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Factors affecting the selection of business arrangements by hog producers in the United States

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FACTORS AFFECTING THE SELECTION OF BUSINESS ARRANGEMENTS BY HOG PRODUCERS IN THE UNITED STATES

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ABSTRACT

The structure of the U.S. hog industry is changing rapidly. U.S. hog farms have become smaller in number, larger in size and more specialized. This study examines the factors that influence the hog producer's choice among business arrangements offered in the U.S. hog industry. A national survey was mailed to 4,986 hog producers to determine these factors. The survey consisted of questions covering topics such as: production characteristics, autonomy, transaction costs, risk, social relationships, and demographics. A response rate of 21% was received from the mailed surveys. Four alternative business arrangements were used: independent production, cooperative farming, flat-fee contract, and incentive payment contract. The multinomial logit and binomial logit models were employed to determine factors influencing producers' choice of business arrangement. Results indicate that independent producers are, in general, more likely to be breeding sow operators, diversified, corn producers, located in the same counties as flat-fee contract producers, frequent checkers of market prices, have higher debt, value autonomy and relationships with feed merchants more, and be relatively more educated than incentive payment contract producers. Cooperative producers are also more likely to be breeding sow operators, diversified, corn producers, and located in the same counties as flat-fee contractees. They are also likely to have accumulated higher assets, have higher debt and greater farm assets, be risk averse, be concerned about autonomy and relationships with feed merchants, and be relatively more educated than incentive payment contract producers. Flat-fee contract producers are more likely to be finishers located in counties with independent and cooperative producers, work more hours off-farm, and be owners of greater farm assets. They are less likely to value autonomy and more likely to value relationships with neighboring farmers. Finally, incentive payment contract producers are generally larger, lower debt finisher or breeding sow operators who work more hours off-farm, value autonomy less and relationships

with lenders more than other business arrangements. They are likely to be located in counties with cooperative producers.

CHAPTER 1

INTRODUCTION

The structure of the U.S. agricultural sector has changed greatly in recent years. Hog farms have decreased drastically in numbers and increased progressively in size. Available data show that U.S. hog farm numbers have declined from a high of 4.85 million in 1920 to about 85,760 in 2000 (Agricultural Statistics, 1930–2000, NASS, 2001). A more microscopic view of how the hog industry has changed structurally can be seen in the number of hog operations in various size categories. The two size categories that have shown the greatest change are the 1 to 99 head and 5,000 or more head. The number of farms having 1 to 99 head decreased 64% from 1993 to 2000. In contrast, farms having 5,000 or more head increased by 112% over the same time period. This historical trend reveals that the larger operations are gaining the greatest market share, while the smaller are showing the greatest loss.

The same conclusion can also be drawn from a marketing perspective. In 1997, 145 firms marketing 50,000 hogs or more a year marketed approximately 33.1 million hogs, 37% of the total (Lawrence et. al, 1998). In comparison, in 1994, only 16 million head marketed by 66 firms in that size category.

As these changes in farm size materialize, the way hog farmers conduct business is also changing. There are many types of business arrangements used in hog production. The most common ones are independent, cooperative membership, flat-fee contracts, contracts with incentives, tournament contracts, and vertical integration. In recent years, the greatest increase in the participation of any one business arrangement has been with contract production. According to Rhodes (1992), approximately 10% of the nation's hogs were produced under contract in 1989. By 1994, he found that the number of growers producing hogs under contract production had increased to 16%. Another follow-up to Rhodes' study was conducted by

Lawrence et al. (1998). They found that, in 1997, 40% of the hogs farrowed and 44% of the hogs finished were produced by producers involved in production contracts. Most of the growth occurred in the over 50,000 head size category.

Large contractors that contract with hog producers include Cargill, Carroll Foods, Murphy Farms, Prestage Farms, and others. In many cases, contract production has allowed producers to establish large-scale hog units due to lower short-run capital requirements. According to Martin (1997), contract hog production is an important part of the emerging system of vertical coordination (VC). To some, the phrase "contract farming" to some is analogous to vertical integration (VI); to others it implies a cooperative agreement. Vertical integration and contract production have evolved along with or in response to production specialization that has gradually transformed the production of hogs. Firms producing hogs under contract have enhanced the quality and quantity of pork produced within the industry (Kliebenstein and Lawrence, 1995). There are many more specific factors influencing the trend toward rapid growth in contract production in the last decade. Some of these factors will be discussed in later chapters.

In spite of the increased number of contract producers within the last decade, the majority of the U.S. hog farm population still consists of independent producers. Large changes are occurring among independent producers. As the number of hog farms continues to decrease, a large proportion of farmers exiting the market are independent producers. Also, there are some types of cooperatives, such as Farmland and ValAdCo (Value-Added Corn), that have made it possible for producers to stabilize farm income as well as maintain some control over marketing and production decisions. Considering these past and present changes in the structure of the U.S. hog industry, it is of interest to determine the type of business arrangement that is best suited for

a producer, given his or her location, production specialty, risk awareness, and financial situation.

This study examines the factors that influence the hog producer's choice among business arrangements offered in the U.S. hog industry. Specifically, the study will provide updated information about the decision making process of hog producers under alternative business arrangements, including factors that influence such decisions.

1.2 Problem Statement

Since the late 1970's and early 1980's, the rapid change in the structure of the U.S. hog industry has altered the way U.S. producers raise hogs. Thus, there are many questions that are of great interest concerning the U.S. hog industry, such as (1) What types of business arrangements do producers now accept? (2) What factors influence their decisions to accept one business arrangement over another?, and (3) Why do producers accept specific business arrangements with particular types of hog production?

In the hog industry, two keys to stabilizing and increasing farm income are reducing risk and transaction costs. One of the problems that hog producers face is fluctuating hog prices (Iowa State University Cooperative Extension Service, 1991–2000). For some producers, contract production has been the solution whereby they have reduced price risk and transaction costs. Some types of cooperative farming have also enabled producers to stabilize farm income as well as maintain their control over marketing and production decisions. According to Martin (1997), more than 80% of the hogs marketed in North Carolina are produced under contract. Lawrence (1998) states that more than seven million hogs are shipped annually into Iowa for contracted finishing operations. Because of contracts and other supporting factors, such as the absence of corporate farming and environmental laws, there have been enormous changes in the hog industry, particularly in the Southeastern U.S. In spite of the benefits contracts offer, a large

percentage of today's hog producers remain independent. It is of interest to determine the type of business arrangement that is best suited for a producer, given his location, production specialty, and financial situation.

1.3 Justification

Hog enterprise incomes have increased as farms have become larger. Along with these larger operations, income variability has increased as more hogs are sold from less diversified operations. In conjunction with the increase in the size of hog farms, there have been increased transaction costs and increased asset specificity. Like the poultry industry, the hog industry has vertically coordinated in an attempt to offset price risk, decrease transaction costs and more efficiently meet consumer demand. However, in many of the traditional hog producing states, certain types of business arrangements have been banned. Anti-corporate farming laws have become forceful public policies in states such as Iowa, Nebraska, Oklahoma, Kansas, North Dakota, South Dakota, Wisconsin, and Minnesota. Yet, in many non-traditional hog producing states, VC production has not been restrained. States such as North Carolina, Arkansas and Oklahoma have recently experienced substantial increases in hog production through independent firms and vertically coordinated systems. Some of the key factors that have been responsible for their expansions are combinations of relatively inexpensive land and labor, adequate water supplies, less stringent environmental laws, producers' willingness to adopt new technology, and the welcoming of VC firms as business opportunities in the state. It is of national interest to determine which types of producers have been willing and are able to adopt new business arrangements. Are these producers significantly different in resources, background, and goals from the traditional independent producer?

1.4 Research Objectives

The main objective of this study is to evaluate the adoption of business arrangements by hog producers in the U.S. The specific objectives of this study are to:

1) Identify alternative business arrangements currently being used in the U.S. hog industry;

2) Identify the determinants that influence hog producers' choice among different types of business arrangements;

3) Develop a survey to collect information on the various business arrangements used by hog producers in the U.S., and;

4) Determine the influence of economic and non-economic factors on the choice of business arrangements by hog producers.

Before the discussion is continued on factors influencing the choice of business arrangements, a general overview of the U.S. hog industry is given. The overview of the U.S. hog industry includes the following: technology and management practices, U.S. pork consumption, U.S. export markets, environmental concerns, and types of business arrangements currently being used in the industry.

1.5 External Factors Influencing the Structure of the U.S. Hog Industry

1.5.1 The Impact of Technology on Today's Hog Industry

As new technology in hog production continues to be adopted, the structure of the hog industry is becoming more similar to that of the broiler industry, in which virtually all broilers are raised under contract. Through research and technology, the hog industry has made major improvements in animal breeding stock, disease control, rations, equipment and facilities. Changes in equipment and facilities have included the adoption of automatic feeders, climate controlled buildings, and computerized information systems for monitoring herd performance and health. Two of the most significant improvements in technology have been in breeding

stock and swine nutrition. Improvements in the industry's genetic pool have allowed farmers to produce greater numbers of leaner, faster growing pigs per sow. For instance, in 1954, the average litter size per sow was 5.3 piglets; however, by 2000, this figure had increased by 68% to 8.89 piglets (U.S. Census of Agriculture, 2000).

In addition to improved breeding stock, the quality of hogs (in terms of the leanness and fat content) has also increased. As a result of these advances in technology, U.S. hog producers have been able to increase their productivity. However, the benefits of these advanced technologies have accrued only to those producers who could finance them. Producers who could not adopt these new technologies due to insufficient funds, knowledge, or location, lost their ability to compete causing some to exit the industry. Some other technologies such as, "all in – all out" hog finishing, weekly farrowing, high-density fat-added diets, intensive breeding to keep facilities full, split-sex feeding, terminal cross breeding programs, artificial insemination, porcine somatotropin, and computer programs, have also served to increase productivity.

1.5.2 The U.S. Economy

1.5.2.1 Domestic Pork Consumption

Pork has the world's highest per-capita consumption of any meat. According to USDA, of the world meat consumption in 2000, 41% was pork, 29% was poultry, 25% was beef and 5% was other meats. Pork consumption has been on the rise in recent years. From 1980 to 2000, the volume of pork consumed in the world rose 73% (Cunningham, 2000). In the U.S., consumer interest in pork is steadily growing. Pork ranks third in meat consumption in the U.S. USDA data show that U.S. pork consumption increased throughout the 1990s with the exception of small declines in 1993, 1995, and 1996.

One of the reasons for the increase in U.S. pork demand is the industry's ability to enhance the quality of pork by reducing back-fat and increasing leanness. Pork is viewed by

some as versatile, convenient and nutritious (Hendricks, 2001). "The Other White Meat" campaign was launched in 1987 and studies reveal that consumers have changed their perceptions of pork, considering it as a white meat (Hendricks, 2001). This association is important because 54% of consumers surveyed believed white meat was healthier, tasted good, was leaner, and their families liked it. Results of this study showed that 40% of the respondents would like to see more pork on restaurant menus and almost 60% of these consumers felt that pork was different from their routine and was a delicious alternative (Hendricks, 2001). The interest in pork by consumers has helped drive sales of pork both in restaurants and at the retail level.

As the popularity of pork increases, supermarkets are enjoying the benefits of pork sales (Hendricks, 2001). From 1999 to 2000, pork consumption increased by 9.3% and a USDA (2000) study recorded that retail price levels for pork had increased (Hendricks, 2001). These findings indicate that consumers were increasingly willing to pay more for pork. This speaks to the competitiveness of U.S. hog producers and their ability to produce a desirable product. Technology has made it possible for some independent, cooperative, or contract producers to finish more uniform hogs. As a result, society has benefited from a continuous flow of uniform hogs that produce better quality pork products.

1.5.2.2 Changes in the Domestic Price of Pork

Historically, low hog prices have presented major problems for many producers. Iowa market prices for finished hogs fell as low as $13.92 per hundredweight in December 1998 (see Table 1.1). As a result, some farmers were not able to cover their production expenses and were forced out of business. Farm prices for finished hogs in 2001 averaged $45.40 per hundredweight, which is $2.54 higher than the 2000 farm price ($42.86) (USDA-Baseline Projections, 2002). This up-swing can be attributed partly to a lower supply of hogs. Hog prices

for April, 2001, reached a high of $67.00 per hundredweight. Market analysts postulated that for all of 2002, profits were expected to average $10.41 per hundredweight compared with $13.37 in 2001(USDA-Baseline Projections, 2002). According to Hurt, these good fortunes can be attributed to smaller pork supplies than expected, and stronger demand as a result of higher retail beef prices and especially Foot and Mouth Disease (FMD) in Europe between 1999-2001 helped stimulate U.S. pork exports (Hurt, 2001).

Historically, U.S. hog prices have been known to exhibit a cyclical behavior. One of the basic principles of economics states that as supplies of a commodity increase, prices decrease. This, in turn, leads to a decrease in supply, and higher prices. "Hog cycles have been characterized to some extent by alternating major peaks and minor peaks" (McCoy, 1979: p. 83). In other words, the propensity for a high peak to be followed by a low peak is almost inevitable. The variation in prices during the hog cycle provides some insight to reasons why the structure of the hog industry is changing. To reduce the price risks incurred during the hog cycle, some hog producers have turned to production contracts. Production contracts have enabled producers to better stabilize income through fixed, incentive and guaranteed minimum payments. Smaller hog producers who are not involved in production contracts are forced to compete with larger vertically coordinated firms that are able to produce better quality pork at lower per unit costs. This, in turn forces many small hog producers out-of-business, while large contract and cooperative producers expand to meet the market demands.

Like most agricultural production cycles, the duration of the hog cycle is determined by many factors. These factors may include "life-cycle of hogs, as well as the rate at which producers alter production practices in response to enterprise profitability" (Agricultural

Marketing Manual - February, 1999). A hog seasonal cycle is 12 months (see Figure 1.1). A hog market cycle is generally about three to four years, compared to a cattle cycle of ten years or more.

According to Iowa market prices for hogs, which are usually lower than the average U.S. hog prices, the selling price per hundredweight from 1991 to 2000 followed this behavior. Table 1.1 shows Iowa's market prices for finished hogs per hundredweight. In 1991, the average price per hundredweight was $49.92. The lowest selling seasonal price for that year was 22% below the average price, while the highest was 11% above the average. During 1996, Iowa producers experienced the highest average price ($52.89 per hundredweight) of the decade. The high price reported that year was 11% above the average seasonal price, while the lowest price was 19% below the average. Lower hog prices occurred during the 1998 production period. The average price for that period was $31.68, which is the lowest recorded in the Iowa market during the 1990s. The highest price recorded for that period ($42) exceeded only one other production period. In December, 1998, Iowa producers experienced the lowest price for market hogs they had received in years. The fluctuation in Iowa and U.S. market prices for finished hogs per hundredweight, along with some other factors, explain why contract production in the hog industry is increasing. More hog producers are choosing contractual agreements to help reduce or eliminate the price risk associated with marketing finished hogs.

1.5.3 U.S. Export Markets

The U.S. has become the second largest net exporter of pork in the world. This is a surprising turnaround considering that the U.S. was the largest importer of pork during the 1980s. Pork exports totaled 556,895 metric tons in 2000, grossing $1.3 billion (Cohen, 2001). Pork ranks third among the meats exported by the U.S. In 2000, hog exports increased 12% by

Table 1.1: Iowa Market Prices for Finished Hogs per Hundredweight.

	Production Period									
	Jan-91 to Dec-91	Jan-92 to Dec-92	Jan-93 to Dec-93	Jan-94 to Dec-94	Jan-95 to Dec-95	Jan-96 to Dec-96	Jan-97 to Dec-97	Jan-98 to Dec-98	Jan-99 to Dec-99	Jan-00 to Dec-00
Average	49.92	43.24	45.72	39.53	41.85	52.89	51.29	31.68	32.01	42.76
Highest	56.24	48.64	49.05	47.75	49.18	59.09	58.66	42.00	37.44	49.72
Lowest	38.84	39.70	40.38	28.01	35.50	42.60	39.85	13.92	25.93	36.03

Source: Iowa State University Cooperative Extension Service, years 1991 - 2000.

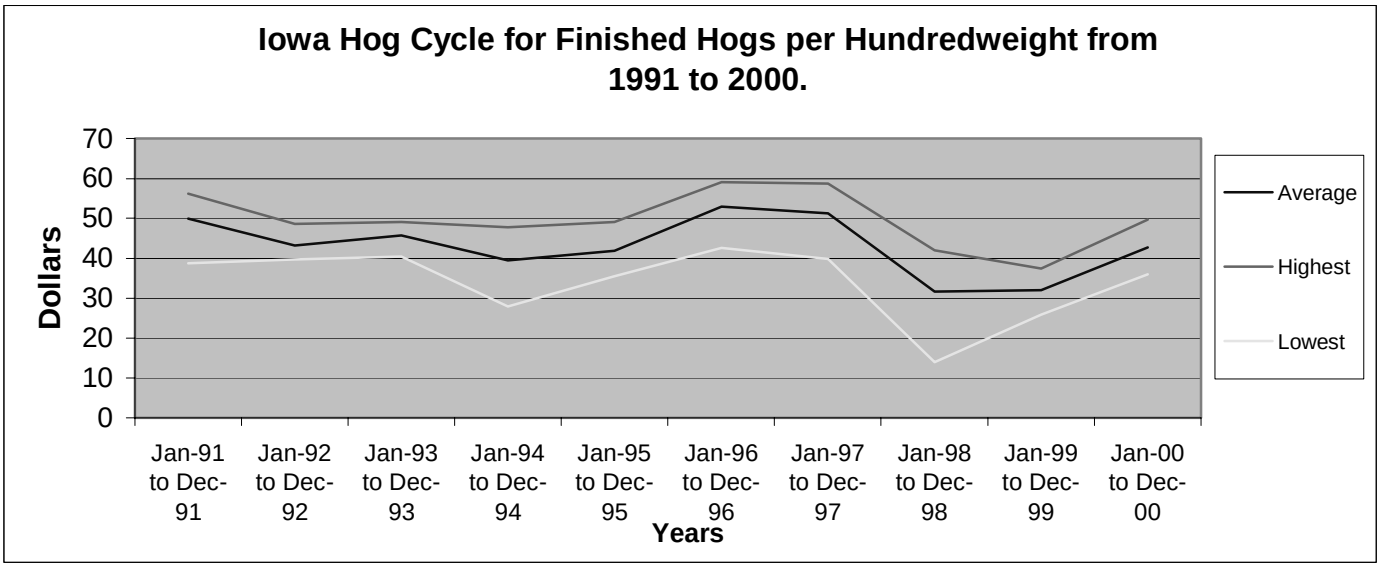

Figure 1.1: Iowa Hog Cycle for Finished Hogs per Hundredweight from 1991 to 2000.

volume and 18% by value compared to 1999. During the first five months of 2001, pork meat exports were up 14%, which represents an increase of 23% in value from 2000. From 1990 to 1999, U.S. pork exports increased 469%, which is considerably higher than beef and veal (133%) or broilers (385%) (Agricultural Statistics, 1990–2000).

The major geographical regions that import U.S. pork are Latin America and Asia. Within these geographical regions, the countries that consume the most U.S. pork are Japan, South Korea and Mexico. In 2000, Japan, South Korea, and Mexico imported 192,485, 12,439 and 94,839 metric tons, respectively (ERS-Livestock, 2001). These three countries accounted for 48%, 3% and 24% of the U.S. pork exports, respectively. Other countries that are expected to become major importers of U.S. pork are Argentina and China. Argentina recently opened its market to U.S. boneless pork. In 2001, Argentina was expected to import 30,000 metric tons a year. Likewise, the U.S.–China trade agreement was projected to increase the supply of pork to Chinese consumers by 1.2 billion, and boost the value of U.S. market hogs $5 per head in 2001 (NPPC, 2000).

1.5.4 U.S. Hog Production and Environmental Pollution

There are negative externalities generated by hog production units that are presently threatening the quality of life of people living near them. The move toward specialization and vertical coordination has increased the size and geographic concentration of hog operations (Metcalfe, 2001). Hog operations with 2000 or more animals increased from 28% in December, 1993, to 68.5% in December, 1999 (Metcalfe, 2001). According to Hubbell and Welsh (1998), North Carolina and Arkansas have experienced the greatest growth in large operations. Almost 40% of this growth occurred in North Carolina (Martin and Zering 1997; Hubbell and Welsh, 1998). Due to the high density of hogs per square mile, many environmental issues have arisen and become of great concern.

Historically, agricultural industries have accounted for a large percentage of the nonpoint source pollution in the U.S. To protect people and wildlife habitats, laws such as the Clean Water Act and the Safe Drinking Water Act were enacted by the federal government. The Clean Water Act is a quality control policy that was established initially in 1972 to reduce nonpoint source pollution, such as runoff from urban and agricultural lands and industrial dumping (USEPA, 1995). The Safe Drinking Water Act was originally passed by Congress in 1974, to protect public health by regulating the nation's public drinking water supply. Further amendments to these laws concerning non-point source pollution were added from 1986 to 1996 (USDA, 1997 and 1999). The purpose of both Acts was to ensure all U.S. citizens, regardless of their geographical location, clean drinking water.

The state of North Carolina has experienced manure runoffs that have caused both water and air pollution. Manure runoffs from large intensive hog feeding operations have been responsible for pollution of rivers and shorelines, while large quantities of ammonia (nitrogen) have caused foul odors in residential areas located near large hog operations (Hog Watch). The bacteria, antibiotics and heavy metals found in hog manure have also posed threats to human health. Because of the breadth of these pollution problems in various regions of the U.S., the federal government has stepped in to ensure the employment of an adequate property rights regime. Lax environmental regulation laws in the presence of increasing geographical concentration of hog feeding operations have been challenging for states like North Carolina. Studies that have examined the effect of environmental regulation on agricultural operations have discovered that higher stringency of regulation (as it relates to size and manure disbursement) does have a significant effect on the location of dairy farm operations (Osei and Lakshminarayan 1996; Outlaw 1993) and in aquaculture operations (Wirth and Luzar 1998).

1.6 Discussion of the Current Business Arrangements Used in the U.S. Hog Industry.

The following discussion presents information about the major business arrangements used in U.S. hog production: independent production, cooperative, and contract production. This discussion explains the different aspects of producing under these business arrangements and provides examples of specific firms in the U.S. producing under these business arrangements.

1.6.1 Independent Production

The "do-it-all" philosophy still characterizes the goals of many independent producers. An independent producer secures all of his or her production inputs, and makes all decisions concerning the production and marketing of hogs (Welsh and Bryan, 1999). Hogs are sold on the open market by the producer. All production expenses/profits generated through the production and sale of hogs are incurred/realized by the producer.

