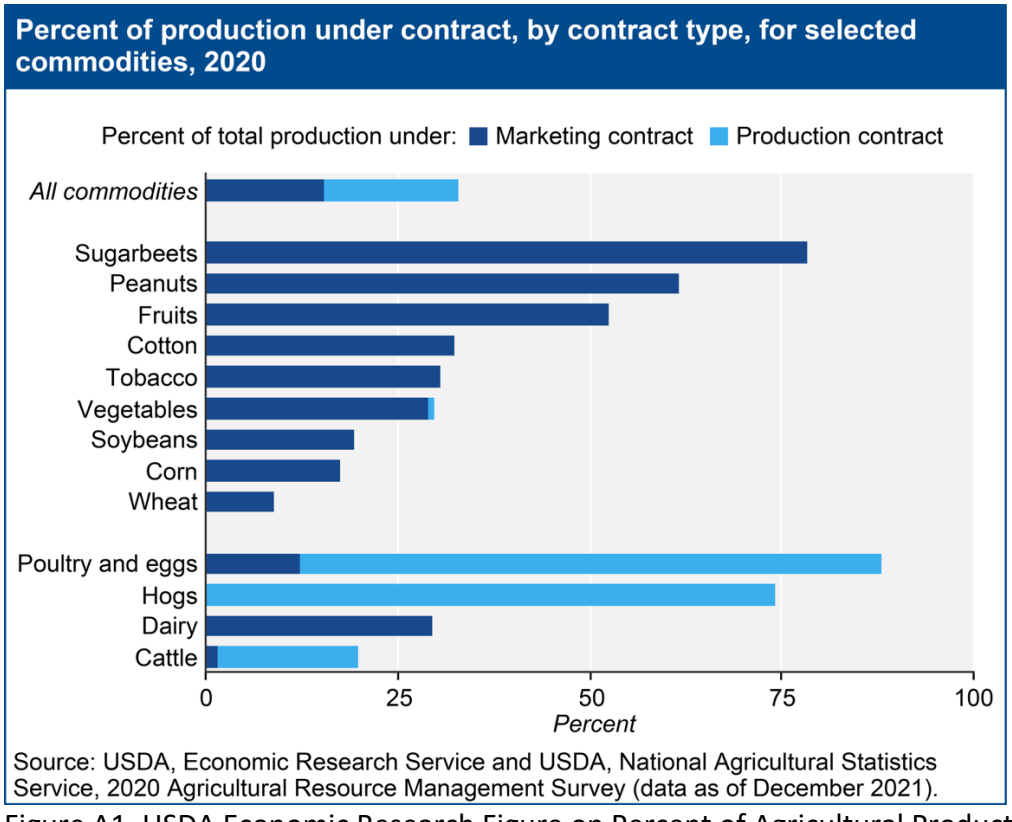


Figure A1. USDA Economic Research Figure on Percent of Agricultural Production Sold under Contract

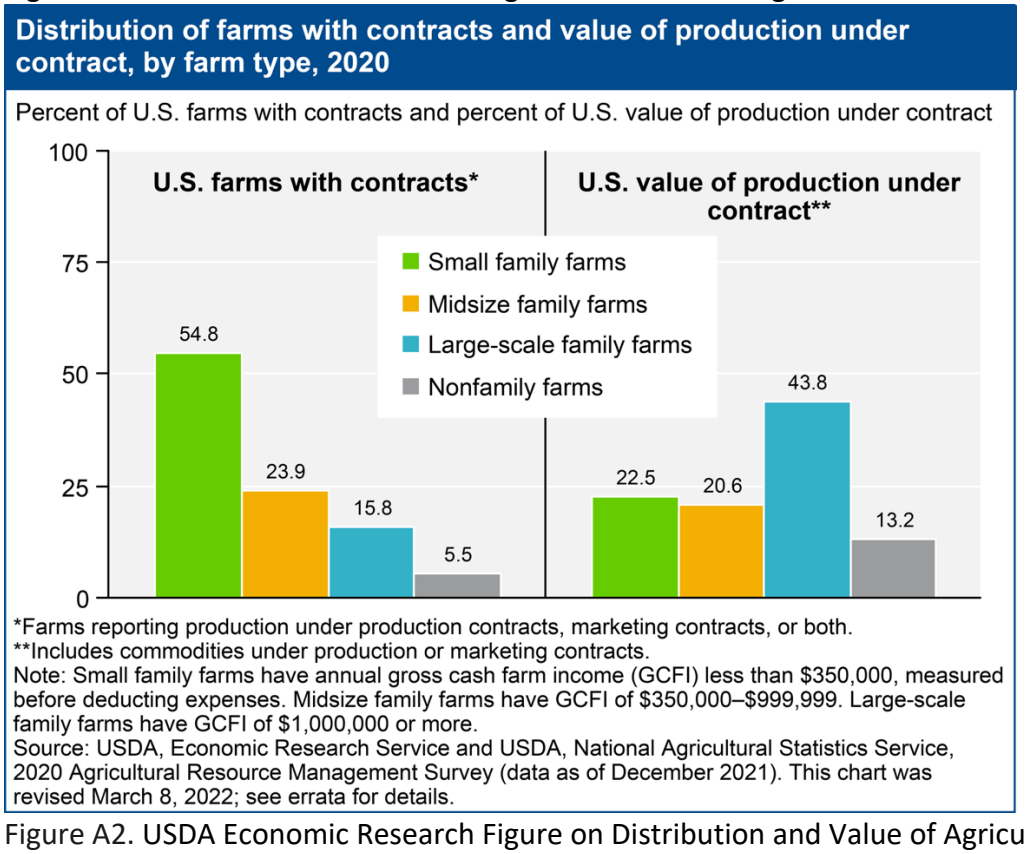


Figure A2. USDA Economic Research Figure on Distribution and Value of Agricultural Production Sold under Contract