1.6.2 Cooperative Farming

Cramer et al. (2001) define a cooperative as "an association of member-owners operating a business that provides services at cost to its patrons" (p.492). Cooperative hog farming businesses are typically organized, capitalized, and managed by/for its members. There are a number of different types of cooperatives involved in today's U.S. hog production industry. One of the largest cooperatives in the U.S. hog industry is *Farmland Industries*. As a cooperative, *Farmland Industries* strives to (1) provide world-class genetics at a reasonable cost; (2) incorporate "all in/all out" systems; and (3) identify producers who would maintain an "all in/all out" hog production system (Reilly and Reynolds, 1994).

From a production perspective, *Farmland Industries* offers a number of options to producers working under its program. For instance, under a finishing agreement, producers' choices include a guaranteed price contract, including incentives based on such factors as feed conversion, leanness and death/loss ratio (Reilly and Reynolds, 1994). Producers also have the

choice of an option that entails some market risk, but leads to greater expected profits. These agreements allow *Farmland Industries* to supply breeding stock, feed, veterinary care and medication, transportation, record-keeping needs and other technical assistance to producers, as well as supplying a market for pigs.

In 2001, *Land O'Lakes Farmland Feed* utilized three hog production systems. They include the nursery management system, the lean gain program, and the sow nutritional program. *Land O'Lakes Farmland* Feed has a highly productive wean starter program. The program incorporates a wide base of protein ingredients – milk, animal and plant protein blends – to produce an optimal mix of protein for the starter – feeding program. *Land O'Lakes Farmland* Feeds typically weans at less than 21 days. The all-in/all-out nursery utilizes 7-day weaning and had a mortality rate of 1.5% in 2001. The lean grain nutrition program has helped *Land O'Lakes Farmland* Feed to produce yearly litter weaning weights that are more than 30 percent greater than 10 years ago.

Another example of a cooperative is *ValAdCo* (Value-Added Corn) in Minnesota, which is a farmer-owned cooperative consisting of 130 members (Cooperatives, 2002). The primary goal of *ValAdCo* is to add value to products such as gilts, corn and soybeans for resale to farmers and markets. Of the many production sites *ValAdCo* has, two of them are "crossing farms" production sites. At crossing farm 1, breeding, gestation and farrowing are done in three separate barns at one location. Crossing farm 2 consists of a nursery and four finishing barns and two-site production involving an "all in/all out" system. *ValAdCo's* by-laws require producers to produce and supply the cooperative with 2,000 bushels of corn a year. According to Bill O'Hare, chief executive officer, *ValAdCo* is the fourth largest load served by Renville-Sibley and has annual sales of about $23 million (Cooperatives, 2002).

Alternatively, there are other cooperatives that may offer risk-sharing programs that include various forms of floor contracts. With such contracts, in exchange for guaranteeing a certain minimum price to the producer, the cooperative takes a certain percentage of returns when prices are high (Rhodes, 1994). In addition to cooperatives that are involved directly in the production of hogs, there are also cooperatives that provide hog producers transportation, feed, and access to slaughter houses/packers. Transportation cooperatives are entities made up of hog producers and trucking companies. They are established to help producers reduce the cost of transporting feed to production sites and hogs to markets.

There are also grain cooperatives of which hog producers are members. Grain cooperatives are organized to create more markets for grain suppliers. One example is the *Farmers Cooperative Elevator Company* (FCEC) of Iowa Falls, in North Central Iowa, which markets grain and supplies, feed, petroleum, fertilizer and other agronomic services (Reilly and Reynolds, 1994). *FCEC* also provides agreements that supply technical and other field services to hog finishers. With these agreements, an active role is taken to help hog producers qualify for loans to purchase state-of-the art facilities. *FCEC* guarantees to pay a portion of a seven-year financial loan that coincides with the length of the production contract. *FCEC* is involved in hog production to broaden the demand for its feed products and grains (Reilly and Reynolds, 1994).

Similarly, there are cooperatives for slaughter houses or packers. These cooperatives are designed to increase the number of hogs slaughtered by packers and to secure markets and premium prices for quality hogs marketed by producers.

For some independent hog producers, cooperatives have been the key to improving productivity as well as reducing production costs. As a result, cooperatives have become an alterative business arrangement that has enabled independent hog producers to compete with vertically integrated firms.

1.6.3 Contract Production

Contract production involves "contractual agreements between producers and their input suppliers or product marketing firms" (Cramer et al., 2001: p.492). Contract farming in the hog industry began in the late 1960's with *Murphy Farms* in Rose Hill, North Carolina, and was later followed by *Tyson Foods* in the early 1970's at Springdale, Arkansas (Futrell, 1989). Most of the early contracts in the U.S. hog industry were offered by feed suppliers who were interested in obtaining or expanding markets for their goods (Martin, 1994; Gillespie, Karantininis, and Storey, 1998). Producers' reasons for entering into these contracts were largely to secure credit, input supplies, and/or a market for their hogs. Some of the early contractual arrangements fell into one of five categories: (1) open account, (2) hog feedlot, (3) profit-sharing, (4) feed conversion, and (5) flat fee contracts.

1.6.3.1 Open Account Contracts

Open account contracts consist of an agreement where the contractor sells producers inputs, such as feed, feeder pigs and medication, on credit or at the retail price (Martin, 1994). Profits for the seller are made by the mark-up on the inputs sold. The producer makes all of the production and marketing decisions. Producers participating in open account contracts are able to shift very little risk, if any, to the input seller. Producers' reasons for accepting this contract are primarily to secure quality production inputs (Martin, 1994).

1.6.3.2 Hog Feedlot Contract

The hog feedlot contract is sometimes referred to as a "hog motel" (Martin, 1994). With this contract, producers who do not have space, equipment or labor to accommodate the number of hogs scheduled for grow-out arrange for a second party to raise the animals. Space at the "motel" is rented based on a flat fee, per square footage, per day, or per pound gained basis. The feed may be supplied by either party. Payment for rental space is made to the owner of the

"motel." Once the hogs have reached market weight, the owner retrieves and sells the hogs. Because the owner of the hogs pays a rental fee and markets his or her own hogs, this arrangement does little to decrease risk exposure to the hog owner. On the other hand, risk may be reduced for the contractee since the contractor pays a flat-fee or agreed upon formula price for hog space and, in some cases, labor. This type of arrangement is common in the upper Midwest.

1.6.3.3 Flat-Fee Contract

With a flat fee contract, the contractor (in most cases a grain supplier) supplies the producer with feed, feeder pigs, and medication (Cozzarin and Westgren, 2000, and Martin, 1994). The producer uses his or her finishing house, utilities, labor, and other equipment to raise hogs for the contractor. The contractor retains ownership of the animals throughout the production process. After the grow-out period, the contractor is responsible for marketing the hogs. The producer is paid a guaranteed flat fee payment (Cozzarin and Westgren, 2000). As a risk reduction method, the flat fee agreement transfers all price risk associated with pigs, feed, and medication prices to the contractor, but not for facilities, labor, etc.

1.6.3.4 Profit-Sharing Contracts

Profit-sharing contracts allow profits to be shared between the producer and the contractor (Cozzarin and Westgren, 2000, and Martin, 1994). Analogous to open account contracts, the contractor supplies the producer with the major inputs at retail prices, while the producer furnishes the finishing house, utilities, labor, and equipment. The contractor controls or regulates all production and marketing practices. Contractor profits are derived from input mark-up and revenue from hog sales, while the producer's profit comes strictly from revenue generated from hog sales. Profit-sharing contracts do not shield the producer from the fluctuations of market hog prices, but they do reduce the producer's operating capital requirements.

1.6.3.5 Feed Conversion Contracts

Feed conversion contracts are designed such that producer compensation is based on feed efficiency (Martin, 1994). Similar to profit-sharing contracts, the contractor provides the feeder pigs, feed and some other variable inputs, while the producer furnishes the finishing house, utilities, labor, and equipment. When the hogs reach market weight, the producer is paid a flat fee price plus a bonus based on the feed-to-gain ratio of the hogs. If the ratio is below a set feed to gain ratio, the producer will receive a higher bonus payment. If it is above the suggested feed efficiency ratio, the producer's bonus will be reduced or zero.

1.6.3.6 Tournament Contracts

Tournaments are competitive contracts that reward producers with bonuses (monetary) based upon performance relative to other contract producers. The best performer receives the largest bonus and the worst performer receives the smallest. Similar to the incentive-based contract, tournament contracts are resource-providing. The contractor provides the feeder pigs, feed and other inputs, while the producer furnishes the finishing house, utilities, labor, and other equipment.

1.6.4 Vertical Integration

"Vertical integration is the linkage of up- and downstream firms through ownership in a single firm" (Gillespie, Karantininis, and Storey, 1998). Within the vertically integrated system, employees are paid an hourly wage by the integrator to manage and raise hogs. The integrator provides all resources used in the production process of hogs, with the exception of labor and managerial ability.

1.7 Segments Involved in Hog Production

Swine production can be classified into four segments: specialized farrow-to-nursery, feeder pig, finishing, and farrow-to-finish units. Some types of VC contracts associated with each are included in the discussion of each segment.

1.7.1 Specialized Farrow-to-Nursery Units

Specialized farrow-to-nursery units are designed to provide husbandry for piglets from the time they are farrowed until they are weaned. In a contractual farrow-to-nursery agreement, the contractor typically determines when the pigs are to be weaned, and supplies the producer with sows and inputs such as feed, veterinary service and medication (Martin, 1994). The producer provides the facilities, labor, and utilities. After the pigs are weaned, the contractor gathers the pigs and pays the producer for the services. Payment to the producer can be based on a piece-rate, flat fee, per day, or per pound gained basis. Incentive payments may also be provided based on the number of pigs weaned (Martin, 1994).

1.7.2 Feeder Pig Enterprises

Feeder pig enterprises are designed to provide husbandry for weaned piglets until the pigs reach a weight of approximately 60 pounds (Cozzarin and Westgren, 2000). Under a contract, the contractor typically supplies the producer with feeder pigs, feed, veterinary services and medication (Martin, 1994). The producer provides the facilities, labor, utilities, and equipment. Once the growth period is completed, the contractor gathers the pigs and pays the producer for his or her services. Payment to the producer can be based on a piece-rate, flat fee, per day, or per pound gained basis. Incentive payments to the producer may also be offered. The incentive payment may be determined by feed efficiency, grow-out time, or mortality. With this agreement, the contractor absorbs all output price risk if the producer is paid on a flat fee or a piece-rate basis (Martin, 1994).

1.7.3 Finishing Operations

In finishing operations, hogs are raised from between 40 and 60 pounds to market weight. Under most contracts, the contractor makes the majority of the production and all marketing decisions (Martin, 1994). The contractor may require the producer to purchase specific equipment or build specific production units. Inputs such as the feeder pigs, feed, and veterinary services and medication are supplied by the contractor. Other inputs, such as labor, utilities, etc., are supplied by the producer. At the end of the grow-out period, the contractor retrieves the hogs and pays the producer based on feed efficiency, grow-out time and weight or based on a tournament, which involves other producers with similar characteristics. If the producer is in a tournament, the bonus payments are determined on a competitive basis with other producers selling during the same time period. Producers are rewarded based on standards and criteria set by the contractor (Martin, 1994). This is the most common segment of hog production for contracts.

1.7.4 Farrow-to-Finish Units

Farrow-to-finish units involve production facilities that are used to facilitate the entire growth process of a hog. There are three phases: a farrowing unit, a wean to feeder pig unit, and a grow-out unit. The producer is required by the contractor to supply the facilities, equipment, utilities and labor needed for production, while the contractor supplies inputs such as animals, feed, veterinary service and medication. Most production and all marketing decisions are made by the contractor. Once the hogs reach market weight, they are retrieved by the contractor. The payment received by the producer is generally based on a flat fee plus a bonus. The bonus is determined by feed efficiency, mortality rate, number of pigs weaned per sow and/or grow-out time. Similar to finishing operations, this agreement also reduces price risk since a flat fee payment is guaranteed (Martin, 1994).

1.8 Thesis Outline

A literature review is presented in Chapter 2. It includes a discussion of autonomy, risk, asset specificity, transaction costs, and social capital. An extensive literature search was done to define and explain the economic theory guiding producers' choice of business arrangement as it relates to the aforementioned terms. Chapter 3 presents the methods, the models and the variables used in the study. It consists of strategies for data collection, description of data, discussion of multinomial and binomial logit models, and a discussion of endogenous and exogenous variables. The results and discussion are presented in Chapter 4. Chapter 5 gives a summary, conclusions and implications of the study, recommendations future research, and a discussion of the limitations of the study.

CHAPTER 2

PREVIOUS STUDIES EXAMINING FACTORS INFLUENCING THE ADOPTION OF CONTRACTING IN AGRICULTURE

2.1 Factors That Influence the Choice of Business Arrangement in the Hog Industry

Why do some producers favor contracting while others do not? According to Rhodes (1994), contracting allows producers to expand their production units, reduce market risk, share management responsibilities and expertise with the contractor, stabilize income, and adopt new technology. Kliebenstein and Lawrence (1995) argue that the primary advantage of contractual arrangements in the hog industry is risk reduction. It is hypothesized that producers decide among alternative business arrangements on the basis of risk, transaction costs arising primarily from asset specificity, and autonomy.

2.2 Autonomy

Gillespie and Eidman (1998) argue that income risk is not the dominant factor that influences business arrangement selection for some independent producers. Some producers prefer to remain independent because it gives them complete control over the production and marketing of their animals. This differs from producers under contracts who share power and management responsibilities. This control is referred to as producer autonomy. Autonomy represents "the desirability of a business arrangement on the basis of how business structure and lifestyle aspects other than income and variability of income are affected" (Gillespie and Eidman, 1998). There are different levels or measures of autonomy. The level of control a producer has over his or her farm operation can influence the choice of business arrangement, with independent farming having the greatest control, generally followed by cooperative farming, contracts with VCs and lastly, VI. For some independent producers, the preference for autonomy is great enough to offset the risk-reducing benefits of contracts (Gillespie and Eidman,

1998). However, other producers are willing to forfeit some of their control to benefit from various contractual arrangements (Gillespie and Eidman, 1998). Therefore, it is important to determine the degree to which autonomy influences a producer's choice of business arrangements.

2.3 Risk

The production of agricultural commodities involves more uncontrollable factors than production of most other items. These uncontrollable factors cause variability in net returns, which is identified as risk. Risk is present in situations where there are a number of potential outcomes that might occur, and there are probabilities associated with each outcome (Pindyck and Rubinfeld, 1995). In the production of agricultural goods, output is subject to variable factors such as weather, disease, prices and technology. Production economists analyze at least two types of risk: price risk and production risk. In addition to these risks, economists working in the field of industrial organization have also conducted extensive research in the area of contract risk (Ward et al., 2000).

2.3.1 Price Risk

From a production perspective, price risk arises due to "differences between realized and expected prices" (Tomek and Robinson, 1990: p.56). According to Martin (1994), price risk makes up approximately 94% of the risk that causes income variability in independent hog production. The amount of price risk a hog producer faces is dependent upon the business arrangement chosen. Roberts et al., (2000) and Martin (1997) conducted studies that examined contracts, risk shifting, and relative performance payments in the pork industry. Martin's findings indicate that, assuming "independent hog producers face 100% price risk, contractees with and without tournaments face only 6.5% and 9.5% price risk," respectively. Therefore,

93.5% and 90.5%, respectively, of the price risks that independent producers face are shifted to the contractor (Martin, 1997).

2.3.2 Production Risk

Production risk arises due to the variability of farm inputs and output. According to Martin (1994), and Knoeber and Thurman (1995), there are two different types of production risk: common risk and idiosyncratic risk. Common risk arises as a result of events that are common across all production units in a given area. Drought is an example of an event that is common across many units. In the context of VC firms, a common risk might be the probability associated with a contractor altering the feed or animal genetics provided to all growers producing under contract (Martin, 1994).

Under a tournament situation, all producers face similar common risks and their relative rankings are likely to remain unchanged regardless of the common risks faced (Martin, 1994). An example would be a contractor supplying substandard feed for a particular week to its producers. The feed will not affect the efficiency rankings because all producers who obtained feed from the contractor would receive the same substandard feed. Independent producers are susceptible to all common risks. Cooperative producers' susceptibility to risk varies depending upon how the cooperative is structured.

Idiosyncratic risk is another production risk that has different effects upon production units (Martin, 1997). Idiosyncratic risk may arise from dysfunctional physical capital. An example of an idiosyncratic risk is the risk of a cooling system breaking in a hog farrowing building during the summer. This event is not likely to be common among all producers in an area at the same time. All producers are subject to idiosyncratic risk. However, the idiosyncratic risk experienced by contract producers may be less than that experienced by independent producers given that most contractors require specific technologies that sometimes obligate

producers to upgrade or purchase new facilities and equipment (Spiekerman, 1998). Independent producers often have limited capital resources available, due partially to their lower chance of obtaining loans from lenders and greater associated initial capital investment (since they must purchase pigs, feed, and some other inputs provided by a contractor). Therefore, their ability to upgrade production facilities as technology changes may be less likely than with producers under contract. As a result, contract producers may experience less idiosyncratic risk since most of their capital inputs are likely to be relatively new in comparison to independent producers.

2.3.3 Contract Risk

Williamson views market failure as resulting from "contractual incompleteness and strategic misrepresentation risk" (Williamson, 1971). Contractual incompleteness is often caused by ex-ante but not necessarily ex-post uncertainty (Williamson, 1971). "Specifically, ex ante costs include: (1) search and information costs; (2) drafting, bargaining and decision costs; and (3) costs of safeguarding an agreement. Ex post costs of contracting include: (1) monitoring and enforcement costs; (2) adaptation and haggling costs; (3) bonding costs; and (4) "maladaptation" costs (Williamson, 1971). For example, producers who engage in short term contracts that require investment in long-life equipment may not be able to fulfill their loan obligations if the contract is not renewed (Williamson, 1971). Strategic misrepresentation risk is high where there are both ex-ante and ex-post uncertainties (Hobbs, 1997). Not only is the future uncertain but it may not be possible, except at great cost, for an outside agency to establish accurately what has transpired after the fact. Perhaps the greatest contract risk that contract producers face is the risk associated with unrenewed or broken contracts. Broken and unrenewed contracts can leave specialized producers in precarious positions. If the producer cannot find another contractor with whom to contract, the producer's possibility of covering his

or her fixed cost may be slim, given the specificity of equipment used. A producer's best option may be to sell the equipment to a producer who is specializing in the same production process. However, it can be difficult to find a buyer for specialized equipment and housing. Hence, contract risk becomes important when determining the full risks associated with hog production using contracts.

2.3.4 Risk Attitudes

Previous studies have identified risk as one of the main factors influencing farmers' reasons for accepting different business arrangements (Rhodes and Grimes, 1994; Gillespie and Eidman, 1998; Martin 1994 and 1997; Knoeber and Thurman, 1995). When evaluating risk, it is common to begin with expected utility theory. von Neumann and Morgenstern postulated that various sets of axioms validate the existence of utilities with the property that expected utility is an appropriate guide for consistent decision making. The four major axioms that support expected utility theory are state independence, reduction of compound lotteries, continuity, and independence of irrelevant alternatives (Silberberg, 1990). Expected utility theory assumes that "if (L, $\succeq$) satisfy the above axioms, there is a utility function μ defined on L that satisfies the expected utility property" (Varian, 1992: p. 174). Many economists believe that, based on normative theories of decision making, an individual should choose a course of action that is associated with the highest expected utility (Mellers, 1992).

A decision maker is said to be risk averse if his utility function is concave and he prefers the expected consequence of any nondegenerate lottery to that lottery. A risk neutral decision maker's utility function is linear; the decision maker is indifferent between a nondegenerate lottery and the expected consequence of that lottery. Lastly, a decision maker is said to be risk

prone if his utility function is convex and he prefers any nondegenerate lottery to the expected consequence of that lottery.

Over time, economists have used a number of models to elicit the risk attitudes of people. Officer and Halter (1968) compared three models, von Neumann and Morgenstern (N-M), a modified version of the von Neumann and Morgenstern (Modified N-M) and the Ramsey method. A single valued utility function was estimated for each model allowing for calculation of the Arrow-Pratt coefficient of absolute risk aversion. The N-M model was the least preferred model. The Ramsey model performed better than the modified N-M model. People found it easier to make choices using the Ramsey model, although calculating the utility associated with each outcome can be more cumbersome than with the Modified N-M (Officer and Halter, 1968, and Knowles, 1984).

King and Robison have used the Interval Approach to measure decision makers' risk attitudes. This approach calculates the interval between the lower and upper bounds on a decision maker's absolute risk aversion function. The respondents are asked to choose between two distributions, each having six possible payoffs with equal probability. A series of questions is asked until the range of the interval is narrowed. Based on the respondent's final choice, the range of the lower and upper bounds determines whether the respondent is very or moderately risk averse, risk neutral or very or moderately risk prone. The Interval Approach is not exact, in that it does not give a single coefficient of absolute risk aversion for the respondent like single-valued utility functions (King and Robison, 1981). Other researchers who have used the Interval Approach include Wilson and Eidman (1983), Tauer (1986), and Schurle and Tierney (1990).

Using a mail survey, Cardona (1999) utilized a method that asked farmers about their risk attitude. Louisiana sugarcane producers were asked to rate their risk attitudes when making farm management decisions. A continuous line was provided between risk averse and risk taker and

producers were to indicate where they fell in terms of risk preference. Once the risk attitude was determined, a model was employed to determine whether risk preferences affected the adoption of best management practices. The risk attitude of sugarcane producers was found to be statistically significant in the adoption decision.

Gillespie and Fausti (2000) used a mail survey to examine the degree of consistency across alternative risk preference elicitation procedures. They compared six risk preference elicitation procedures: (1) a self-rank elicitation method, (2) a scenario looking at a job opportunity, given different income probabilities, (3) five hypothetical investments, each with low, average and high net returns at equal probabilities, (4) the Interval Approach, (5) a hypothetical question measuring the riskiness of calf marketing alternatives, and (6) the Modified von Neumann-Morgenstern approach. Their findings indicated that only questions one and three were rank-order consistent. There was little consistency found in the risk preferences elicited via the other questions.

2.4 Asset Specificity

Specific assets are assets whose value is much greater in a particular use compared to the next-best alternative. Asset specificity exists when one or both parties to a transaction make investments in equipment and/or machinery that involve design characteristics specific to the transaction and which have lower values in alternative uses (Joskow, 1985). Investments of this type are common among contractees; contracts typically involve the performance of work that uses task-specific assets. A specific asset may be physical (unique physical characteristics), human (unique skills), or site specific (unique location) capital (Martinez et al., 1998).

Williamson (1990) indicates that vertical integration is expected to evolve among firms experiencing recurrent transactions when asset specificity is present. One reason for this is vertical integration and some forms of vertical coordination reduces transaction costs. Sporleder

(1994) argues that asset specificity is viewed as a necessary, but not sufficient, condition for firms to choose vertical integration as a vertically-allied, inter-industry form of coordination. State-of-the-art hog production facilities are typically useful only for hog production. Initial investment for such facilities today often exceeds $1 million (Hurt, Boehlje, and Hale, 1995). Thus, there is an incentive for producers investing in such facilities to identify markets for hogs that are stable and profitable. In areas with few or no alternative markets, contracts with financially stable VCs are likely. Thus, divestiture from mistakes when specific assets are involved may prove costly (Sporleder, 1995).

2.5 Transaction Costs

Coase provides a theoretical framework to understand why resource-providing contracts have become more prevalent than others in the U.S. hog industry. Coase (1937) argues that market transactions between independent units are costly, and that the integrated firm can perform repetitive transactions at lower costs. Resource-providing contracts fall between the two extremes of the open market and the vertically integrated firm, and may be viewed as a hybrid between the firm and the market.

Perhaps one reason why hog producers have accepted resource-providing contracts has been to reduce the number of business transactions, thus reducing transaction costs (Ward et al., 2000). Transaction costs are those costs that are required to establish and maintain property rights (Allen, 1991). On the other hand, Joskow (1995) defines transaction costs as expenses associated with inefficient pricing and production behavior. In general, transaction costs are merely expenses producers incur due to the lack of perfect information and resources. Transaction costs arise in day-to-day business because of communication breakdowns, imperfect information, incomplete contract stipulation, and ambiguous entitlements. The number of transactions involved in the production and marketing of agricultural products is many. As more

transactions occur during the production and marketing of goods, the total cost of transactions increases; thus, larger producers are likely to incur higher total transaction costs since they are likely to buy inputs and sell outputs more often than smaller producers (albeit the average transaction cost per unit sold may be lower for larger producers). Some of the most common transaction costs incurred in the livestock industry are information costs, negotiation costs and monitoring costs (Hobbs, 1997).

2.5.1 Information Costs

Independent producers may incur costs in the search for information about products, prices, inputs, and buyers or sellers. For instance, in order to produce and sell farm products, the producer must determine where to purchase inputs and where to market finished products each time a transaction is made. According to economic theory, a rational producer seeks to minimize cost by purchasing homogeneous inputs at their lowest prices. Likewise, a producer who seeks to maximize his or her returns will sell output (hogs) to the buyer who offers the highest price. In the process of obtaining price information, a cost is incurred. This cost may vary depending on the availability of information on market prices. In the U.S., hog producers have access to a time series of published market prices as well as information on the four-year hog cycle. Nevertheless, U.S. hog producers incur costs associated with educating themselves on hog prices offered by different buyers, who are likely to pay different prices on a given day. Compounding this price uncertainty, through public market sales, there is no way of knowing the actual price that hogs will bring before the sale takes place. Thus, public market sales are uncertain and become problematic for independent producers. This situation presents fewer problems to contractees since payments for hogs are set once their contracts are signed. Intuitively, it can be inferred that risky situations lead to higher transaction costs. Likewise, input price uncertainty is reduced for contractees since, with many contracts, inputs are furnished by the contractor.

Human capital gives rise to another form of information costs. Human capital is heterogeneous across firms due to differences in the experience, education, and skill level of managers (Boehlje, 1992) and laborers. To a large degree, a person's managerial skills determine his or her ability to process and evaluate information as well as implement new technology. For example, a hog producer's ability to conduct such tasks as keeping accurate records of the pedigree of each sow and artificially inseminating hogs in a timely manner requires technical and managerial skills.

Although it may seem obvious as to why human capital is important to independent and cooperative producers, given their production and managerial responsibilities, the importance of human capital to contract producers may not be as obvious. Contract producers need human capital to efficiently run breeding sow operations. Breeding sow operations run under production contracts are used to supply feeder pigs for finishing operations. Human capital is also essential for those producers who are operating under incentive payment contracts. Producers under this type of contract are often competing for bonus payments, which require certain managerial skills in order to achieve the lowest costs production, lowest mortality rate and highest percentage of pigs weaned.

Over time, there has been an increase in the investment of human capital in agriculture, allowing producers and agribusiness managers to manage larger scale specialized units and adopt cost-reducing/output-increasing technology more cost effectively (Boehlje, 1992). Thus, hog producers who do not incorporate efficient levels of human capital within their production processes may incur additional information costs from business planners and plant technicians.

2.5.2 Negotiation Costs

Another important classification of transaction costs is negotiation cost. "Negotiation costs arise from the physical act of the transaction, and are influenced by the way the transaction

is carried out" (Hobbs, 1996). Negotiation costs are incurred in all transactions encountered by a producer from the time production inputs are purchased to the time payment is received for the hogs. Hobbs (1997) discusses some negotiation costs and how they influence the decisions made by cattle farmers. There are negotiation costs between contractors and contractees in setting up the contract. For most resource-providing contracts, the contractor supplies the animals, feed, veterinary care, medication, management expertise and all marketing services, while the contractee (producer) furnishes the labor, buildings, equipment, utilities and some management skills. The initial negotiation costs for these types of contracts are normally minimized or limited due to the set features of the contract for all producers. Little negotiation occurs after the contract is signed if the contract covers most contingencies. Most resource-providing contracts are designed such that the contractor incurs the costs of locating a suitable market, negotiating prices for animals, and conducting administrative transactions. Thus, before the initial signing of the contract, the producer incurs time, transportation costs, and the opportunity cost of contracting with another contractor. But, because the life expectancies of these cattle contracts range from three to ten years, the frequency in which both parties incur these negotiation costs is minimized.

In contrast to the negotiation costs incurred under resource-providing contracts, an independent producer faces many of the costs that both the contractor and the contractee incur. An independent producer's negotiation cost could begin with his or her negotiations concerning the location and size of production facilities. Assuming that the producer has the land, hogs, and all the necessary facilities needed for production, some of the first negotiation costs an independent producer incurs involve the purchase of inputs such as feed, medication and labor. The administrative transactions involved in establishing and documenting these agreements are negotiation costs.

Employment of labor also leads to negotiation costs. As an employer, the producer draws up an agreement that establishes the wage per hour and number of hours of work required of employees, as well as other required benefits. The administrative transactions of processing employee applications are continuous negotiation costs that an independent producer incurs. For independent producers, the nature of labor differs from those under contract in that independent producers are managing, working, and also have other laborers conducting various tasks. On the other hand, contract producers of the same size typically are operating with less additional labor since they likely spend less time in managerial operations and more time in operator labor.

Independent producers also incur various other negotiation costs when marketing hogs. The marketing process begins with the price negotiation between the producer and buyer. Independent producers incur costs associated with the chance of default in price agreements, and the delay between the time the hogs are sold and when payment is received (Hobbs 1997).

2.5.3 Monitoring Costs

Monitoring or enforcement costs arise after a transaction has occurred. It may be necessary to monitor the quality of inputs from a supplier or to monitor the behavior of a supplier (or buyer) to assure that all pre-agreed terms of the transaction are in compliance (Hobbs, 1996 and Cozzarin and Westgren, 2000). The cost of monitoring can be expensive for either contract or independent producers. The value of the time spent by a producer assuring that the input quality, production procedures and marketing process meet certain expectations are all considered monitoring costs. Part of this monitoring cost may be borne through the contractor's employment of a field person.

Most contractors operating large hog operations with multiple units have production procedures that are specified within the contract that must be followed by the contractees. For instance, there are usually specific rations that should be fed to pigs (Cline et al., 1995). In

addition, producers must maintain room temperatures, specified levels of cleanliness and biosecurity. The costs of policing these production sites and evaluating producer performance can be significant.

For independent producers, monitoring costs begin at the production site and end at the marketplace. At the production site, independent producers face many of the same monitoring costs that contractees incur, such as monitoring hired labor, input quality and payment fairness. According to Hobbs (1997), in cattle production there are other situations that lead to monitoring costs such as "shrinkage, stress, and exhaustion" in the handling of animals during the exchange process, which can be minimized if detected. Some independent hog producers experience similar problems. For instance, a disease outbreak in a production unit can destroy an entire herd if it is not detected in time. Hence, monitoring the performance and health conditions of hogs can prove to be vital to the success of independent producers.

2.5.5 What Is Missing in Economic Models?

Economists often conduct market analyses based on demand and supply concepts. For these constructs, determinants of demand and supply of goods and services are often specified as given. However, Neoclassical models often leave out factors, such as bounded rationality and social capital that could possibly have tremendous effects on the endogenous variable(s). The propensity of economists to use 'ceteris paribus0' (all other things remaining equal) qualifies them to make predictions given the stated exogenous variables. However, when conducting these analyses, statistical programs are able to identify the incompleteness or inaccuracy of models given the size of their error terms. So, the question arises; what are the missing factors or variables that are common across social and economic interactions and transactions that could improve economists' ability to better understand consumer/producers' behavior? One of the dilemmas economists face when examining economic problems is that of "bounded rationality",

which is to say information is incomplete (Simon, 1978). Complete information or unbounded rationality is impossible for humans to obtain. Bounded rationality exists when hog producers do not have complete information or complete knowledge about available contracts offered by vertically integrated or vertically coordinated firms, market hog prices, feed prices or lean-values. The lack of complete information creates opportunities for exploitation. On the other hand, asymmetric information, which is not complete information, is advantageous to the exploiting party in that it can give rise to opportunistic behaviors. Producers who have asymmetric information are privileged to better contracts, higher hog prices and lower transaction costs, relative to those who do not have asymmetric information.

Another factor that some economists have failed to consider to narrow the margin of error in their analyses is social capital. Human interactions and relationships with one another influence the flow of resources from one hand to the next. This was recognized by Adam Smith (1759) who noted that preferences are "interpersonally dependent," but vary "according to the strength of the relationship" (Robison, 1996). "Every man feels his own pleasures and his own pains more sensibly than those of other people… After himself, the members of his family, those who usually live in the same house with him, his parents, his children, his brothers and sisters, are naturally the objects of his warmest affection" (Robison, p.321). What this implies is that people respond or express different feelings for family members, friends, associates, and members of organizations. This leads us into defining social capital. "Social capital is a person's or group's sympathy or sense of obligation toward another person or group that may produce a potential benefit, advantage, and preferential treatment for others beyond what might be expected in an exchange relationship" (Robison, Schmid, and Siles, 1999).

Studies support the idea that relationships matter in the aggregate as well as at the individual level. Some economists agree that relationships matter, but none feel they are

unimportant (Hirshliefer, 1994, and Gardner, 1995). Economists who share these same feelings also "believe that we can continue business as usual with selfish preferences as the foundation for our models" (Hirshliefer, 1994, and Gardner, 1995). Social capital is important because it determines the way goods and services are allocated, consumed and purchased. People who have businesses and trade with family members, friends, associates and members of organizations, sometimes show favoritism or preferential treatment toward people with whom they have an established relationship. An example of this phenomenon is a farmer who goes to a bank to obtain a loan to purchase a new tractor. At this bank, the loan officer is his neighbor and friend. Through his or her relationship with the loan officer, the individual receives the loan at the lowest possible interest rate with less regard to the farmer's qualifications. In some sense, the farmer's relationship with the loan officer acts as collateral. Another example of social capital is a trading relationship between a hog farmer and feed supplier. The farmer and feed supplier have been trading for several years and, through this interaction, they have become close acquaintances. The benefits of this relationship are at least twofold. For the farmer, he or she can anticipate a fair price for feed, while the feed supplier can expect continuous patronage from the farmer. As the level of trust between the two persons continues to grow, the farmer may receive discounts or benefits that exceed his or her perceived costs.

"Whenever the relationship or social capital between individuals is being considered, it is assumed that there is a level of mutual respect, concern, sympathy or feelings toward one another" (Robison, Myers and Siles, 1999). In other words, there is a balance. This assumption enables one to eliminate opportunistic behaviors. Hence, relationships that involve individuals who have greater feelings or concerns for other persons that are not reciprocated can be exploitive in nature (Robison, Myers and Siles, 1999). A symmetric relationship in nature is also a mutually beneficial relationship (Robison, Myers and Siles, 1999). Such conditions lay out the

foundation on which social capital is established and discussed within this study with respect to business arrangement choice.

2.6 Social Capital

2.6.1 How Is Social Capital Created?

There are specific resources that are used to build social capital. These resources are discussed by Peterson, Robison, and Siles. They postulate that trust, reputation, and identity create three types of social capital: direct, indirect and identity-based social capital (Peterson, Robison, and Siles, 1999).

Direct social capital is believed to be obtained through repeated transactions between exchange partners (Peterson, Robison, and Siles, 1999). As these transactions take place, a level of trust is established between exchange partners through consistency. All relationships are founded on some level of trust. Friendships, boyfriends, girlfriends, and marriages are based on some level of trust that is shown through commitments, responsibilities, respect, loyalty and sympathy. This confidence that is displayed in members of a relationship gives rise to social capital. Common kernels contribute to social capital because their similarities create comfortable environments for communication, interactions, and transactions (Robison, 1999).

Indirect social capital is built upon reputations established with individuals that share direct social capital (Peterson, Robison, and Siles, 1999). Reputations are derived from consistency and reliability of transactions between individuals. A person's ability to consistently deliver goods or services as promised helps foster new relationships with other individuals. For example, a truck driver who picks up and delivers hogs to market safely every week develops a reputation for his reliability. Producers who receive this service tell others of his reliability and the truck driver's clientele increases.

Identity-based social capital is a short-term acquaintanceship that is based on association or affiliation but requires reinforcement to establish a trusting relationship (Peterson, Robison, and Siles, 1999). The association that initiates the acquaintance between the two can be as fundamental as an inherited trait or characteristic such as one's gender, age, ethnic background, nationality, values acquired from parents and other resources inherited as a result of the conditions of one's birth (Robison, 1999). As this commonality unites the two to bring about interactions, as well as transactions, the trading between the two is only temporary. A more sound relationship that is based on consistency, loyalty and reliability is warranted in order to maintain continued transactions (Peterson, Robison, and Siles, 1999). If the relationship is not nourished through trust, then the acquaintanceship will soon be terminated. An illustration of identity-based social capital is the following. Suppose your best friend Farmer Brown and his young son were shopping in your farm supply store and one of the salesmen recognizes the father and son. The father has purchased items from the store on numerous occasions in the past. Given the father's reputation, the son also receives preferential treatment, although he has not reached the age to establish a reputation of his own. However, if the son does not prove himself worthy of the special treatment that has been granted to him based on his father's merits, his privileges will eventually be taken away.

Robison and Siles (1998) posed a question, "What can organizations achieve that lack social capital. Can people successfully pursue their economic needs without social capital? The answer is probably no, unless the other needs are being met in other organizations" (Robison and Siles, 1998). A continuous flow of transactions that generates economic activity is expected to occur, many of which are created through some form of association or affiliation between the buyer and the seller. However, the purpose of theoretical economics is to explain why they are socially attractive (Robison and Siles, 1998).

2.6.2 What Impact Does Social Capital Have upon the Economy?

Social capital is a phenomenon that can influence the flow of goods and services (Robison, 1999). Just as good credit to a loan officer, and good grades and work experiences to an potential employer are used to evaluate one's eligibility for loans or jobs, the status of one's relationship is also used to the determine the magnitude of the treatment received by an individual. The special privileges people receive through a shared sympathetic and committed relationship have not been fully identified (Robison, 1999). It is believed that social capital separates and distinguishes one consumer from another, but there is no known terminology explained in economic literature that identifies the type of financial incentive it provides. The financial incentive associated with social capital is similar to some form of price discrimination, in that the price an individual pays is discounted, because of his or her social relationship with the owner of the merchandise. For example, the price a father or faithful customer pays for a tractor purchased from a farm tractor dealership in which a son or trusted friend works may be discounted and sold at a lower price, due to the existing relationship between the buyer and seller.

There are three forms of price discrimination. First degree price discrimination is "a practice in which the seller is able to sell each successive unit of product at the maximum price that any buyer is willing to pay" (Eckert and Leftwich, 1988: p. 635). Second degree price discrimination is a "practice in which the seller is able to sell blocks of output, charging the maximum possible price for each block and selling additional blocks at successively lower prices" (Eckert and Leftwich, 1988: p. 635). Third degree price discrimination is a "practice in which the seller charges different prices in different markets for a product not accounted for by variations in production or selling costs but based primarily on differences in demand elasticities and prevention of resale among the markets" (Eckert and Leftwich, 1988: p. 635). A fourth

degree of price discrimination is warranted to account for the financial deduction received through social capital. It is true that social capital does not involve direct institutional regulated discounts, but different prices for the same goods and services are charged to different customers. In other words, the price, quantity, and quality of goods and services for sale have little to do with the discounted price received. The deciding factor for preferential treatment is based upon social capital or the buyer's social relationship with the seller.

2.6.3 How Might One Measure Social Capital?

Now that social capital has been defined and its effects are properly identified, one may wonder how social capital is measured. One way to perform this task is to design a study eliciting information about people's relationships with other people, businesses, and organizations. Robison, Myers and Siles (1999) conducted a study examining the percentage of farmland purchases from sellers whom the buyer viewed as a friendly (unfriendly) neighbor, complete stranger, relative, influential person or legal entity. They conducted a survey of 1500 farm owner-operators located in Illinois, Michigan, and Nebraska. This study was designed to determine the influence of relationships on the selection of trading partners and terms of trade for farmland exchanges. The lowest price farm owner-operators were willing to accept "from their friendly neighbors" was $1,664.77 (Robison, Myers and Siles, 1999). Respondents were willing to accept $1,686.45 from friendly neighbors as well. Influential individuals received a higher minimum-selling price than did strangers, $1,876.63. In drawing a distinction, results indicated that unfriendly neighbors received the highest minimum-selling price ($2,114.81), which increases the possibility of a sale not being made between sellers and friendly neighbors (Robison, Myers and Siles, 1999).

Robison (1996) also conducted another study examining the response of college seniors in Agricultural and Natural Resources to a hypothetical prisoners of war problem. The surveyees

were assumed to be prisoners of war with no knowledge of when or if they would be released. The food was tasteless. One day the prisoners were given Hershey candy bars and were told that they may do whatever they wanted with them. The surveyees were asked how many candy bars they would consume and how they would share with other prisoners. Assuming that all respondents had the same Cobb-Douglas function, the own consumption coefficient was the largest followed by sharing, promise keeper (together), and goodwill. Of all the possible outcomes, the most significant correlation was found between own consumption and promise keepers. The more candy bars the prisoner consumes, the less likely he or she will keep promises (Robison, 1996).

Some of the business transactions and neighborly interactions that are highlighted in this study are neighboring farmers, lending institutions, feed merchants (grain supplier), packers and/or slaughter houses, veterinarians, and neighbors that are non-farmers. (See Appendix D, for the survey questions asked concerning social capital.)

CHAPTER 3

METHODOLOGY

The following chapter expounds upon the concepts and principles of economic and choice theories. Consumers and producers are guided by some form of maximization theory, whether it is utility, profit or welfare. This chapter discusses the neoclassical theory of choice, the utility function, qualitative choice models and their estimation, design of the survey, and hypotheses testing procedures.

3.2 Neoclassical Theory of Choice and Preferences

Adam Smith (1776) defines economics as "the" theory of choice. The choices humans make may be pleasant or dismal, but the aspect of choice is asserted to be pervasive. Decisions, i.e., choices, are a consequence of the scarcity of goods and services. However, without scarcity, whatever social science might exist would be vastly different than the present variety. Scarcity, in turn, depends upon postulates about individual preferences, in particular that people prefer more goods to less. If such were not the case, then goods, though limited in supply, would not necessarily be scarce. Therefore, the fundamental conceptualization of the determinants of choice upon which the neoclassical, or marginalist, paradigm is based begins with individual preference.

Why does a consumer prefer good "A" over good "B" and not good "B" over good "A"? The foundation on which the theory of choice stands is sustained and supported by properties that are rational and exhibit normal behavior. Rational or normal behavioral properties are guiding principals that are experientially proven through human interactions, whether they are viewed individually, socially or economically. In addition to individual preferences, there are other properties or axioms that guide economic theory. The axioms that justify consumer

preferences are completeness, reflexivity, transitivity, continuity and strong monotonicity (Varian, 1992).

The axiom of completeness implies that it is possible to compare any two bundles. Assume that a consumer has a choice between any c–bundle and any d–bundle. Also, assume that $(c_1,c_2) \succeq (d_1,d_2)$, or $(d_1,d_2) \succeq (c_1,c_2)$ or both (Varian, 1992). Given this scenario, the consumer will make a decision based on the two bundles or act indifferently between the two bundles. The second axiom, reflexivity, implies that any bundle is just as good as itself: $(c_1,c_2) \succeq (c_1,c_2)$ (Varian, 1992). Reflexivity may be viewed as trivial because any bundle is just as good as an identical bundle. That is, homogenous goods with similar attributes are preferred or indifferent to themselves.

The third axiom, transitivity, assumes that if $(c_1,c_2) \succeq (d_1,d_2)$ and $(d_1,d_2) \succeq (g_1,g_2)$, then $(c_1,c_2) \succeq (g_1,g_2)$ (Varian, 1992). In other words, if a person believes that C is at least as good as D and that D is at least good as G, then that person also believes that C is at least as good as G (Varian, 1992). For most people, transitivity is more cumbersome. It is not certain whether transitivity of preferences is an important property that preferences must have. From a logical perspective, there is not a compelling reason as to why preferences have to be transitive. In fact, transitivity is viewed more as "a hypothesis about people's choice behavior, not a statement of pure logic" (Varian, 1993: p. 36).

The fourth axiom, continuity, states that for all d in C, the set $\{c: c \succeq d\}$ and $\{c: c \preceq d\}$ are closed sets. In other words, if d is strictly preferred to g and if c is a bundle that is close enough to d, then c must be strictly preferred to g (Varian, 1992).

The last and final axiom is strong monotonicity. Strong monotonicity implies that if $c \geq d$ and $c \neq d$, then $c \succ d$ (Varian, 1992). This axiom means that more of any good is strictly better. That is, all goods under observation are good or desirable.

Assuming that these axioms exist, there is said to be a continuous utility function that represents a consumer's preferences. By specifying the above axioms, it can be better understood how to analyze choices through utility functions.

3.3 The Utility Function and Utility Maximization

A utility function enables one to identify all possible consumption bundles arranged in an order such that more preferred bundles get assigned higher values than the less preferred bundles (Varian, 1993). That is, a bundle (c_1,c_2) is preferred to a bundle (d_1,d_2) if and only if the utility of (c_1,c_2) is larger than the utility of (d_1,d_2): in symbols, $(c_1,c_2) \succ (d_1,d_2)$ if and only if $u(c_1,c_2) > u(d_1,d_2)$ (Varian, 1993).

From a neoclassical perspective, utility is ordinal. That is, utility is not quantifiable. It is used only to rank the different consumption bundles in some orderly fashion. In other words, one person's utility cannot be compared to another person's utility by assigning numbers to bundles of goods. The primary concept on which emphasis is placed, is that more of a good is preferred to less. Because consumers prefer more to less, whether it is in terms of quality or quantity, non-satiation is perhaps the most essential property when ordering and ranking utility functions (Varian, 1993).

In keeping with the non-satiation property, it is assumed that consumers strive to get the most satisfaction they can out of the various goods and services purchased and consumed. An optimal utility solution $U^*(p_1,p_2,M)$ maximizes an individual's utility given two prices and income. The quantities x_1 and x_2 are used to "maximize utility subject to the budget constraint"

(Silberberg, 1990: p. 310). The behavioral assertion is that a consumer engages in constrained maximizing behavior such that desirable alternatives are those that satisfy the individual's constraints. However, given that we live in a world of scarcity, consumers are faced with making choices concerning the levels of consumption they will undertake (Silberberg, 1990). Assuming the consumer is rational, the intricate calculations will be made regardless of scarce resources to achieve a maximum of utility.

In summary, it has been shown in the last three subsections that the choices of a rational consumer are rooted in his or her preferences, which are supported by specific axioms that give rise to a utility function, capturing the individual's personal desires. Given the postulated utility function, consumers seek to maximize their levels of satisfaction. Using these same fundamental principles, the next section identifies and discusses choice models appropriate for analyses of alternative dependent variables.

3.4 Choice Models

This study utilizes a polychotomous choice framework to determine the factors that influence producers' decisions for accepting certain business arrangements (BA). An empirical multinomial logit (MNL) model is used to analyze the choice of alternative BAs. According to Maddala (1997), the MNL model was originally derived from the Luce model. Luce (1959) derived the model given by Equation 3.4.1 starting from the independence of irrelevant alternatives (IIA) axiom on the choice probabilities.

$$prob(Y_i = 1 | X) = \frac{e^{v_i}}{\sum_{j=1}^{m} e^{v_j}} \qquad \textbf{(3.4.1)}$$

The Luce model is associated with this property because the odds ratio for the *i*th and *j*th choices is $\exp(V_i)/\exp(V_j)$, where $V=\beta'X$, which is the same irrespective of the total number *m* of choices

considered. The property of the IIA axiom exists when probabilities are not equally shared for two or more alternatives that are close substitutes (Kennedy, 1998). In 1974, McFadden updated the model, which became known as the multinomial logit (MNL) model. As a special case of the Luce model, the multinomial logit model also has the property of the IIA axiom on the choice probabilities. Logit models can be expressed as having dichotomous or polychotomous variables. Dichotomous or binary models give the option of choosing one of two alternatives. Polychotomous models such as the multinomial logit consist of many alternative choices, of which one is chosen (Kennedy, 1998).

The multinomial logit model is derived from a random utility function. Utility U_{ij} is derived by the *i*th individual from the *j*th choice. This can be written as: $U_{ij} = \bar{U}_{ij} + e_{ij} = x'_{ij}\beta + e_{ij}$ where U_{ij} is the average utility, e_{ij} is a random error, x'_{ij} is the set of explanatory variables, and β is a vector of unknown parameters (Judge et al., 1985). For this utility function, e_{ij} is a random variable that is independently and identically distributed with a Weibull density function. The model assumes the choice probabilities are dependent on individual characteristics (Maddala, 1997). The multinomial logit model has been used to study choice of transportation modes (Theil, 1969), automobiles (Cragg and Uhler, 1970), the determinants of occupational choice (Schmidt and Strauss, 1975b), factors influencing technology adoption (Caffey and Kazmierczak 1994), whether part-time farming is a step in the way out of agriculture (Kimhi, 2000) and others. In this study, the probability associated with the individual's adoption of the business arrangement is assumed to follow an underlying logistic distribution and can be described as (Greene, 1997):

$$P_{ij} = \frac{e^{\beta_i' X_i}}{1 + \sum_{k=1}^{m-1} e^{\beta_i' X_i}} \quad j = 1,2,\ldots,m-1 \qquad \textbf{(3.4.2)}$$

where P_{ij} represents the probability that $Y=j$, for $j=1,2,...m$, m is the number of choices, X represents the set of characteristics for individual i, and β is a set of estimated parameters that describe the influence of X on the probability of preferring a given item.

The Independence of Irrelevant Alternatives (IIA) assumptions associated with MNL become problematic because they impose the restriction that cross-price elasticities are the same across alternatives. As a solution, McFadden (1981) proposes the Nested Multinomial Logit (NMNL) model, which is a computationally feasible generalization of the MLN model. The NMNL model relaxes the homoscedasticity assumption in the conditional logit model that also provides an intuitively appealing structure to group the alternatives into subgroups. The subgroups allow the variance to differ across the groups while maintaining the IIA assumption within the groups.

3.5 Binominal Logit

While the MNL model is used to analyze producers' choice of business arrangements from a more general prospective, the binomial logit model is employed to identify specific characteristics associated with production contracts. Flat-fee and incentive payment contracts had to be analyzed separately from business arrangements as a whole in order to capture the influence of certain contract-specific variables on the selection among production contracts.

Binary choice models are used when decisions of individuals involve two alternatives, where only one is chosen. The binomial logit model has been used in such studies as applying marketing channel theory to food marketing in developing countries (Dijkstra and Meulenbery, 2001), determining the effect of strawberry density on the spread of anthracnose caused by colletotrichum actatum (Madden and Boudreau, 1997), estimating densities of grasshopper assemblages (Legg et al., 1993), analyzing spring and summer infestations of the Russian wheat aphid (Legg et al., 1992) and many others. The binary choice of the i^{th} individual is conveniently

represented by a random variable y_i that takes the value 1 if one choice is made and 0 if the other choice is made. If P_i is the probability that y_i takes the value 1, then 1-P_i is the probability that y_i is 0. This can be summarized by writing the probability function for y_i as:

$$f(y_i) = P_i^{y_i}(1 - P_i)^{1-y_i} \qquad y_i = 0, 1 \qquad \textbf{(3.5.1)}$$

Economists are typically interested in examining the factors that affect the choice probability P_i. The average utility derived from a choice by an individual is based on the attributes of the choice, which are specific to the individual. By taking the utility derived from the choices as the average utility plus a random disturbance, we have:

$$U_{i0} = \bar{U}_{ij} + e_{i0} = Z'_{i0}\delta + W'_i\gamma_0 + e_{i0} \qquad \textbf{(3.5.2)}$$

$$U_{i1} = \bar{U}_{i1} + e_{i1} = Z'_{i1}\delta + W'_i\gamma_1 + e_{i1}. \qquad \textbf{(3.5.3)}$$

where U_{i0} and U_{i1} are the utilities of the two choices, $\bar{U}_{i0}$ and $\bar{U}_{i1}$ are the average utilities, Z'_{i0} and Z'_{i1} are vectors of characteristics of the alternatives, as perceived by individual *i*, W'_i is a vector of contract production characteristics of the i^{th} individual, and e_{i0} and e_{i1} are random disturbances (Judge et al, 1988). Suppose utilities U_{i0} and U_{i1} are random. The i^{th} individual will choose alternative one only if $U_{i1} > U_{i0}$ or if the observable, or latent, random variable $y_i^* = U_{i1} - U_{i0} > 0$. Values of the observable random variable y_i are expressed as:

$$y_i = \begin{cases} 1 \text{ if } y_i^* > 0 \\ 0 \text{ if } y_i^* \leq 0 \end{cases} \qquad \textbf{(3.5.4)}$$

The probability that $y_i = 1$ is $P_i = \Pr[y_i = 1] = \Pr[y_i^* > 0] = \Pr[e_i^* > x_i'\beta]$ (Judge et al, 1988: p. 787). To make the model complete, a logistic probability distribution is chosen for disturbance terms e_i^*. The cumulative density function (CDF) of the logistic random variable is

$F(t) = 1/[1+\exp(-t)]$ (Judge et al, 1988: p. 787). The logistic distribution closely approximates the normal distribution. Both distributions are symmetric with zero means.

3.6 Marginal Effects

The marginal effects (marginal probabilities) are calculated for the choice of alternative business arrangements. In the multinomial logit model, the coefficients for β are not directly tied to the marginal effects (Greene, 2000). From Equation 3.6.1, we can express the marginal effects of the attributes on the probabilities as such:

$$\delta_j = \frac{\partial P_j}{\partial X_k} = P\left[\beta_j - \sum_{k=1}^{m-1} P_k \beta_k\right] = P_j\left[\beta_j - \overline{\beta}\right]. \qquad \textbf{(3.6.1)}$$

Each subvector of β is taken into consideration in every marginal effect by way of probability and weighted average that exists in δ_j (Greene, 1997). These can be calculated using the parameter estimates. Equations 3.6.1 could possibly cause some confusion, although the usual focus is on the coefficient estimates. "Note, for example, that for any particular X_k , $\partial P_j / \partial X_k$ need not have the same sign as β_{jk}" (Greene, 1997: p. 916).

The Delta method is used to compute the standard errors for functions of parameters obtained by the standard estimator. To test the null hypothesis, Ho: $\delta_j = 0$, the t-statistic (3.6.2) is used, which follows an asymptotically standard normal distribution (Greene, 1997) and is given by

$$t = \frac{\hat{\delta}}{se(\hat{\delta})}. \qquad \textbf{(3.6.2)}$$

The asymptotic standard error of $\hat{\delta}_j$ is given by the root square of the asymptotic variance,

$$Asy.Var(\delta_j) = \sum\sum\left(\frac{\partial \delta_j}{\partial \beta_l}\right) * Asy.Cor\left[\beta_l, \beta_m\right]\left(\frac{\partial \delta_j}{\partial \beta_m}\right), \qquad \textbf{(3.6.3)}$$

where $\frac{\partial \delta_j}{\partial \beta_l} = [1(j = l) - \rho_l][\rho_j I - \delta_j X] - \rho_j[\delta_j X']$ with a vector with entries equal to 1 if $j = l$, and zero if not (Greene, 1997).

When analyzing models with discrete dependent variables, the marginal effects are sometime calculated differently. For the binomial logit model, the two choices are flat-fee contract (0) or incentive payment contract (1). The predicted probabilities $F(\hat{\beta}'x) = \hat{F}$ and the estimated marginal effects $F(\hat{\beta}'x) = \hat{F}$ multiplied by $\hat{\beta} = \hat{f}\hat{\beta}$ are nonlinear functions of the parameter estimates. To calculate the standard errors, a linear approximation approach (delta method) is used. The predicted probabilities are,

$$Asy.Var[\hat{F}] = \partial\hat{F} / \partial\hat{\beta}]'V[\partial\hat{F} / \partial\hat{\beta}], \quad \textbf{(3.6.4)}$$

where

$$V = Asy.Var[\hat{\beta}]. \quad \textbf{(3.6.5)}$$

The marginal effects for the binomial logit model are calculated as $\hat{f} = \hat{\Lambda}(1 - \hat{\Lambda})$, where the notation $\hat{\Lambda}$ represents the logistic cumulative distribution function.

3.7 Multicollinearity Analysis

Because economists are rarely involved in controlled experiments, there are often concerns surrounding the effects of multicollinearity in their data. Multicollinearity is not a statistical or econometric problem, but a data problem that violates one of the assumptions of the Classical Linear Regression (CLR) model, which specifies that there must not be an exact linear relationship between independent variables (Kennedy, 1998). The major "consequence of multicollinearity is that the variances of the OLS estimates of the parameters of the collinear variables are quite large" (Kennedy, 1998: p.184). If there is high correlation between two

variables, little variation is unique to each variable, leaving a larger percentage of the variation common among the two variables (Kennedy, 1998). "This means that the OLS procedure has little information to use in making its coefficient estimates, just as though it had a very small sample size, or a sample in which the independent variable did not vary much" (Kennedy, 1998: p. 185). Having high variance minimizes the accuracy of the parameter estimates, which in turn makes the hypothesis test groundless.

Multicollinearity problems normally arise when the data that are being analyzed are cross sectional or panel. Cross sectional or panel data may cause multicollinearity problems for several reasons other than linear relationships among independent variables. Other possible reasons cross sectional or panel data may become problematic are: 1) some independent variables may have varied together because the data were not collected from a wide enough base, or 2) there could in fact exist some type of approximated value among some of the regressors (Kennedy, 1998).

3.8 Detecting Multicollinearity

The procedures used in detecting multicollinearity have become quite controversial among economists. This is believed to have occurred due to the inadequacy of some detection methods, which are scrutinized justifiably (Kennedy, 1998). The inadequacies of these methods are centered around their inability to lower the variance of the independent variables. Perhaps one the most popular ways of detecting multicollinearity is by examining the correlation matrix. The correlation matrix can be obtained by conducting simple regression analyses where all pairs of independent variables are compared. A successful analysis of the data reveals correlation coefficients, which are the off-diagonal elements in the variance co-variance matrix for a given data set. Multicollinearity is believed to exist whenever the correlation coefficients have values of 0.8 or greater (Kennedy, 1998). A value of 0.8 or greater indicates that the two independent

variables are highly correlated with one other. Alternatively, one may use the condition index to detect multicollinearity. The condition index measures "the square root of the ratio of the largest to the smallest characteristic root of X`X" (Kennedy, 1998: p. 187). Any number greater than 20 gives indications of possible collinearity problems (Greene, 2000). Another way of detecting multicollinearity is by calculating the inverse of the correlation matrix (Kennedy, 1998). The inverse correlation matrix gives us the variance inflation factor (VIF), which is represented by the diagonal elements of this matrix. If the R_i^2 is near unity, the VIF is high, which indicates that there are collinearity problems (Kennedy, 1998). Collinearity is believed to be harmful when VIF_i is greater than 10 (Kennedy, 1998).

3.9 Testing for Heteroskedasticity

Given the nature of the survey data (cross-sectional), possible heteroskedasticity problems become a normal concern when testing model significance. Heteroskedasticity is an econometric problem that exists when the variances in the variance/covariance matrix are not constant (Judge et al, 1988). In testing for the significance of the model, the null hypothesis and alternative hypothesis are as such:

H_0: $\beta_1 = \beta_2 = \beta_3 = \ldots\ldots = \beta_n = 0$

H_A: at least one $\neq 0$

where βs represent the variances in the null hypothesis. If the null hypothesis (H_0) is not rejected, there is not sufficient evidence to suggest that heteroskedasticity exists, but if the alternative hypothesis (H_A) is not rejected, heteroskedasticity exists.

One method of testing for inconsistence of variances in the variance-covariance matrix is by way of the multiplicative heteroskedasticity model. Similar to the above test, the multiplicative heteroskedasticity model tests "the null hypothesis H_0:$\alpha^* = 0$ against the

alternative hypothesis H_1:α* ≠ 0" (Judge et al, 1988: p. 370). The multiplicative heteroskedasticity model utilizes an estimator $\hat{\alpha} = (Z'Z)^{-1}Z'q$, where α is the estimator, Z = $(z_1 z_2 \ldots z_T)'$, and the matrix $(Z'Z)^{-1}$ represents D (the unknown covariance matrix) (Judge et al, 1988). In the $(Z'Z)^{-1}$ matrix the first row and first column are deleted. Then, from

$$\sqrt{T}(\hat{\alpha} - \alpha + 1.2704d) \xrightarrow{d} N(0, 4.9348\Sigma_{zz}^{-1}), \quad \textbf{(3.9.1)}$$

$$\hat{\alpha}^* \sim N[\alpha^*, 4.9348D] \quad \textbf{(3.9.2)}$$

and

$$\frac{(\hat{\alpha} - \alpha^*)' D^{-1} (\hat{\alpha} - \alpha^*)}{4.9348} \sim \chi^2_{S-1} \quad \textbf{(3.9.3)}$$

hold approximately. Given the null hypothesis α* = 0, Equation 3.9.3breaks down to $(\hat{\alpha}^{*\prime} D^{-1} \hat{\alpha}^*) / 4.9348$. To test for heterosckedasticity, the multiplicative model computes this value and evaluates it based on the χ^2 distribution (Judge et al, 1988).

The final model that may be used is the Heteroskedasticity Extreme Value Logit (HEVL). HEVL is also a constructive method that is not frequently used but is recommended by Munizaga et al., (2000) and Greene (2000) for correcting heteroskedasticity between options. In order to account for heteroskedasticity between options, HEVL assumes that the error terms are mutually independent extreme value distributed but are allowed to have differing variances. The choice probabilities are given by (Munizaga et al., 2000):

$$P_i = \int_{w=-\infty}^{\infty} \prod_{j \in C_n j \neq i} \Lambda \left[\frac{V_i - V_j + \theta_{iw}}{\theta_j} \right] \lambda(w) dw, \quad \textbf{(3.9.4}$$

where $\lambda(t) = e^{-t} e^{-e^{-1}}$, V_j = nonstochastic part, θ_j = scale parameters and $\Lambda(t) = e^{-t} e^{-e^{-t}}$.

When testing for the two heteroskedasticity problems, Munizaga et al. 2000, found that Multinomial Probit (MNP) and the HEVL were the theoretically correct models that showed better results than the other observed models. The HEVL model "recovered accurately the target parameter values and performed satisfactorily in terms of the response analysis" (Munizaga et al., 2000).

3.10 Measuring Goodness-of-Fit

"A goodness-of-fit measure is a summary statistic indicating the accuracy with which a model approximates the observed data" (Maddala, 1997: p. 37). There are many ways to measure the goodness-of-fit for a particular model. For linear regression models, one of the most frequently used methods is the R^2. However, for logit models, goodness-of-fit can be measured by computing the direct R^2 or the pseudo R^2 from the likelihood-ratio test (Maddala, 1997). As we consider the goodness-of-fit for limited dependent variable models, the R^2 criterion does not satisfy specific properties of economic theory. The results indicate that the β coefficients are inconsistent and the parameters are meaningless. However, hope of finding a legitimate goodness-of-fit criterion was given through the ingenuity of Cragg and Uhler (1970) and McFadden (1974) in creating the pseudo-R^2. This criterion can be illustrated by defining R^2 in relation to the likelihood ratio statistic. Suppose we have the goodness-of-fit measure "$R^2 = 1 - \left(\frac{L_\omega}{L_\Omega} \right)^{2/n}$ where n is the number of observations, L_Ω is the maximum of the likelihood function when maximized with respect to all parameters β_j and L_ω is the maximum when maximized with respect to the constant term α_j only" (McFadden, 1998: p. 39). When considering this goodness-of-fit in the logit model, "even though $R^2 \rightarrow 0$ as $L_\Omega \rightarrow L_\omega$, the upper

bound is much less than 1" (McFadden, 1998: p. 39). Pseudo-R^2 is believed to be a better measure. Cragg and Uhler (1970) define pseudo-R^2 as

$$pseudo - R^2 = \frac{1-(L_\omega / L_\Omega)^{2/n}}{1-(L_\omega / L_{\max})^{2/n}} = \frac{L_\Omega^{2/n} - L_\omega^{2/n}}{1-L_\omega^{2/n}} \qquad \textbf{(3.10.1)}$$

where $L_\omega = \prod_{j=1}^{m}\left(\frac{n_j}{n}\right)^{n_j}$, $L_{max} = 1$, and L_Ω is the same as defined above (Cragg and Uhler, 1970). The Cragg and Uhler method is ideal because it allows the upper bound on pseudo-R^2 to be one. Thus, as a measuring criteria for goodness-of-fit, one can now make the assumption that the larger the pseudo-R^2, the better the fit of the model.

3.11 T-Test of Different Population Sizes

Before conducting the multinomial logit or binomial logit analysis, it is useful to test for the differences between the dependent variables for each independent variable. Suppose we were given two populations with means μ_1 and μ_2. Now assume that we have independent random samples of size n_1 and n_2 for which the sample means $\bar{x}_1$ and $\bar{x}_2$ and s_1^2 and s_2^2 variance

$$s_1^2 = \frac{\sum_{i=1}^{n_1}(x_i - \bar{x}_2)^2}{n_1 - 1} \quad \text{and} \quad s_2^2 = \frac{\sum_{i=1}^{n_2}(x_i - \bar{x}_2)^2}{n_2 - 1} \qquad \textbf{(3.11.1)}$$

$$t = \frac{(\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^{\frac{1}{2}}} \qquad \textbf{(3.11.2)}$$

are calculated (Kanji, 1993). The test statistic in Equation 3.11.2 may be compared with the Student's t-distribution with degrees of freedom (Kanji, 1993: p.29) given by

$$v = \left\{ \frac{\left\{ \frac{s_1^2}{n_1} + \frac{s_2^2}{n_2} \right\}^2}{\frac{s_1^4}{n_1^2(n_1+1)} + \frac{s_2^4}{n_2^2(n_2+1)}} \right\} - 2 . \qquad \textbf{(3.11.3)}$$

The interpretation of this t-test is as follows: if the critical value associated with degrees of freedom is less than the Student's t-distribution, then the hypothesis that the two population means are equal is rejected. If the contrary is true, then there is no significant difference between the two population means.

3.12 Survey Design and Implementation

3.12.1 Mailing the Survey

A national survey was conducted during the summer and fall of 2000 to provide data for this study. Approximately 4,986 surveys were mailed with a response rate of 21% (1,030). The producers surveyed were taken from a random sample of National Hog Producer magazine subscribers. Sufficient numbers of respondents for each business arrangement were represented in the data sample. As shown in Table 2, a stratified sample of U.S. hog producers was used, more specifically, 831 producers in each of the following hog inventory categories: 200-999 hogs, 1,000-1,999 hogs, 2,000-2,999 hogs, 3,000-4,999 hogs, 5,000-9,999 hogs, and 10,000 hogs and over. The U.S. Department of Agriculture reports that in 1999, 52,730 producers had 1-99 hogs, 32,105 had 100-999 hogs, 6,500 had 1,000-1,999 hogs, 5,120 had 2,000-4,999 hogs, and 2,005 had over 5,000 head in inventory. Thus, our group has a higher percentage of the larger producers than the general hog producer population.

The producers surveyed were asked a series of questions. The survey was divided into five sections. Section I of the survey attempts to capture the production characteristics of U.S. hog farmers. The purpose of this section is to determine the size of the farmer's hog operation

and farm (in terms of the number of acres), types of labor, as well as the different modern technologies incorporated within the production and marketing process.

Section II was designed to elicit farmers' levels of and preferences for autonomy. The ability to make production and marketing decisions are authoritative powers that are important to some farmers, and less important to others. This section is used to determine the decision-making power exercised by farmers. More specifically, it is of interest to know the inputs and marketing decisions farmers are more likely and less likely to allow contractors to control.

Table 3.1: Farm Size Categories Surveyed.

Size Category	Number of Names Requested
10,000+	831
5,000 -- 9,999	831
3,000 -- 4,999	831
2,000 -- 2,999	831
1,000 -- 1,999	831
200 -- 999	831
Total	4,986

Section III was designed to identify the business arrangements and transaction costs that are common in the hog industry. More specifically, this section determines whether farmers are independent farmers, cooperative farmers, vertical integrators or contract farmers. If contract farmers, the type of contract is determined among flat-fee contract, contract with incentive payments, or tournament contract.

Section IV elicits the socioeconomic characteristics of farmers. This section captures personal information that may influence farmers in choosing one business arrangement over another. These questions ascertain information such as age, gender, martial status, education, family size, household income, race, social relationships, and reasons for farming.

Section V was designed to elicit the risk preference of each farmer. Given the nature of hog production, risk will always be a determining factor that farmers use to make production plans and marketing decisions. The first question allows each farmer to evaluate and define his or her own risk preference. The second question gives the farmer a hypothetical situation of a financial investment venture. Farmers are then asked to choose one of the five investment options.

In our efforts to design a survey that maximizes response rate, a hybrid stemming from Dillman's (1978) Total Design Method (TDM) was used. The major strength of the TDM as a comprehensive system is that it meticulously follows the prescribed procedures that consistently produce high response rates for most survey populations. The first step to the TDM is to formulate questions that are interesting to the respondent and provide a cover letter identifying the purpose of the survey and the types of questions that will be asked. The second step is to construct the questions so that they are relatively easy to read and answer. Third, the survey should be printed in booklet format with a topically neutral but interesting cover. The fourth step is to use a photo reduction of regular-sized type to make pages seem smaller and easier to complete. The final step is to use four carefully spaced mailings. These mailings must include a postcard follow-up one week after the original mailing; a replacement questionnaire and cover letter informing the recipient the questionnaire has not yet been received four weeks after the original mailing; and a second replacement questionnaire and cover letter seven weeks after the first mailing. Some other methods to improve response rates are first class postage, and monetary awards or gifts as incentives for completing the survey.

The hybrid method used for this study consisted of an initial mailing of the survey followed by a postcard reminder two weeks later. After the postcard reminder was mailed, a second mailing of the survey was sent. In keeping with Dillman's approach, all of the letters

sent to farmers during the second mailing of the survey were signed personally. Contrary to Dillman's approach, all surveys and reminders were mailed out as bulk mail due to financial constraints. As a gift, a Community tea bag was mailed with each survey in the first mailing.

3.12.2 Data Specification

In order to conduct a thorough analysis, a sufficient number of respondents for each business arrangement must be represented in the sample data. It was estimated that approximately 167 observations of each business arrangement would be received. Of the 167 observations, 140 were expected to be complete, which is enough to properly determine factors influencing the choice of business arrangement. The expected response rate was 20%, based on previous similar studies. Thus, approximately 5,000 hog producers were surveyed in order to obtain the desired sample size of 1,000. Because previous studies (Lawrence et al. 1998 and Rhodes and Grimes 1994) have shown that larger producers are more likely to be involved in some form of contractual agreement with vertical integrators or coordinators, the random stratified sample was designed to represent the farm size categories shown in Table 2. The study area is the entire United States, thus enabling the examination of a traditional region of production (Midwest), as well as the newly expanding regions (Southeast and West).

3.12.3 Pilot Study

A pilot study that consisted of two Louisiana hog farmers, two Louisiana State University faculty and one staff member was conducted to obtain constructive criticism and ways to improve the survey. The respondents were informed that this was a pilot study and that the information collected from the survey would to be used for dissertation research. Emphasis was placed on the importance of their feedback.

The two LSU faculty members did not answer the survey as if they were hog producers, but were merely asked to comment on the content. The two Louisiana hog producers and the

LSU swine unit manager were given the survey and a cover letter addressed to them and asked to complete the survey as if they had received it in the mail. Respondents were also encouraged to ask questions in relation to any item that appeared on the survey that they did not understand. Immediately after the respondents finished, their times of completion were recorded and they were asked a series of questions in reference to their overall perception of the survey. Each respondent was asked if the survey was attractive and, if they received it in the mail, would they fill it out. All of the respondents agreed that the survey was attractive and that they would fill it out if it were received in the mail. Respondents were then asked to rank the clarity of the survey on a scale of 1 to 10, with 10 being extremely clear and 1 being unclear. One of the respondents ranked the clarity of the survey as a 9, while two gave it a ranking of 8. Likewise, respondents were asked to rate the quality of the survey on a scale of 1 to 10. To prevent biasing the results, the respondents were allowed to use their personal definitions of quality in answering this question. Using the same measure as in the previous question, they rated the quality of the survey as 8, 9, and 10, respectively. It was also important to know whether any of the questions offended the respondents. All responded "no" to this question. Finally, the respondents were asked whether or not they would fill out this survey if it were from another university outside of the state of Louisiana. The respondents agreed that they would fill out the survey if it were received from another university outside of Louisiana.

The comments and suggestions received from the respondents were useful in that they enabled us to add, delete or clarify the questions in our final survey. All information given by the respondents was thoroughly analyzed for completeness and immediately incorporated into the study.

3.13 Theoretical Model

As illustrated in Figure 3.1, the MNL model is a tree-like structure that consists of the root and four trunks. The business arrangement is expressed as the root, and the choice of business arrangement (independent, cooperative, flat-fee contract and incentive payment contracts) as the trunks. The type of contract chosen (flat-fee or incentive payment/tournament) is estimated using a binominal logit model. Table 3.2 defines each business arrangement. However, only four of these business arrangements are used in this study, independent production, cooperative farming, flat-fee contract, and incentive payment contract. One of the business arrangements, vertical integration, was deleted due to few observations; another business arrangement, tournament contract, was combined with the incentive payment contract due to similar characteristics and few tournament contract observations.

The MNL model proposed above can be written under the following general form:

Business Arrangement = f(Farm/Locational Characteristics, Farm Financial Characteristics, Producer Attitudes, Social Capital, Production Characteristics).

A more specific theoretical model can be expressed as:

BAMT = f(NGHF, MKTPRICE, TIMEHSYS, CORN, RISKAVER, AUUNOTIMP, AUERIMP, COMPHS, BACHELO, AGE, TOTALFD, HOG250, SOUTH, BIOSECUR, HIINCOME, BREEDSOW, HIGHDEBT, NHWOFFFA, FCONTRWI, FFLATFEE, VALFAMAS, LENDINST, FEEDMERC, NEIGFARM)

CONTRACT = f(MOPUNDCO, CONTWNFA, NEWREFAC, NUACRES, EXRAIHOG).

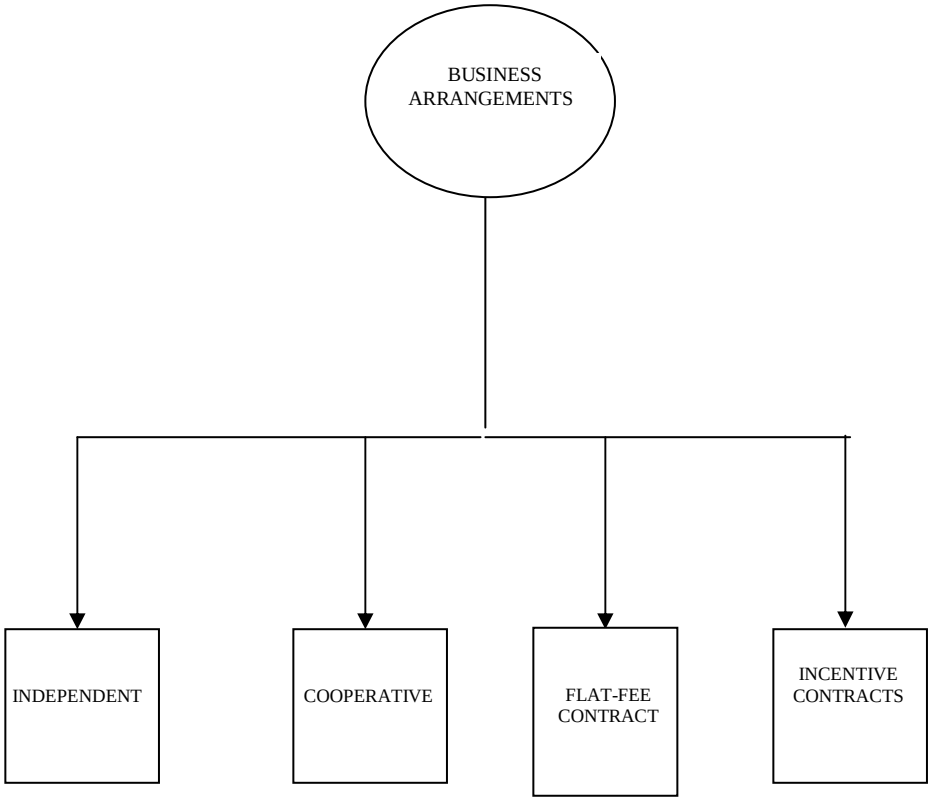

Figure 3.1: A Conceptual Model of U.S. Hog Industry Business Arrangements.

Table 3.2: A Description of the Business Arrangements Analyzed.

Business Arrangement	Description
Independent Production	All inputs involved in the production process are owned and managed by the producer. The producer incurs all risk and transaction costs through the production and marketing of hogs.
Cooperative Farming	A jointly owned farm enterprise consisting of two or more farmers who aggregate their resources and expertise to finance, produce and/or market hogs.
Contract with Incentives	The contractor or integrator provides the producer with inputs such as feeder pigs, feed, veterinary services and medication, while the producer supplies the labor, utilities, buildings, and fuel. This contract includes an incentive-based payment that is rewarded on the basis of feed efficiency, minimum mortality, and length of time in grow-out.
Tournament Contract	This agreement is similar to the previous contract in terms of input supply and incentive criteria; however, this contract differs in the number of farmers competing for incentive payments, which varies with performance.
Flat-fee Contract	This contract has the same characteristics as the previous contract, but it does not include bonus or incentive payments. The producer is paid a guaranteed piece-rate payment for his/her services, and at the end of the grow-out period, the contractor reclaims the hogs.
Vertical Integration	A firm that owns up-and downstream firms and supplies all inputs for the production of hogs and employs producers at a wage to manage the unit.

3.13.1 Exogenous Variables Used in the Multinomial Logit Analysis

- Farm/Locational Characteristics

HOG250 = Number of 250 Pound Hogs Sold per Year

HOG250 is measured as a continuous variable. Producers were asked if they raised hogs to a weight of 200 – 300 pounds for market in 1999 and, if yes, approximately how many? Technological change has encouraged hog operation expansion. Studies have shown that the average production costs of larger hog farms is significantly lower than that of small hog farms (Barkema and Cook, 1993). Some producers seeking an opportunity to expand small hog farms have turned to contract production since contractual arrangements help producers establish steady cash flows and obtain loans for expansion. In order to qualify for some production contracts, the producer must rent or own land for manure application and purchase new or renovate existing facilities. Some of the facilities recommended or required by contractors are capable of housing up to 1,100 pigs per unit. It is hypothesized that producers who finish more hogs will be more likely to adopt contracts than independent or cooperative production.

BREEDSOW = Number of Sows Used in Hog Operation

BREEDSOW is a continuous variable indicating the number of breeding sows used in the operation. Producers surveyed were asked, "How many breeding sows are used in your hog operation?" It is hypothesized that producers with more breeding sows are more likely to be independent or cooperative producers than contract producers. The reason for this is that breeding sow operations are specialized, more highly skilled operations that require more intensive labor than finishing operations. Given that contractors have no control over the additional labor force hired to run breeding sow operations, the quality and quantity of pigs farrowed are subject to vary from one contract producer to the next. This variation has potential

to reduce the uniformity of animals produced, which in turn affects the value of the hogs. Many vertically coordinated firms own the farrow to nursey units and contract out the finishing portion.

TOTALFD = Number of Other Farm Enterprises

TOTALFD is measured as a continuous variable. Producers were asked, "What other type(s) of farm animals and/or crops do you raise"? Producers were asked to identify any other additional livestock and/or crops they were raising on the farm. Traditionally, producers have used diversification as a financial risk management tool. The rationale guiding this management strategy is that more enterprises reduce total income variability. Today, there remain a substantial number of producers who utilize this management strategy. Some producers supervise all the breeding, gestation, farrowing, weaning, nursing, finishing of hogs, and raising of other animals, as well as plant, harvest and mill their own feed on one farm. The incentive to diversify is less for most contract producers since most contracts are set up to reduce price risk to the producer. One of the drawbacks of diversified farming is the potential reduction of production efficiency due to the inability to excel at multiple tasks. Some contractors do not allow certain types of diversified farming (often due to concerns of disease that can be transferred among species). As a result of these factors, it is hypothesized that diversified farms will more likely be managed by independent producers.

CORN = Corn Production

CORN is measured as a dummy variable. Each producer was asked if he or she raised corn. Corn is the major ingredient in most U.S. hog feed rations, and corn accounts for almost two-thirds of the costs of hog production (Barkema and Cook, 1993). It is hypothesized that corn production is more likely to be vertically integrated with independent or cooperative hog producers than contract producers. Most producers under resource-providing contracts receive feed and other inputs from the contractor. This provides the contractor the ability to control

inputs and, ultimately, the type of hog produced. In such cases, feed costs are incurred by the contractor; thus there is no need to grow corn for hog feed.

FCONTRWI = Incentive Payment Contracts Used in County

FCONTRWI is measured as a dummy variable. Each producer was asked, "What type(s) of business arrangements are farmers in your county presently producing hogs under"? This variable seeks to determine the types of hog operations that are presently being used by other hog producers in the surveyee's community. It is hypothesized that, in counties with incentive payment contracts, the producer will be more likely to adopt a contract. The justification for this hypothesis could conceivably be based on many factors, anti-corporate farming laws being one of them. Most states that have anti-corporate farming laws do not allow any form of contracting to coexist with independent or cooperative operations. Agglomeration economies is another justification. Based on the hypothesis, it is expected that more flat-fee contracts and incentive payment contracts would congregate in the same communities. One of the advantages of economics of agglomeration is lower input, production and marketing costs. Vertically coordinated and vertically integrated firms who own or coordinate with up- and down stream businesses supply inputs and marketing services to growers at lower cost. The costs of these production inputs and marketing services are lower because the hog production sites are located within close proximity of feed suppliers, packagers/slaughter houses and contractors, which help reduce transportation costs, transaction costs and shorten communication gaps.

FFLATFEE = Flat-fee Contracts Used in County

FFLATFEE is measured as a dummy variable. Similar to FCONTRWI, producers were asked to indicate whether other flat-fee contracts exist within their communities. Using the same reasoning expressed for the variable FCONTRWI, it is hypothesized that flat-fee contracts are more likely to exist in communities where there are other flat-fee contracts.

SOUTH = Hog Production in the South

South is a dummy variable indicating that the farm is located in one of the following 11 states: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, or Virginia. During the past twenty years, hog production in the Southern region has increased significantly. For instance, in North Carolina, the number of hogs produced increased from 1.9 million in 1975 to 9.3 million in 1996, an increase of almost 400% (Hubbell and Welsh, 1998). Today, North Carolina ranks second in production in the U.S. Other southern states that have experienced significant expansion include Arkansas, Mississippi, and Georgia. The growth of hog production in the Southern states has been attributed to producers' willingness to accept vertically coordinated and integrated firms since they had little existing industry that could be threatened by the advent of a new business arrangement. In addition, it can be attributed to a lack of anti-corporate farming laws in the South. Thus, it is hypothesized that producers from the Southern U.S. are more likely to be contract producers than producers in other regions.

TIMEHSYR = Number of Times Hogs are Sold per Year

TIMEHSYR is measured as a continuous variable. Producers were asked how many times per year they sold hogs at local auctions, packers or slaughter houses. The number of trips a producer makes to a market to sell his/her hogs or purchase production inputs is directly related to the cost of production. The more transactions a producer makes in selling animals or purchasing production inputs, the higher are his/her transaction costs (Hobbs, 1997). A guiding criterion for choosing the appropriate business arrangement lies in the number of market transactions a producer makes. In today's hog industry, larger independent hog operations are more likely to conduct more market transactions than smaller ones due to the number of animals involved and, in the case of farrow-to-finish operations, year-round breeding. However, over the

past several decades, producers have been able to reduce these transaction costs via contract production and certain forms of cooperative farming. This is mainly because contractors and some types of cooperatives absorb or conduct the transaction. Therefore, it is hypothesized that producers requiring more market transactions are more likely to contract to reduce transaction costs.

NHWOFFFA = Number of Hours Worked Off-farm

NHWOFFFA is measured as a continuous variable. The producers surveyed were asked how many hours per week they worked off the farm. An increasing number of U.S. producers have accepted off-farm jobs to supplement their primary income. However, it is hypothesized that producers who work fewer hours off farm are more likely to be independent or cooperative producers, given their production and marketing responsibilities. Since contract producers of the same size spend less time making production and marketing decisions, they are expected to have more time to work off-farm.

- Farm Financial Characteristics

HIGHDEBT = High Debt

HIGHDEBT is a dummy variable indicating that the farmer's debt-to-asset ratio is 40 percent or greater. Producers were asked, "What is your debt-to-asset ratio"? One of the advantages of most production contracts is that some of the inputs are supplied by the contractor. Inputs (such as feed, animals, veterinary care, and medication) supplied by the contractor enable producers to reallocate resources toward purchasing other factors of production. Initial investment for other factors of production such as farrowing, nursery and finishing facilities may cost more than $1 million (Hurt, Boehlje, and Hale, 1995). Most contract producers are required to purchase one or more of these facilities in order to be eligible for a production contract. In contrast, independent and cooperative producers are responsible for all inputs involved in the

production hogs; but are under no obligation to purchase new state-of-the-art facilities. Thus, it is hypothesized that higher debt producers are more likely to be independent or cooperative than contract producers.

VALFAMAS = High Level of Farm Assets ≥ $1.5 Million

VALFAMAS is a dummy variable that indicates the value of the operator's total farm assets is greater than or equal to $1.5 million. Each producer was asked the total value of his or her farm assets, including land value. For contract eligibility, there are two essential criteria that many contractors require of potential contractees. The first is the ownership of state-of-the-art facilities or renovation of old facilities. The second is the ownership or rental of adequate arable land for manure application. These two resources account for a large proportion of the total farm assets. Based on these criteria, it is hypothesized that flat-fee or incentive based contracts will likely have greater total farm assets than independent or cooperative producers.

HIINCOME = Producer's Net Household Income ≥ $100,000

HIINCOME is measured as a discrete variable. To measure income, each producer was asked to indicate his or her total net household income for the year 1999. For this study, the influence of HIINCOME on the choice of business arrangement is indeterminate. However, it will be used as an exploratory variable in this study.

- Producer Attitudes

AUERIMP = Autonomy Is Very Important

AUERIMP is measured as a dummy variable. Some producers have opposed contract farming due to the amount of control lost in their operations. The ability to make one's own production and marketing decisions is of great importance to some producers. A producer's level of autonomy is related to his or her choice of business arrangement. Independent farming is considered to involve the highest level of autonomy, followed by cooperative farming, and

contractual arrangements, respectively. The autonomy of producers was measured by determining each producer's preference for making production and marketing decisions. Based on this information, it is hypothesized that producers who feel that autonomy is very important will more likely be independent and secondly cooperative producers (Gillespie and Eidman, 1998).

AUNOTIMP =Autonomy Is Not Very Important

AUNOTIMP is measured as a dummy variable. Hog producers were asked, "how important is it to you for you to have complete control over all production, marketing, and management decisions in your hog operation?" The possible responses were "not important", and "not very important". Consistent with AUERIMP, it is hypothesized that autonomy will not be as important to persons under flat-fee or incentive based contracts as it is to persons involved in independent or cooperative operations.

BIOSECUR= Rating of Operation Bio-security

BIOSECUR is measured as a continuous variable. Producers were asked to rate their bio-security system on a scale of 0 to 10, with 10 being the highest level of bio-security and 0 being the lowest. Biosecurity is a level of protection producers have on the farm to prevent diseases from destroying their herd. Some biosecurity strategies are shower-in, shower-out, air-tight rooms, limited access, etc. With a higher rating indicating greater agency costs and a lower rating indicating a lower agency costs of bio-security, it is hypothesized that producers who rate their bio-security higher will more likely be involved in contracts or cooperatives, and producers who rate their bio-security lower will more likely be independent producers. In reference to contract producers, it is hypothesized that producers operating under incentive contracts will have higher bio-security than flat-flee contract producers. There are two rationales guiding these hypotheses. The first rationale is based on the fact that many contract producers are

required to upgrade or purchase new facilities that are highly task programmable. Higher task programmable facilities give rise to uniformity in the quality and quantity of products produced. However, if bio-security is low, the quality and quantity of hogs produced by higher task programmable facilities stand the chance of being destroyed by disease outbreaks. Therefore, high bio-security is a necessary condition for higher task programmable facilities.

MKTPRICE = Frequency of Checking Hog Prices

MKTPRICE is measured as a continuous variable. Producers were asked how regularly they consulted sources for information on market hog prices and desired leanness/back-fat values. The possible responses were "never", "once quarterly", "once monthly", "once every two weeks", "once a week", or "two or more times a week". The cost of obtaining price information is a transaction cost incurred by a producer who markets his or her own hogs. Hog prices can vary greatly from month to month. For instance, the U.S. average price for hogs from mid 1996 to mid 1997 ranged between $50 and $60 per cwt, but dropped as low as $13 in November, 1998. To measure MKTPRICE, producers were asked the number of times per month they collect information on market prices for hogs and desired leanness/back-fat values. It is hypothesized that producers who consult these sources frequently will more likely be independent or cooperative producers than contract producers. Contract producers are less likely to consult various sources for price information because the base price, bonus incentive and quality of animals desired are specified in their contracts.

RISKAVER = Producer Is Risk Averse

RISKAVER is measured as a discrete variable. Because different business arrangements involve different associated risks, producers are likely to choose among business arrangements according to their risk attitudes. To measure producers' risk attitudes, a hypothetical question used by Fausti and Gillespie was phased as follows:

"Suppose you have $100,000 to invest. Suppose there are five different options in which you might invest your money. These options are illustrated below in the chart and table. With the first option, you are certain to receive $10,000, or a 10% return. Thus, at the end of the year you will have $100,000 + $10,000 = $110,000. Money in a savings account would be an example of such an investment. However, you can increase your average net return by increasing the riskiness of your investment. In Option 2, for instance, you have a 1/3 chance of receiving an average net return of $10,600. However, with this investment, you increase the riskiness since you would also have a 1/3 chance of receiving $8,170 and a 1/3 chance of receiving $13,030, other options involved larger variances in income. Please examine the five options and answer the following question. Of these investments, which investment would you choose?" A bar graph and table showing the returns for each choice were provided on the survey form.

The investments were developed so that the selection of one would indicate the decision maker fell into one of five intervals of the coefficient of absolute risk aversion. These five intervals were chosen according to a study conducted by Babcock, Choi and Feinerman (1993). Based on the answer chosen, a producer could be classified as highly risk averse, very risk averse, moderately risk averse, moderately risk prone or very risk prone. This question was used by Fausti and Gillespie (2001), in a comparative analysis of risk preference elicitation procedures using mail survey. Given its applicability and understandability for most producers, this question was added to the survey. It is hypothesized that risk averse producers will more likely accept risk-reducing contracts, while moderately risk prone or highly risk prone producers will more likely be involved in independent or cooperative production. One purpose of many contracts is to reduce both production and price risk. Most contracts offer payment floors and a constant flow of animals throughout the operations that help stabilize producer income.

Producers who are not sheltered from production and/or price risk are subject to incur substantial risk.

LENDINST = Producer's Relationship with Lending Institutions

LENDINST is measured as a dummy variable. Producers were asked to rate how important were their social relationships with lenders. The possible answers to the question were "not important at all", "not very important", "somewhat important" and "very important". Along with the competitive nature of the hog industry comes the need for better production facilities and resources for expansion. To purchase these facilities, producers must have the financial resources required, and may be required to obtain a loan from a financial institution. In addition to the basic criteria required by lenders to provide loans, positive relationships with bankers or loan officers are often considered advantageous. Personal knowledge of an applicant can make a difference in the loan approval process in cases where the applicant is "marginal." To measure the value of social relationships, surveyed producers were asked to rate the importance of their relationships with lending institutions. It is hypothesized that relationships between loan officers and independent and cooperative producers are more important than they are between loan officers and contract producers. The justification for this hypothesis is twofold. First, independent and cooperative producers are more likely to be dependent on lending institutions for loans to purchase animals, feed, and other inputs that are supplied by many contractors for contract producers. Secondly, contract producers may use their contractual agreements as leverage or payment security. Because independent and cooperative producers cannot guarantee a steady flow of animals circulating through their hog operations, social capital may become more important and play a more significant role in the loan officer's decision to grant the loan.

FEEDMERC = Producer's Relationship with Feed Merchants

FEEDMERC is measured as a dummy variable. Producers were asked to rate how important were their social relationships with feed merchants. The possible answers to the question were "not important at all", "not very important", "somewhat important" and "very important". Most independent and cooperative producers rely on feed merchants to supply feed for their hog operations. Most contract producers are not faced with the problem of providing feed for their operations, given that most contractual agreements include feed as one of the inputs supplied by contractors. Thus, development of social capital between the two parties is likely to be less important. Therefore, it is hypothesized that producers who rate social relationships with feed merchants higher are more likely to produce under an independent or cooperative arrangement producers than a contract.

NEIGFARM = Producer's Relationship with Neighboring Farmers

NEIGFARM is measured as a dummy variable. Producers were asked to rate the importance of their social relationships with neighboring farmers. The possible answers to the question were "not important at all", "not very important", "somewhat important" and "very important". Producers have historically shared production and marketing information to help aid new producers and others who were unfamiliar with procedures used for operating new technologies. This information held substantial economic value, as producers could use it to increase productivity and, thus, profit. It is hypothesized that there is less need for information exchange among contract producers than independent or cooperative producers. Production contracts involve a relationship between the contractor and contractee, where the production and marketing decisions are shared. In some instances, the contractor determines the technologies to be used, the type of feed to use, when to market the hogs and where they are to be sold. The independent producer holds all decision making power, but may benefit economically from

information from other producers. Hence, it is hypothesized that social capital with neighboring farmers is likely to be more important to independent and cooperative producers than contract producers.

- Producer Characteristics

AGE = Age of the Producer

AGE is measured as a continuous variable. The age of producers was obtained by simply asking them their present age. The age of a producer is likely related to his/her willingness to accept a contract. It is expected that young or beginning producers are more apt to accept contracts to help establish a steady cash flow and to enhance chances for loan eligibility. Contracts are likely more appealing to young, beginning producers because less equity capital is needed to begin producing and most production inputs with the exception of buildings, land, labor and utility are supplied by the contractor. However, the opposite is true for experienced producers who are nearing retirement. Older producers are less likely to be concerned with expanding production and are likely to have developed and adjusted their own production and management practices. Boehlje (1992) identifies this point as the third stage in the family life cycle where producers exit and intergenerational transfer of property takes place. Thus, the likelihood of their producing under a contract is expected to be lower. It is hypothesized that new and younger producers will more likely be involved in production contracts, while older producers will more likely be involved in independent and cooperative operations.

BACHELO = Producer Finished a Bachelor's Degree

BACHELO is measured as a discrete variable. The higher the level of education a producer has, the greater the probability that he/she will understand and incorporate the necessary skills to efficiently manage a hog operation. It is hypothesized that producers with Bachelors degrees are more likely to be independent or cooperative producers than contract

producers. The rationale guiding this hypothesis is based on the greater responsibilities held by independent and cooperative producers as compared to those held by contract producers. Independent and cooperative producers are more likely to make their own production and marketing decisions, which require certain amounts of financial, marketing, farm, and managerial knowledge. Many studies have used education as an indicator for management capabilities (e.g., Cardona 1999, Caffey and Kazmierczak, 1997). In contrast, most contract producers do not make all of their production and marketing decisions; many are made by the contractor. Thus, education is less likely to be of importance.

COMPHS = Producer Completed High School

COMPHS is measured as a dummy variable. As discussed in BACHELO, the higher the level of education a producer has, the greater the probability that he/she will understand and incorporate the necessary skills to efficiently manage a hog operation. Thus, it is hypothesized that producers who completed high school are more likely to be independent or cooperative producers.

3.13.2 Exogenous Variables Used in the Binomial Logit Analysis

MOPUNDCO = Months the Producer Has Raised Hogs Under Contract

MOPUNDCO is measured as a continuous variable. Producers were asked to indicate the number of months they have produced hogs under contract. The influence of MOPUNDCO on the choice of production contracts is indeterminate. The variable is included for exploratory purposes.

CONTWNFA = Contracts with Neighboring Farmers

CONTWNFA is measured as a dummy variable. Producers surveyed were asked if their present contract was with a neighboring farmer. Contracts with neighboring farmers are often short-term agreements. This type of contract exists in situations where one neighbor has an

overflow of hogs for which he or she does not have space to complete the grow-out; a contract is offered to a neighboring farmer to raise them. In these situations, the owner of the hogs is likely to pay the contractee for the space that the animals occupy plus feed costs and any other costs associated with the grow-out. Such "farmer-to-farmer" contracts do not normally include enough producers to involve tournaments and may not include incentive payments to encourage efficiency. Thus, it is hypothesized that contracts with neighboring farmers will be more strongly associated with flat-fee contract producers than incentive contract producers.

NEWREFAC = Purchase New Facilities or Renovate Existing Facilities

NEWREFAC is measured as a dummy variable. Producers surveyed were asked if new facilities or the renovation of old facilities was a requirement for their contract. Producers were to answer "yes" or "no" to this question. The influence of new facilities or renovated facilities is indeterminate. Thus, this variable is included for exploratory purposes.

NUACRES = Number of Total Farm Acres

NUACRES is measured as a continuous variable. Each producer was asked, "Approximately how many acres of land were used to support your hog operation"? An important requirement for raising hogs commercially is land. The Environmental Protection Agency (EPA) requires that all commercial hog producers have sufficient land for manure management (Spiekerman, 1998). In addition to the EPA requirement, most contract producers are also required by the contractor to utilize a certain number of acres in their production process. For instance, Murphy Farms requires its applicants to own or lease a minimum of 320 acres for 3,300 pigs. It is indeterminate the influence that the number of acres will have on the choice among contracts.

EXRAIHOG = Producers with Experience Raising Hogs

EXRAIHOG is analyzed as a discrete variable. A survey question asked producers to indicate whether or not they had experience raising hogs before signing their first production contract. Growers who are producing hogs under incentive-based contracts are hypothesized to be people who will more likely have prior experience raising hogs than flat-fee contract producers. The rationale for this hypothesis stems from the nature of incentive contracts. Incentive contracts are competitive and their bonuses are based on production efficiency. In any given situation, producers try to maximize profits by utilizing their farming expertise or knowledge of animal husbandry. Producers who are not able to employ these types of skills are not likely to be as competitive; thus they are hypothesized to be less willing to accept an incentive-based contract.

CHAPTER 4

RESULTS AND DISCUSSION

The following section presents comparisons of descriptive statistics on survey data for each business arrangement, in addition to discussing the model results.

4.1 Descriptive Analysis of Survey and Data

During the summer and fall of 2000, two mailings of the U.S. Hog Production survey (Appendix D) were sent. Four thousand nine hundred and eighty six surveys were mailed in the first mailing. A postcard was sent after the first survey mailing. A total of 1,031 surveys were returned completed. Excluding producers who indicated they were no longer in business, the return rate was 21 percent. To explain producers' choices of business arrangements, information was collected on six basic categories: farm characteristics, financial characteristics, producer attributes, social capital, producer and locational characteristics, and contract characteristics.

Of the 1,031 complete surveys returned, 684 were from independent producers, while 66, 81, 118, 21 and 61 were from cooperative, flat-fee, incentive payment/tournament, vertical integration and other producers, respectively. For the purpose of this study, vertical integration and other types of business arrangements are not included in the multinomial logit or binomial logit model. Reasons for their exclusion are the lack of sufficient observations and the lack of clearly defined business arrangements.

In addition, for each variable, a statistical analysis was conducted using a t-test for two population means (where the variances are unknown and unequal) to determine if the means for all business arrangement combinations (independent versus cooperative, cooperative versus flat-fee, flat-fee versus incentive, cooperative versus incentive, independent versus flat-fee, or independent versus incentive producers) were equal. Using a two-tailed t-distribution, the

hypothesis that the means for each business arrangement combination are equal was tested at the 10%, 5% and 1% levels (see Appendix A).

4.2 Farm Characteristics

Producers were asked to indicate the structure of their farm businesses. From Table 4.1, the percentage of producers who were involved in sole proprietorships was greater for flat-fee contract producers than it was for independent, cooperative or incentive payment contract producers. The mean values were significantly different for independent and cooperative producers, cooperative and flat-fee contract producers, and cooperative and incentive payment contract producers. The percentage of producers who were a part of partnerships was greater among cooperative producers than it was among independent, flat-fee contract or incentive payment contract producers. Producers who were involved with partnerships were significantly different for independent and cooperative producers, cooperative and flat-fee contract producers, and cooperative and incentive payment contract producers. Incentive payment contract producers had a larger percentage of family corporations than did producers under other business arrangements. Independent and cooperative producers as well as cooperative and incentive payment contract producers had mean values that were significantly different. The percentage of cooperative producers involved in non-family corporations exceeded that of independent, flat-fee contract or incentive payment contract producers, but only independent and cooperative producers' mean values were significantly different. As expected, producers who operated under cooperative agreements were highest, percentage wise, among cooperative producers than among independent, flat-fee contract, or incentive payment contract producers. Statistically, only independent and cooperative producers, cooperative and flat-fee contract producers, and

Table 4.1: Descriptive Statistics of Exogenous Variables for the Multinomial Logit Model.

Variable	Independent Production	Cooperative Member	Flat-fee Contract	Incentive Payment Contract
Farm / Locational Characteristic				
			Number	
Business Structure				
- Sole Proprietorship	367.00	17.00	46.00	56.00
- Partnership	127.00	26.00	16.00	22.00
- Family Corporation	162.00	9.00	15.00	31.00
- Non-Family	17.00	7.00	4.00	5.00
- Cooperative	1.00	9.00	0.00	2.00
			Percentage	
Business Structure				
- Sole Proprietorship	54 .00	25.00	56.00	47.00
- Partnership	19.00	38.00	20.00	19.00
- Family Corporation	24.00	13.00	18.00	26.00
- Non-Family	3.00	10.00	5.00	4.00
- Cooperative	0.00	13.00	0.00	2.00
Average No. of 250 Pound Hogs Produced per Farm	2,523.00	7,795.00	3,900.00	10,927.00
Percentage of Producers Who Have a Finishing Operation	0.37	0.51	0.84	0.81
Average No. of Breeding Sows Used in Operation, per Farm	263.00	759.00	49.00	297.00
Percentage of Producers Who Have a Breeding Sow Operation	0.06	0.04	0.04	0.03
Average No. of 50 Pound Feeder Pigs Produced per Farm	357.00	1,323.00	2,179.00	2,184.00
Percentage of Producers Who Have a Feeder Pig Operation	0.18	0.32	0.27	0.21
Percentage of Producers Who Have a Farrow to Finishing Operation	0.58	0.37	0.01	0.03
Percentage of Producers Who Have a Farrow to Wean Operation	0.15	0.25	0.09	0.16
Number of Enterprises	3.30	2.80	2.60	2.90
Average No. of Years Raising Hogs	26.80	20.80	18.50	19.20
Average No. of Acres per Farm	623.00	803.00	497.00	479.00
Percentage of Producers Who Raised Corn on the Farm	0.87	0.71	0.80	0.65
Percentage of Producers Who Raised Soybean on the Farm	0.81	0.69	0.75	0.65
Average No. of Technologies and Management Practices Adopted	2.57	3.96	1.98	2.37

(Table Continued)

Variable	Independent Production	Cooperative Member	Flat-fee Contract	Incentive Payment Contract
Farm / Locational Characteristic				
Percentage of Flat-fee Contracts Used in the County	0.40	0.49	0.68	0.35
Percentage of Incentive Contracts in the County	0.37	0.60	0.50	0.81
Percentage of Farms Located in the Southern U.S.	0.02	0.01	0.13	0.31
No. of Times Hogs Sold per Year	32.00	48.00	19.00	12.00
No. of Hours Worked Off-Farm Weekly	26.00	22.00	33.00	30.00
No. of Full-Time Workers	1.12	3.40	0.79	1.69
No. of Part-Time Workers	0.78	1.17	0.45	0.70

(Table Continued)

Variable	Independent Production	Cooperative Member	Flat-fee Contract	Incentive Payment Contract
Farm Financial Characteristics				
		Number		
Debt-to-Asset Ratio				
- No Debt	179	7	8	12
- 1 to 20%	136	11	16	24
- 20 to 40%	175	15	19	23
- 40 to 60%	107	17	20	30
- 61% or Greater	35	4	15	14
		Percentage		
Debt-to-Asset Ratio				
- No Debt	28.3	12.9	10.2	11.6
- 1 to 20%	21.5	20.3	20.5	23.3
- 20 to 40%	27.6	27.7	24.3	22.3
- 40 to 60%	16.9	31.4	25.6	29.1
- 61% or Greater	5.5	7.4	19.2	13.6
		Number		
Total Value of Farm Assets				
- $0 - $499,999	166	11	26	32
- $500,000 to $999,999	201	12	23	35
- $1,000,000 to $1,499,999	114	6	10	18
- $1,500,000 to $1,999,999	49	8	8	12
- $2,000,000 to $2,499,999	43	3	5	6
- > $2,500,000	78	21	6	12
		Percentage		
Total Value of Farm Assets				
- $0 - $499,999	25.5	18.0	33.3	31.0
- $500,000 to $999,999	30.8	19.6	29.4	33.9
- $1,000,000 to $1,499,999	17.5	9.8	12.8	17.4
- $1,500,000 to $1,999,999	7.5	13.1	10.2	11.6
- $2,000,000 to $2,499,999	6.6	4.9	6.4	5.8
- > $2,500,000	11.9	34.4	7.6	11.6
		Number		
Net Household Income				
- $19,999 or Less	81	2	6	8
- $20,000 to 39,999	183	14	30	24
- $40,000 to 59,999	161	19	22	22
- $60,000 to 79,999	69	12	8	19
- $80,000 to 99,999	43	4	4	15
- $100,000 to 199,999	46	4	4	17
- $200,000 or More	24	5	1	2
		Percentage		
Net Household Income				
- $19,999 or Less	13.3	3.3	8.0	7.4
- $20,000 to 39,999	30.1	23.3	40.0	22.4
- $40,000 to 59,999	26.2	31.6	29.3	20.5
- $60,000 to 79,999	11.3	20.0	10.6	17.7
- $80,000 to 99,999	7.0	6.6	5.3	14.0
- $100,000 to 199,999	7.5	6.6	5.3	15.8
- $200,000 or More	3.9	8.3	1.3	1.8

(Table Continued)

Variable	Independent Production	Cooperative Member	Flat-fee Contract	Incentive Payment Contract
Producer Attitudes				
		Number		
The Importance of Having Complete Control over All Production, Marketing and Management Decisions in Your Hog Operation.				
- Not Important at All	16	5	20	25
- Not Very Important	169	8	13	17
- Somewhat Important	466	30	33	44
- Very Important	6	22	13	30
		Percentage		
The Importance of Having Complete Control over All Production, Marketing and Management Decisions in Your Hog Operation.				
- Not Important at All	2.4	7.7	25.3	21.5
- Not Very Important	25.7	12.3	16.4	14.6
- Somewhat Important	70.9	46.1	41.7	37.9
- Very Important	0.9	33.8	16.4	25.8
Average Rate of Biosecurity per Farm	5.90	7.03	6.69	6.96
		Number		
Frequency of Checking Market Hog Prices				
- Never	36	4	35	31
- Once Quarterly	19	3	3	3
- Once Monthly	24	3	3	10
- Once Every Two Weeks	46	5	4	8
- Once a Week	118	13	11	20
- Two or More Times a Week	422	39	23	40
		Percentage		
Frequency of Checking Market Hog Prices				
- Never	5.5	6.0	44.8	27.4
- Once Quarterly	2.8	4.5	3.8	2.9
- Once Monthly	3.5	4.5	3.8	9.7
- Once Every Two Weeks	7.0	6.0	5.1	7.8
- Once a Week	17.7	18.1	14.1	17.7
- Two or More Times a Week	63.4	58.2	29.1	35.3
		Number		
Frequency of Checking Lean and Back-Fat Value				
- Never	157	8	47	59
- Once Quarterly	133	23	15	23
- Once Monthly	117	10	8	15
- Once Every Two Week	77	5	3	3
- Once a Week	90	12	3	6
- Two or More Times a Week	74	7	3	6
		Percentage		
Frequency of Checking Lean and Back-Fat Value				
- Never	24.2	12.3	59.5	52.6
- Once Quarterly	20.5	35.3	18.9	20.5
- Once Monthly	18.0	15.3	10.1	13.4
- Once Every Two Week	11.8	7.6	3.8	2.6
- Once a Week	13.8	18.4	3.8	5.3
- Two or More Times a Week	11.4	10.7	3.8	5.3
Labor Quality per Farm	5.9	7.2	6.3	6.5
Producers Who Were Risk Averse in Invest.	0.79	0.83	0.73	0.77

(Table Continued)

Variable	Independent Production	Cooperative Member	Flat-fee Contract	Incentive Payment Contract
Social Capital				
		Number		
Importance of Relations with Lenders				
- Not Important at All	29	0	3	2
- Not Very Important	43	4	6	4
- Somewhat Important	205	13	23	26
- Very Important	389	49	47	85
		Percentage		
Importance of Relations with Lenders				
- Not Important at All	4.3	0	3.7	1.8
- Not Very Important	6.4	6.0	7.5	3.1
- Somewhat Important	30.7	19.6	29.1	22.4
- Very Important	58.4	74.2	59.4	72.3
		Number		
Importance of Relations with Feed Merchants				
- Not Important at All	23	0	6	15
- Not Very Important	58	4	12	9
- Somewhat Important	327	35	42	53
- Very Important	262	27	18	39
		Percentage		
Importance of Relations with Feed Merchants				
- Not Important at All	3.4	0	7.6	12.5
- Not Very Important	8.6	6.0	15.3	7.1
- Somewhat Important	48.8	53.0	53.8	46.2
- Very Important	39.1	40.9	23.0	34.0
		Number		
Importance of Relations with Veterinarians				
- Not Important at All	11	0	6	7
- Not Very Important	42	7	11	10
- Somewhat Important	257	25	35	42
- Very Important	355	34	27	58
		Percentage		
Importance of Relations with Veterinarians				
- Not Important at All	1.6	0	7.5	6.0
- Not Very Important	6.3	10.6	13.9	8.0
- Somewhat Important	38.6	37.8	44.3	36.0
- Very Important	53.3	51.5	34.1	50.0
		Number		
Importance of Relations with Neighbors that are Non-Farmers				
- Not Important at All	21	2	2	0
- Not Very Important	55	4	1	7
- Somewhat Important	257	27	40	37
- Very Important	334	33	36	70
		Percentage		
Importance of Relations with Neighbors that are Non-Farmers				
- Not Important at All	3.1	3.0	2.5	2.8
- Not Very Important	8.2	6.0	1.2	6.0
- Somewhat Important	38.5	40.9	50.6	32.5
- Very Important	50.0	50.0	45.5	60.3
		Number		
Importance of Relations with Packers and/or Slaughter Houses				
- Not Important at All	29	0	15	27
- Not Very Important	72	7	17	17
- Somewhat Important	269	24	27	37
- Very Important	291	35	20	35
		Percentage		
Importance of Relations with Packers and/or Slaughter Houses				
- Not Important at All	4.3	0	18.9	23.0
- Not Very Important	10.8	10.6	21.5	14.0
- Somewhat Important	40.6	36.3	34.1	32.0
- Very Important	44.0	53.0	25.3	31.0

(Table Continued)

Variable	Independent Production	Cooperative Member	Flat-fee Contract	Incentive Payment Contract
Social Capital				
		Number		
Importance of Relations with Neighboring Farmers				
- Not Important at All	20	2	1	1
- Not Very Important	18	2	1	2
- Somewhat Important	234	28	27	34
- Very Important	396	34	50	80
		Percentage		
Importance of Relations with Neighboring Farmers				
- Not Important at All	2.9	3.0	1.2	1.0
- Not Very Important	2.6	3.0	1.2	1.8
- Somewhat Important	35.0	42.4	34.1	29.0
- Very Important	59.2	51.5	63.2	68.0

(Table Continued)

Variable	Independent Production	Cooperative Member	Flat-fee Contract	Incentive Payment Contract
Producer Characteristics				
Average Age	49	45	44	47
			---Number---	
Years of Educational Training				
- Less than High School	29	2	4	9
- Completed High School	226	17	21	44
- Some College or Tech School	245	20	37	40
- Bachelor's Degree	147	21	17	21
- Master's Degree	22	3	2	3
- Doctoral Degree	11	1	0	1
			---Percentage---	
Years of Educational Training				
- Less than High School	4.2	3.1	4.9	7.6
- Completed High School	33.2	26.5	25.9	37.2
- Some College or Tech School	36.0	31.2	45.6	33.9
- Bachelor's Degree	21.6	32.8	20.9	17.8
- Master's Degree	3.2	4.6	2.4	2.5
- Doctoral Degree	1.6	1.5	0	0.8

cooperative and flat-fee contract producers' mean values were significantly different from each other.

The average number of finished hogs sold per farm was higher for incentive payment contract producers than for flat-fee contract or independent producers. Cooperative and flat-fee contract as well as cooperative and incentive payment contract were the only combinations that were not significantly different. The percentage of producers who had a finishing operation was higher for contract producers than it was for cooperative or independent producers. All business arrangement combinations were significantly different except flat-fee contract and incentive payment contract.

On average, cooperative producers had more breeding sows on their farms than did incentive payment contract, independent, or flat-fee contract producers. The number of breeding sows was significantly different for all business arrangement combinations except for independent and incentive payment contract. Six percent of the independent producers ran breeding sow operations, while 4%, 4% and 3% of the cooperative producers, flat-fee contract producers, and incentive payment contract producers, respectively, ran breeding sow operations. However, there were no significant differences among the business arrangements as to whether a breeding sow operation was run.

The average number of feeder pigs sold by contract producers was higher than it was for independent producers. A larger percentage of cooperative producers (32%) raised feeder pigs than did flat-fee (27%), incentive payment producers (21%), or independent producers (18%). Producers who sold feeder pigs were significantly different only for independent and cooperative, and independent and flat-fee contract.

The percentage of producers who had a farrow to finish operation was higher for independent producers than it was for cooperative, incentive payment contract or flat-fee

contract producers. All of the business arrangement combinations were significantly different except for flat-fee contract and incentive payment contract. The percentage of producers who had a farrow to wean operation was higher for cooperative producers than it was for independent or flat-fee contract producers. Cooperative and incentive payment contract as well as independent and incentive payment contract were the only business arrangement combinations that were not significantly different.

Independent producers had more other farm enterprises than did producers under the other business arrangements. The only business arrangement combinations that were significantly different were independent and cooperative, independent and flat-fee contract, and independent and incentive payment contract.

On average, independent producers had been raising hogs longer than producers under any other business arrangement. The average number of years independent producers had been raising hogs was 27. On the other hand, cooperative, flat-fee and incentive payment contract producers had been raising hogs for averages of 21, 18, and 19 years, respectively. The business arrangement combinations that were significantly different were independent and cooperative, independent and flat-fee contract, and independent and incentive payment contract.

Cooperative producers, on average, used more acres for their hog operations than did producers under contract. The average number of acres used by cooperative producers was 803. Independent, flat-fee, and incentive payment contract producers used 623, 497, and 479 acres, respectively. All means were significantly different except for independent and cooperative, and flat-fee and incentive payment contract.

More independent producers raised corn than did cooperative producers or incentive payment contract producers. Eighty-seven percent of the independent producers surveyed raised corn, while 71%, 80% and 65% of the cooperative, flat-fee, and incentive payment contract

producers, respectively, raised corn. Given these percentages, only independent and cooperative, flat-fee and incentive payment contract, and independent and incentive payment contract were significantly different.

Similar to corn production, more independent producers were involved in soybean production than incentive payment contract or cooperative producers. Eighty-one percent of the independent producers surveyed raised soybeans, while 69%, 75%, and 65% of the cooperative, flat-fee contract, and incentive payment contract producers, respectively, raised soybeans. Cooperative producers adopted more technologies and management practices (TMP) than did other producers. TMP include four breeding practices: weekly farrowing, terminal cross-breeding programs, intensive breeding, and artificial insemination; and five production management practices: all-in all-out production, the use of high-density fat-added diets, split-sex feeding, porcine somatotropin, and the use of computer programs for hog farm management. Flat-fee contract producers adopted fewer TMPs than did the other producers. Only the number of technologies and management practices adopted by independent and incentive payment contract producers were not significantly different.

Sixty-eight percent of the flat-fee contract producers surveyed indicated that there were other flat-fee contract producers in their counties, while 49%, 40% and 35% of the cooperative, independent, and incentive payment contract producers, respectively, indicated that there were flat-fee contract producers present in their counties. There were no significant differences in independent and cooperative, as well as the independent and incentive payment contract mean values. Eighty-one percent of the incentive payment contract producers indicated that there were other incentive payment contract producers present in their counties, while 60%, 50%, and 37% of the cooperative, flat-fee and independent producers, respectively, revealed that there were

incentive payment contract producers residing in the same counties. All business arrangement combinations were significantly different except cooperative and flat-fee contract.

Thirty-one percent of incentive payment contract respondents were from one of the Southern states of the U.S. Only 13%, 1% and 2% of the flat-fee contract, cooperative, and independent producers who responded to the survey had hog farms located in the South. All combinations were statistically different except independent and cooperative business arrangements.

The average number of times per year cooperative and independent producers sold hogs was 48 and 32, respectively. Flat-fee contract and incentive payment contract producers grew hogs out for market sale an average of 19 and 12 times per year, respectively. There were significant differences in all business arrangement combinations except for independent and cooperative, and flat-fee contract and incentive payment contract.

Flat-fee contract producers worked more hours, on average, off-farm than did producers under any other business arrangement. All business arrangement combinations were significantly different except independent and cooperative, and flat-fee contract and incentive payment contract.

The average number of full-time workers employed on any given hog farm was higher for cooperative hog farms than for other hog farms. Cooperative hog farms employed twice as many full-time workers as incentive payment contract producers, and three and four times as many as flat-fee contract and independent producers. Only independent and flat-fee contract, and independent and incentive payment contract were not significantly different. The average number of part-time workers employed also was higher among cooperative producers. All business arrangement combinations were significantly different except for independent and cooperative, and independent and incentive payment contract. Following cooperative producers,

independent, incentive payment contract and flat-fee contract was the order in which the number of part-time workers per farm descended.

4.3 Financial Characteristics

Independent producers had lower debt to asset ratios than did cooperative, flat-fee contract or incentive payment contract producers. There were no significant differences between the mean values for cooperative and flat-fee, flat-fee and incentive payment contract, or cooperative and incentive payment contract.

The value of total farm assets, including land, was higher for cooperative producers than for other business arrangements. Only the mean values for independent and cooperative, cooperative and flat-fee, and cooperative and incentive payment contract were significantly different.

The percentage of producers who had a net household income greater than or equal to $100,000 for 1999 was higher for incentive payment contracts than for any other business arrangement, but not significantly greater than cooperative producers. Following incentive payment producers, cooperative producers, independent, and flat-fee producers had progressively lower total net household incomes. All business arrangement combinations were significantly different except cooperative and incentive payment contract.

4.4 Producer Attributes

Producers were asked how important it was to have complete control over all production, marketing, and management decisions in their hog operations. A larger percentage of flat-fee and incentive payment contract producers rated autonomy as not important at all than did cooperative and independent producers. All of the business arrangements were significantly different except flat-fee and incentive payment contract. The percentage of contract producers who rated autonomy as not very important exceeded that of independent, while a higher

percentage of cooperative producers rated autonomy as somewhat important than did independent producers. The percentages of producers who rated autonomy as very important were highest among independent producers relative to producers under any other business arrangement. Only flat-fee and incentive payment contract, and cooperative and incentive payment contract were not significantly different.

Using a scale from 0 to 10, with 10 being the highest and 0 being the lowest, producers were asked to rate the bio-security system on their hog farms. Cooperative producers rated their bio-security systems 7, while incentive payment contract, flat-fee contract, and independent producers rated their systems 6.96, 6.69, and 5.90, respectively; independent production had a significantly lower rating than the others.

Sixty-three percent of the independent producers consulted sources of information on market prices for hogs two or more times a week, while 58%, 29%, and 35% of the cooperative, flat-fee and incentive payment contract producers, respectively, did likewise. Cooperative and independent producers checked prices more often than did contract producers. All business arrangement combinations were significantly different except independent and cooperative, and flat-fee and incentive payment contract.

The percentage of producers who checked information on lean value and back-fat once a month or more was greatest among independent producers relative to producers under any other business arrangement. Combinations that were not significantly different include independent and cooperative, and flat-fee contract and incentive payment contract.

The quality of labor available for hog production was rated higher by cooperative producers than by independent, flat-fee contract, or incentive payment producers. On a scale of 0 to 10, where 0 is the lowest quality and 10 is the highest quality, the average rating for cooperative producers was 7.2, while the averages for independent, flat-fee contract and

incentive payment contract producers were 5.9, 6.3, and 6.5, respectively. There were significant differences between all of the business arrangement combinations except flat-fee contract and incentive payment contract, and independent and flat-fee contract.

To measure risk attitudes, producers were asked to choose between five investment opportunities. Each of the five investments had three states of nature and, thus, three potential net returns outcomes (See the Appendix E). Over 72% of the producers under each alternative business arrangement were rated risk averse, but no combinations were significantly different. This result does not indicate that risk is unimportant in the business arrangement selection decision. Larger, less diversified producers generally incur greater risk, providing greater incentive to adopt an alternative business arrangement.

4.5 Social Capital

Social relationships with other people were measured by the producer rating whether the relations were "not important at all", "not very important", "somewhat important", or "very important". Cooperative producers rated relationships with lending institutions as more important than did independent or flat-fee contract producers. Interestingly, incentive payment contract producers rated relationships with lending institutions as more important than did flat-fee contract producers. However, a large percentage of each business arrangement rated relationships with lending institutions as very important and all were significantly different except independent and flat-fee contract, and cooperative and incentive payment contract. The percentages of cooperative, incentive payment contract, flat-fee contract, and independent producers who rated relationships with lending institutions as very important were 74%, 72%, 59%, and 58%, respectively.

Both cooperative and independent producers felt that relationships with feed merchants were more important than did contract producers. There were no significant differences between

independent and cooperative, and flat-fee contract and incentive payment contract. More producers felt that relationships with feed merchants were somewhat important than they did very important, not very important or not important.

Independent, cooperative, and incentive payment contract producers rated relationships with veterinarians of greater importance than did flat-fee contract producers. Contract producers felt that relationships with veterinarians were of less importance than did independent or cooperative producers. The percentage of producers who rated relationships with veterinarians more important was greater for independent producers followed by cooperative, incentive payment, and flat-fee contract producers, though all were not significantly different.

Incentive payment producers rated relationships with non-farmers as more important than did independent producers. Fifty percent of the independent and cooperative producers felt that these relationships were very important, while 46% and 60% of the flat-fee contract and incentive payment contract producers, respectively, felt likewise.

Cooperative and independent producers rated relationships with packers and/or slaughterers more important than did contract producers. Cooperative producers rated relationships with packers as more important than did independent producers. All business arrangement combinations were significantly different except flat-fee and incentive payment contract.

Social relationships with neighboring farmers were rated as important among contract producers, independent and cooperative producers, though the mean values of flat-fee contract and independent were not significantly different. Following incentive payment contract producers in declining order, flat-fee contract, independent and cooperative producers, respectively, felt relationships with neighboring farmers were important, but not all were significantly different.

4.6 Producer Characteristics

Independent producers were older than cooperative and flat-fee contract producers. The average age for independent producers was 48 years old, while the average ages of cooperative, flat-fee contract, and incentive payment contract producers were 45, 44, and 47, respectively. Cooperative and flat-fee contract, cooperative and incentive payment contract, and independent and incentive payment contract were not statistically different.

More incentive payment contract producers completed high school than did flat-fee contract producers. The percentage of producers who had completed some college was highest for flat-fee contract (46%) followed by independent (35%), cooperative (32%) and incentive payment contract (21%). The combinations that were significantly different include cooperative and flat-fee contract, flat-fee and incentive payment contract, and independent and flat-fee contract. A higher percentage of cooperative producers completed a Bachelor's degree than did producers under any other business arrangement, though the difference between cooperative producers and flat-fee producers was not statistically significant.

4.7 Contract Production Characteristics

Of the producers under contract, the average number of months under contract was higher for incentive payment contracts than for flat-fee contracts, and significantly different. The incentive payment contract producer's average number of months under contract was 55 months, while the average for flat-fee contract producers 43 (see Table 4.2).

Thirty-nine percent (32) of the flat-fee contract producers had contracts with neighboring farmers, while only 10% (12) of the incentive payment contract producers did. These mean values were significantly different. Sixty-nine percent (81) of the incentive payment contract producers were required to purchase new or renovate existing facilities. The percentage of

Table 4.2: Descriptive Statistics of Exogenous Variables for the Binomial Logit Model.

Variable	Flat-fee Contract	Incentive Payment Contract
Contract Production Characteristics		
Number of Months Producing Under Contract	43.21	55.49
Percentage of Producers Who Had Contracts with Neighboring Farmers	0.39	0.10
Percentage of Producers Required to Obtain New or Renovate Facilities	0.41	0.68
Percentage of Feed Is Provided by the Contractor	0.88	0.91
Percentage of Animals Are Provided by the Contractor	0.87	0.92
Percentage of Medication Provided by the Contractor	0.87	0.90
Percentage of Producers Who Had Raised Hogs Prior to Accepting a Contract	0.89	0.91
Percentage of Number of Acres Used for Hog Production	497.00	479.00

flat-fee contract producers who were required to do the same was 41% (34). These percentages were significantly different.

The primary inputs supplied by contractors are feed, animals, and medication. Ninety-one percent (107) of the incentive payment contract producers received feed from the contractor, while 88% (72) of the flat-fee contract producers were provided feed. Ninety-two percent (108) and 87% (71) of the incentive payment contract and flat-fee contract producers, respectively, were supplied animals for their production operations. Medication was received by 90% (106) of the incentive payment contract producers and 87% (71) of the flat-fee contract producers, but there was no statistical difference between the two.

Approximately 91% (107) of the incentive payment contract producers had experience raising hogs prior to accepting a contract, while 89% (73) of the flat-fee contract producers did likewise. The average number of acres used for hog production was higher for flat-fee contract producers than for incentive payment contract producers, though the difference was not statistically significant.

4.8 Heteroskedasticity Analysis

Using selected variables expressed in the categories above, both multinomial logit and binomial logit analyses were conducted to determine their influence on a producer's choice of business arrangement. However, there are some potential problems that must be detected and corrected for in the case of their presence before estimating either of the models. When logit models employ cross-sectional data, one of the statistical problems that may arise is heteroskedasticity. Heteroskedasticity implies that the disturbances (error terms) have different variances (Judge et al, 1988). Although multinomial logit models have been widely used in agricultural research, the problem with heteroskedasticity has received less attention. Munizaga et al., (2000) identify two different kinds of heteroskedasticity: between observations and

between options. Heteroskedasticity between observations exists when two separate data sets are used concurrently; for example, one data set from a Stated Preference (SP) experiment and another from a Revealed Preference (RP) experiment. Heteroskedasticity between options exists when ranking the outcomes from SP experiments where respondents have to consider several options and rank them in order of preference. Given the two heteroskedasticity problems, the one that is more applicable to this study is heteroskedasticity between options. There were several questions asked within the survey that required producers to rank their responses. Thus, between options could conceivably be a problem, and not between observations given that only one data set was used. In the study conducted by Munizaga et al., (2000), the MNL, Hierarchical Logit, Single Element Nested Logit, Heteroskdasticity Extreme Value Logit (HEVL) and Multinomial Probit were used to test two heteroskedasticity problems that were artificially incorporated into the data generation process. Of the possible options available to test and correct for heteroskdasticity problems, Greene (2000) and Munizaga et al., (2000) recommended using the HEVL. (HEVL was discussed in more detail in Chapter 3.)

Within the framework of the MNL model, the HEVL was implemented and executed using the Limdep 7.0 software. The results yielded from this analysis indicated that there were no heteroskedasticity problems since the standard errors and associated P-Values, and the predicted outcomes remained unchanged after the test was performed. The correctly predicted outcomes before and after testing for heteroskedasticity were 77.6%. These findings were not surprising given that the exogenous variables used in this particular analysis did not include any responses that were ranked in nature. For purposes of this discussion, suppose that there was a heteroskedasticity problem between observations and not between options. Munizaga et al. postulated that MNL is remarkably robust in the case of heteroskedasticity between observations.

Thus, the HEVL model and Munizaga et al. postulation address both heteroskedasticity problems that are encountered when running MNL models (see Appendix B).

When testing for heteroskedasticity in the binomial logit model, Greene (2000) utilizes a multiplicative heteroskedasticity model. The multiplicative heteroskedasticity framework is a constructive model in that it allows one to test and correct for heteroskedasticity. This heteroskedasticity test for the binomial logit model was conducted and conveniently run using Limdep 7.0 software. The analysis revealed that there was no evidence of heteroskedasticity in the binomial logit model. The standard errors, P-Values and the percentage of correctly predicted outcomes (70.5%) remained the same before and after the heteroskedasticity test (see Appendix B, Table 5.7a & b). The procedure used to execute the multiplicative heteroskedasticity model is discussed in Chapter 3.

4.9 Multicollinearity Analysis

A second problem that one may encounter when using cross-sectional data is multicollinearity. Multicollinearity exists when there are two or more independent variables correlated with one another. Since multicollinearity is a data problem and not a statistical problem, it can be resolved by adding more uncensored data, changing the form of certain correlated variables, or deleting the less important variables that show strong correlations with more important ones. Technical procedures, such as the Pearson Correlation analysis, Variance Inflation Factor, or Condition Index can be used to detect this problem. The Pearson Correlation coefficient was first used to detect multicollinearity. Based on the rule of thumb, if a correlation coefficient is greater than or equal to 0.80, multicollinearity might prove to be a problem (Kennedy, 1998). None of the correlation coefficients for the variables used in either model are greater than or equal to 0.80. The highest coefficient in Table 6.2 (Appendix C) for testing

multicollinearity for variables used in the multinomial logit is 0.48, between total farm diversity, TOTALFD, and corn production, CORN, which suggests that corn production is one of the enterprises that makes up the diversity of the farm. (The first value in the Pearson Correlation tables in Appendix C represents the coefficient estimates, while the second and third number represent the probabilities and observations, respectively.) For the binomial logit, the highest coefficient is 0.24, between new facilities required, NEWREFAC, and MOPUNDCO months under contract, which suggests that the longer a producer has been producing hogs under contract, the more likely he was required to purchase new or renovate existing facilities (Table 6.4, Appendix C).

Since correlation coefficients are not precise indicators of multicollinearity (they may be low, but multicollinearity still may be present), VIF and condition indexes were calculated. The test results are presented in Tables 4.3a) and b) and Tables 4.4a) and b).

Examining the VIF coefficients, all variables in both tables are 1.43 or smaller. Some of the VIF coefficients in Table 4.3a) that are slightly larger than the rest of the variables are autonomy is not important, AUNOTIMP, contract is with a neighboring farmer, NEIGFARM, and debt asset ratio, DARATIO. The same variables had relatively larger correlation coefficients (Table 6.2, Appendix C). Also, in Table 4.4a), the VIF coefficients for the binomial logit model that are slightly larger than the rest of the variables are MOPUNDCO and number of acres on the farm NUMACRES. Judging purely from the size of the VIF coefficients, multicollinearity does not appear to be problem. However, VIF measures are not precise indicators of multicollinearity, as was discussed in Chapter 3.

The final test of multicollinearity is conducted by examining the condition indexes presented in Table 4.3b) and Table 4.4b). For two variables, the condition indexes are greater than 30. Therefore, these two variables may cause multicollinearity. Unfortunately, this test

Table 4.3a. The Results of the Multicollinearity Test: Variance Inflation Factors. Multinomial Logit

Variable	Variance Inflation
INTERCEPT	0
HOG250	1.04842
BREEDSOW	1.09499
TOTALFD	1.26344
DARATIO	1.35445
AUNOTIMP	1.43761
AUVERIMP	1.24916
BIOSECUR	1.18507
AGE	1.18193
COMPHS	1.14110
BACHELO	1.05074
CORN	1.18712
MKTPRICE	1.12722
VALFARAS	1.19748
NEIGFARM	1.39651
RISKAVER	1.10713
FFLATFEE	1.11983
FCONTRWI	1.06022
HINCOME	1.11607
SOUTH	1.26759
LENDINST	1.11618
FEEDMERC	1.34843
TIMEHSYR	1.18974
NHWOFFFA	1.06206

Table 4.3b. The Results of the Multicollinearity Test: Condition Indexes. Multinomial Logit

Number	Eigenvalue	Condition Index
1	15.69144	1.00000
2	1.33335	3.43052
3	1.01152	3.93861
4	0.91677	4.13714
5	0.73992	4.60509
6	0.72222	4.66120
7	0.63683	4.96384
8	0.52201	5.48267
9	0.46525	5.80747
10	0.36967	6.51518
11	0.36433	6.56273
12	0.24717	7.96775
13	0.23505	8.17049
14	0.15350	10.11066
15	0.12187	11.34710
16	0.11470	11.69611
17	0.09943	12.56245
18	0.08609	13.50089
19	0.05374	17.08823
20	0.03978	19.85974
21	0.03158	22.29209
22	0.02546	24.82742
23	0.01593	31.38083
24	0.00239	81.08269

Table 4.4a. The Results of the Multicollinearity Test: Variance Inflation Factors. Binomial Logit

Variable	Variance Inflation
INTERCEPT	0
MOPUNDCO	1.14531
CONTWNFA	1.08668
NEWREFAC	1.01766
NUMACRES	1.10599
EXRAIHOG	1.07257

Table 4.4b. The Results of the Multicollinearity Test: Condition Indexes. Binomial Logit

Number	Eigenvalue	Condition Index
1	3.91073	1.00000
2	0.79501	2.21791
3	0.71842	2.33314
4	0.29048	3.66921
5	0.23635	4.06775
6	0.04903	8.93139

does not allow one to determine which particular variables are causing multicollinearity. Though condition indexes greater than 20 may point to multicollinearity, only condition indexes of 100 or more can cause substantial variance inflation and large potential harm to regression estimates (Belsley, Kuh and Welsch). In both models, the condition indexes are less than 100. This indicates that there are no serious multicollinearity problems for either model.

4.10 Multinomial Logit Analysis

The results section will proceed in the following order: first, the results of the multinomial logit will be discussed; and secondly, the results of the binomial logit will be discussed.

Table 4.5 shows the results of the multinomial logit analysis of business arrangement choices. At the top of the table, the different business arrangement combinations are shown. The results shown are associated with each exogenous variable. The results reported include the coefficient estimates and the associated standard errors (in parenthesis). Marginal effects are also reported. Two asterisks by the coefficient estimate indicate that the variable is significant at the 5 percent level, while one asterisk indicates that the variable is significant at the 10 percent level. The percentage correctly predicted for the multinomial logit analysis was 77.6, and the McFadden's likelihood ratio index (or Pseudo R^2) was 0.2643.

4.10.1 Farm / Locational Characteristics

In the multinomial logit analysis, all of the variables discussed in each category were significant at the 10% or 5% level except producer's age. From Table 4.5, cooperative producers and producers under contract have a higher probability of raising more finisher hogs than do independent producers. Producers who make significantly large capital investments in buildings

Table 4.5: Results of the Multinomial Logit Analysis of Business Arrangement Choice.

Variable	Cooperative vs. Independent	Flat-fee Contract vs. Independent	Incentive Contract vs. Independent	Flat-fee Contract vs. Cooperative	Incentive Contract vs. Cooperative	Flat-fee Contract vs. Incen. Con.
Constant	0.273171	1.432510	2.195337 *	0.784372	1.926771	-1.32389
	(1.14666)	(1.11060)	(1.19374)	(1.80390)	(1.62870)	(1.49277)
Farm/Locational Characteristics						
No. of 250 Pound Hogs Produced	0.000076 **	0.000081 **	0.000092 **	0.000005	0.000015	-0.000010
	(.000020)	(.000023)	(.000020)	(.000018)	(.000013)	(.000014)
Number of Breeding Sows	0.000001	-0.002268 **	-0.000440 **	-0.002259 **	-0.000444 **	-0.001795 **
	(.000034)	(.000751)	(.000180)	(.000755)	(.000181)	(.000759)
Number of other Enterprises on Farm	-0.077506	-0.260791 **	-0.058967	-.2165605 *	0.018646	-.2242453 *
	(.091862)	(.104584)	(.082979)	(.127242)	(.106524)	(.115785)
Corn Produced on the Farm	-0.716955 **	-0.821658 **	-0.736454 **	0.210977	-0.019529	0.219606 *
	(.278575)	(.283807)	(.275020)	(.131210)	(.113166)	(.117702)
Flat-fee Contracts Used in the Co.	-0.013794	1.109618 **	-0.574232 **	1.092989 **	-0.562195 **	1.656162 **
	(.293307)	(.305514)	(.266033)	(.394174)	(.357309)	(.357094)
Incentive Contracts in the Co.	0.882185 **	0.028259	2.227833 **	-.845766 **	1.345251 **	-2.206412 **
	(.295108)	(.297359)	(.305779)	(.091862)	(.392517)	(.386804)
Farm Located in the Southern U.S.	0.058974	0.150382	1.693151 **	.2087404	1.634253 **	-1.261179 *
	(.674094)	(.714558)	(.430471)	(.902693)	(.694865)	(.668546)
No. of Times Hogs Sold per Year	0.001170	-0.000695	-0.000298	-0.001848 **	-0.001485	-0.000338
	(.000848)	(.000505)	(.000487)	(.000945)	(.000928)	(.000590)
No. of Hours Worked off Farm	0.005618	0.011698 *	0.014903 **	-0.007035	0.009385	-0.002443
	(.007506)	(.006922)	(.006578)	(.009186)	(.008847)	(.008050)
Freq. of Checking Market Prices	-1.500616	-0.883093	-2.62640 **	0.582653	-1.12772	1.912145
	(1.23939)	(1.12260)	(.962640)	(1.47973)	(1.37436)	(1.18935)
Farm Financial Characteristics						
Debt-to-Asset Ratio	0.000096	-0.001212 **	-0.001217 **	-0.001311	-0.001313 *	0.000015
	(.000669)	(.000538)	(.000462)	(.000808)	(.000745)	(.000608)
Total Value of Farm Assets	0.000026	0.001626 **	0.000284	-0.001565 *	0.000254	0.001339 *
	(.000556)	(.000673)	(.000502)	(.000821)	(.000679)	(.000749)
Net Household Income ≥ $100,000	0.099078	-0.967470	0.321851	-1.094316	0.225601	-1.332742 **
	(.419063)	(.598787)	(.369594)	(.679275)	(.483895)	(.636729)
Producer Attitudes						
Autonomy Is Not Very Important	0.950459 **	1.755178 **	1.565193 **	0.791276 **	0.611828 **	0.194493
	(.264615)	(.223250)	(.214569)	(.274725)	(.260847)	(.209713)
Autonomy Is Very Important	-0.950381 **	-1.754728 **	-1.561233 **	-0.790883 **	-0.607934 **	-0.197379
	(.264397)	(.223117)	(.214395)	(.274556)	(.260644)	(.209669)
Rating of Biosecurity	0.000083	0.002837 **	0.000035	0.002704 *	-0.000057	0.001951
	(.000711)	(.001419)	(.000618)	(.001539)	(.000873)	(.001226)
Self Assess. of Risk Preference	0.396397	-0.144010	-0.291659	-0.547608	-0.690644 *	0.098299
	(.340701)	(.311865)	(.276080)	(.432350)	(.404355)	(.365386)
Social Capital						
Imp. of Relations with Farmers	0.002527	0.475214 **	0.168021	0.471062 **	0.162947	0.290802 *
	(.008206)	(.174202)	(.159020)	(.174008)	(.159207)	(.159536)
Imp. of Relations with Lenders	0.163143	0.070932	0.376650 **	-0.097169	0.209600	-0.289576 *
	(.164777)	(.176723)	(.170290)	(.223702)	(.218308)	(.264615)
Imp. of Relations with Feed Merch.	-0.165125	-0.546852 **	-0.543779 **	-0..375195 **	-0.372179 **	-0.002670
	(.164692)	(.133070)	(.133082)	(.188174)	(.188187)	(.002164)

(Table Continued)

Variable	Cooperative vs. Independent	Flat-fee Contract vs Independent	Incentive Contract vs Independent	Flat-fee Contract vs. Cooperative	Incentive Contract vs. Cooperative	Flat-fee Contract vs. Incen. Con.
Producer Characteristics						
Age	-0.001428	-0.000829	0.001840	-0.000659	0.003269	-0.002542
	(.000925)	(.001100)	(.002479)	(.001230)	(.002547)	(.002586)
Producer Completed High School	-0.638242	-0.409624	-1.244805 **	0.156464	-0.607999	0.763650
	(.587859)	(.658668)	(.511471)	(.798653)	(.677438)	(.724486)
Producer Holds Bachelor's Degree	0.228868	-0.387197	-0.611277 **	-0.592506	-0.835997 **	0.304908
	(.296363)	(.340116)	(.310721)	(.416749)	(.388279)	(.407182)

** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.
% Correctly Predicted: 77.6; McFadden's likelihood ratio index: 0.2643; Chi-Squared = 440.35**

Table 4.6: Marginal Effects of the Multinomial Logit Analysis of Business Arrangement Choice.

Variable	Independent Production	Cooperative Member	Flat-fee Contract	Incentive Payment Contract
Constant	-0.202117	-0.000483	0.076047	0.126552
	(.206751)	(.143817)	(.116179)	(.084333)
Farm / Locational Characteristics				
No. of 250 Pound Hogs Produced	-0.000016 **	0.000006 **	0.000005 **	0.000004 **
	(.000005)	(.000002)	(.000002)	(.000001)
Number of Breeding Sows	0.000171 **	0.000027	-0.000185 **	-0.000013
	(.000063)	(.000016)	(.000077)	(.000012)
Number of other Enterprises on farm	0.026623 **	-0.004675	-0.020467 *	-0.001479
	(.013344)	(.009237)	(.010587)	(.004965)
Corn Produced on the Farm	0.149671 **	-0.058386 *	-0.056245 *	-0.035039 *
	(.072180)	(.034104)	(.032543)	(.020797)
Flat-fee Contracts Used in the Co.	-0.045036	-0.008630	0.095635 **	-0.041968 *
	(.046371)	(.029475)	(.042991)	(.022233)
Incentive Contracts in the Co.	-0.182350 **	0.072127 **	-0.020263	0.130486 **
	(.054155)	(.036049)	(.026997)	(.048855)
Farm Located in the Southern U.S.	-0.096304	-0.008355	0.001661	0.102998 **
	(.091989)	(.067220)	(.057947)	(.043567)
No. of Times Hogs Sold per Year	-0.000036	0.000127	-0.000068	-0.000023
	(.000095)	(.000091)	(.000048)	(.000030)
No. of Hours Worked Off Farm	-0.001961**	0.000333	-0.000822	-0.000805 *
	(.001015)	(.000748)	(.000616)	(.000470)
Freq. of Checking Market Prices	0.309790 *	-0.122752	-0.041794	-0.145244 *
	(.169037)	(.125748)	(.090190)	(.074295)
Farm Financial Characteristics				
Debt-to-Asset Ratio	0.000131	0.000031	-0.000094 *	-0.000068 **
	(.000086)	(.000068)	(.000055)	(.000036)
Total Value of Farm Assets	-0.000124	-0.000016	0.000132 *	0.000007
	(.000087)	(.000055)	(.000073)	(.000030)
Net Household Income ≥ $100,000	0.040624	0.017673	-0.083214	0.024916
	(.067642)	(.041897)	(.057060)	(.023963)
Producer Attitudes				
Autonomy Is Not Very Important	-0.271013 **	0.066030 *	0.126249 **	0.078733 **
	(.063962)	(.034603)	(.048734)	(.030024)
Autonomy Is Very Important	0.270787 **	-0.066057 *	-0.126236 **	-0.078492 **
	(.063906)	(.034588)	(.048728)	(.029939)
Rating of Biosecurity	-0.000197	-0.000021	0.000234 *	-0.000015
	(.000135)	(.000073)	(.000135)	(.000038)
Risk Averse	-0.009367	0.043778	-0.014317	-0.020093
	(.043793)	(.036398)	(.025661)	(.017966)

(Table Continued)

Variable	Independent Production	Cooperative Member	Flat-fee Contract	Incentive Payment Contract
Social Capital				
Imp. of Relations with Farmers	-0.039890 *	-0.005960	0.038376	0.007474
	(.023400)	(.004660)	(.025142)	(.011389)
Imp. of Relations with Lenders	-0.036392 *	0.012920	0.001915	0.021556 **
	(.020443)	(.013215)	(.013894)	(.005727)
Imp. of Relations with Feed Merch.	0.076241 **	-0.006903	-0.040361 **	-0.028975 **
	(.023521)	(.015034)	(.015464)	(.010584)
Producer Characteristics				
Age	0.000085	-0.000149	-0.000065	0.000129
	(.000184)	(.000102)	(.000091)	(.000157)
Producer Completed High School	0.140164 *	-0.050892	-0.019828	-0.069443 *
	(.083455)	(.058030)	(.053239)	(.037466)
Producer Holds Bachelor's Degree	0.036103	0.031779	-0.030817	-0.037064
	(.045436)	(.031129)	(.029460)	(.022673)

** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.
% Correctly Predicted: 77.6; McFadden's likelihood ratio index: 0.2643; Chi-Squared = 440.35**

and equipment to raise a larger number of finishing hogs are likely to find the provisions of a contract more attractive than smaller producers. Also, the uncertainty associated with marketing and financing the large capital investment is reduced with a contract. Likewise, cooperative producers are able to combine their resources so that the resources owned by one member of the cooperative can be devoted to buying more of his or her production specialty. This, in turn, increases the possibility of cooperative hog producers being able to expand herd size given the availability of resources.

As expected, a large number of breeding sows is associated with a lower probability of being a contract producer relative to an independent or cooperative producer. The managerial abilities required for breeding sows are generally greater than for other types of hog operations. Thus, vertical coordinators are more likely to manage the breeding of sows in house and contract out the less management-intensive finishing stage (Knoeber and Thurman, 1995). From a production contract perspective, the probability is higher that incentive payment contract producers would have a larger number of breeding sows than flat-fee contract producers. Incentive payments provide greater incentive for closer management in this management intensive stage.

Flat-fee contract producers have a lower probability of having other enterprises on their farms relative to independent, cooperative or incentive payment contract producers. It was hypothesized that diversified farms would more likely be managed by independent and cooperative producers than by contract producers. Diversification is a risk management strategy. Thus, as expected, the greater risk associated with nondiversified production provides greater incentive for a risk reducing flat-fee contract. In addition, diversified farms, particularly farms with other animals, pose the threat of disease outbreaks that could potentially destroy the hog

herd. Some contractors do not allow their hog producers to raise other farm animals to avoid this problem.

Raising corn is associated with a greater probability of being an independent producer relative to a cooperative or contract producer. Because independent producers are more likely to be responsible for supplying all of the production inputs, it is expected that they would be more likely to raise corn. Corn is the most important input used in the production of hogs as feed accounts for the largest percentage of total production costs. Independent producers are likely to raise corn to lower the production costs associated with transportation, transaction costs, etc. Cooperative producers are less likely to raise corn for the following reasons. Cooperative farms are often structured such that the members combine their resources and management expertise to produce hogs. Given the nature of certain cooperatives, such as *ValAdCo*, corn and other resources may be supplied by other members of the cooperative. Of the two contracts, flat-fee contract producers are more likely to raise corn than incentive payment contract producers. Flat-fee producers raise more corn, but they are less diversified than incentive payment producers. In some instances where flat-fee producers are contracting with neighboring farmers (particularly in the Midwestern Corn Belt) who have an excess supply of hogs, the growers may be responsible for supplying production inputs, including feed. This would increase the demand for corn by flat-fee contract producers.

In counties where flat-fee contracts are used, there is a lower probability that contracts with incentive payments are present relative to independent, cooperative, or flat-fee contract production. One explanation for this is flat-fee producers were more likely to enter into short-term contracts with neighboring farmers, who were likely independents or cooperatives who had an excess supply of hogs. It is possible that short-term flat-fee contracts are complementary with independent production, especially during periods of favorable prices. There is a greater

probability of other flat-fee contracts being present relative to producers under other business arrangements.

In counties where contracts with incentive payments are used, the probability is higher that more incentive payment contract and cooperative producers are present. Contrary to the reported result, it was hypothesized that cooperative producers were less likely to coexist in counties with contracts with incentive payments. Cooperatives are, in some cases, arising as an alternative to production contracts. Perhaps the greater likelihood of cooperatives existing in counties with more incentive payment contracts is due to the greater awareness of the need for remaining independent producers to compete with the vertically coordinated firms. The remaining independent producers must cooperate to compete. Another possible reason could be that slaughters/packagers in the area require a minimum number of hogs delivered.

Producers in the South have a higher probability of being an incentive payment contract producer relative to an independent or cooperative producer. Southern states such as Arkansas, Mississippi and North Carolina have experienced substantial increases in contract production. This change may be partially due to a lack of anti-corporate farming laws, the need for economic development in rural communities, and the previous introduction and acceptance of broiler contracting in the region.

The greater the frequency of selling hogs, the higher the probability that the producer is a cooperative producer relative to a flat-fee contract producer. By having more control over their production, marketing and management decisions than flat-fee contract producers, cooperative producers may sell hogs as often as they like. This freedom, in turn, increases the number of transactions incurred by cooperative producers, which also increases transaction costs. For some flat-fee contract producers, market transaction costs are internalized and absorbed primarily by the contractor. The frequency at which hogs are sold is controlled and regulated by the

contractor. Contract production is designed to lower transaction costs by reducing the number of market transactions.

The more hours worked off-farm, the higher the probability of being a contract producer versus an independent producer. Most contract producers are relieved from the responsibility of making all of the production, marketing and management decisions, thus allowing time for off-farm employment. Independent producers manage their own hog operations, making all production and marketing decisions. These responsibilities leave less time for off-farm employment.

An increase in the frequency of checking market prices of hogs is associated with an increase in the probability of being an independent producer relative to an incentive payment contract producer. Independent producers are more interested in the market price of hogs because their payments are directly dependent upon market prices. Conversely, incentive contract producers are less interested in these prices because their wages are predetermined and bonuses are typically based on production efficiency. This shows evidence of the decreased information costs associated with collecting price data under production contracts relative to cooperative or independent production.

4.10.2 Farm Financial Characteristics

A higher debt-asset ratio is associated with a higher probability of being an independent producer relative to a flat-fee contract producer. Also, a higher debt-asset ratio is associated with a higher probability of being an independent or cooperative producer relative to an incentive payment contract producer. Independent and cooperative producers incur higher debt-asset ratios than contract producers because the additional production inputs such as feed, animals, medication, and veterinary services that are supplied by the contractor must be purchased by independent and most cooperative producers.

A higher total value of farm assets is associated with a higher probability of being a flat-fee contract producer relative to an independent or incentive payment contract producer. However, a higher total value of farm assets is associated with a higher probability of being a cooperative producer relative to a flat-fee producer. Given these results, logically, it seems fitting for cooperative producers to also have greater farm assets than independent or incentive payment contract producers. It was hypothesized that flat-fee or incentive payment contract producers would have the highest total value of farm assets because of the stipulations that govern contract eligibility.

Having a higher net household income is associated with an increased probability of the producer being an incentive payment contract producer relative to a flat-fee contract producer. Incentive payment contract producers had the highest net household income as shown in the previous descriptive data analysis.

4.10.3 Producers' Attitudes

The feeling that it is not very important to have complete control over production, marketing, and management decisions is associated with a higher probability of being a contract producer relative to being an independent or cooperative producer. Likewise, the feeling is associated with a higher probability of being a cooperative producer relative to an independent producer. Autonomy is most important to the independent producers. Their business structure is generally designed such that power or authority is shared with no other party. Contract production and some cooperative operations involve relationships where managerial responsibilities are shared. These results show the differences in attitudes of producers under different business arrangements toward autonomy. Results of the "autonomy is very important" variable are similar to those of the "autonomy is not very important" variable.

Higher bio-security ratings are associated with an increased probability of being a flat-fee contract producer relative to an independent or cooperative producer. As hypothesized, contract producers have higher bio-security ratings due to higher demand for state-of-the-art facilities. Some of the state-of-the-art hog facilities purchased by contract producers are equipped with air-tight doors and showers to prevent disease outbreaks. These facilities are necessary for eligibility of some contracts. State-of-the-art facilities are optional for independent or cooperative production.

Cooperative producers were more likely to be risk averse than incentive payment contract producers. This is consistent with the hypothesis. The marginal effects show no significance for this variable.

4.10.4 Social Capital

A higher rating of the importance of relationships with neighboring farmers is associated with a greater probability of being a flat-fee contract producer relative to the other business arrangements. It was hypothesized that independent and cooperative producers would rate the importance of relationships with neighboring farmers higher than contract producers. One explanation for this unexpected finding may exist in the number of flat-fee contracts with neighbors. Thirty-two percent of flat-fee contracts are with neighboring farmers. This high percentage of flat-fee neighbor contracts is likely to encourage or be the result of good social relations between the two parties.

In contrast to the hypothesis made about relations with lending institutions, a higher rating of the importance of relationships with lending institutions is associated with a greater probability of being a contract with incentive payments producer relative to an independent or flat-fee contract producer. The structure of an incentive payment contract is competitive. In order for an incentive contract producer to maximize profits, he or she must be able to produce

efficiently to the contractor's standards. Production efficiency begins with the technology adopted. Investing in technologies that increase the level of production efficiency reinforces the importance of establishing relationships with lending institutions. According to the results of the survey, on average, incentive contract producers are larger, and are thus more likely to borrow more money from lending institutions.

A higher rating of the importance of relationships with feed merchants is associated with a greater probability of being an independent or cooperative producer relative to flat-fee contract or incentive contract producer. Resource providing contracts, such as flat-fee or incentive payment contracts, supply producers with certain inputs for hog production. One of those inputs is feed. Because feed is supplied by contractors, flat-fee contract and incentive payment contract producers have little need to develop strong relationships with feed merchants, which is not the case for most independent and cooperative producers. Independent and many cooperative producers are responsible for providing all inputs used in hog production.

4.10.5 Producer Characteristics

Having a high school diploma is associated with a higher probability of being an independent producer relative to an incentive payment contract producer. Likewise, having a college bachelor's degree is associated with a higher probability of being an independent or cooperative producer relative to being an incentive payment contract producer. As expected, these results indicate that independent and cooperative producers have higher levels of education than do incentive payment contract producers. This is consistent with the greater span of control associated with independent production and cooperative farming relative to contract production. The skills needed to run an independent or cooperative farm are generally greater due to the managerial, financial, marketing, and farm knowledge that go into operating the farm. The knowledge contract producers need to run their hog operations is less relative to independent and

cooperative producers because contractors generally teach producers how to raise hogs, instruct them on what technologies to use, provide feed rations, and determine when and where hogs are to be placed and sold.

4.11 Binomial Logit Results

Table 4.7 shows the results of the binomial logit model for contract choice. Marginal effects for the model are reported in Table 4.8. Two asterisks by the coefficient estimate indicate that the variable is significant at the 5 percent level, while one asterisk indicates that the variable is significant at the 10 percent level. The percentage correctly predicted for the binomial logit analysis was 70.5, and McFadden's likelihood ratio index was 0.1438.

The number of years producing under contract, contract with neighboring farmers and the purchase of new or renovation of existing facilities were significant at the 10%, 5%, and 5% levels, respectively. The same variables were also significant at their respective levels in the marginal effects (see Table 4.8). As shown in Table 4.7, more years producing under contract is associated with a greater probability of being an incentive payment contract producer relative to a flat-fee contract producer. Incentive payment contract producers have a lower probability associated with having contracts with neighboring farmers than do flat-fee contract producers. Most contracts with neighboring farmers are based on some type of a fixed rate payment. In instances where a neighboring farmer allows spillover hogs to be raised by another farmer, he or she normally pays for rented space or simply provides the producer a set wage to grow-out the hogs to market weight. Neighboring farm contracts are less likely to be incentive payment contracts because incentive payment contracts are normally associated with larger contract producers and neighboring farm contracts do not typically involve other competing contract producers. A higher probability that contracts with neighboring farmers are under a flat-fee contract is consistent with the proposed hypothesis for this variable.

Table 4.7: Results of the Binomial Logit Analysis of Production Contracts.

Variable	Incentive Contract vs Flat-fee Contract
Constant	-0.124452 (.531560)
Number of Years Producing Under Contract	0.006998 * (.004170)
Producers Who Had Contracts with Neighboring Farmers	-1.741972 ** (.401280)
Producers Required to Obtain New or Renovate Facilities	0.936739 ** (.330611)
Number of Acres Used for Hog Production	0.000130 (.000224)
Producers Had Raised Hogs Prior to Accepting a Contract	-0.041332 (.530340)

** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.
% Correctly Predicted: 70.5; McFadden's likelihood ratio index: 0.1438; Chi-Squared = 38.24**

Table 4.8: Marginal Effects of the Binomial Logit Analysis of Production Contracts.

Variable	Incentive Contract vs Flat-fee Contract
CONSTANT	-0.029909 (.127969)
Number of Years Producing Under Contract	-0.001682 * (.001000)
Producers Who Had Contracts with Neighboring Farmers	-0.418644 ** (.097681)
Producers Required to Obtain New or Renovate Facilities	0.225124 ** (.079373)
Number of Acres Used for Hog Production	0.000031 (.000054)
Producers Had Raised Hogs Prior to Accepting a Contract	-0.009933 (.127460)

** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.
% Correctly Predicted: 70.5; McFadden's likelihood ratio index: 0.1438; Chi-Squared = 38.24**

Producers who were required to purchase new or renovate existing facilities have a higher probability associated with being an incentive payment contract producer relative to a flat-fee contract producer. Because incentive payment contracts are based on incentive or merit payments, there is greater incentive for producers under this business arrangement to acquire the best technology available to increase profit. From a contractor's prospective, new or renovated existing facilities are needed to produce production uniformity. Thus, one way contractors can ensure a certain quality or standard is maintained, is by imposing a stricter policy associated with the purchase of new or renovated facilities for incentive payment contract producers.

CHAPTER 5

SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

5.1 The Problem

Understanding the reasons why hog producers are using certain types of business arrangements in an industry that is undergoing substantial structural change is what this study sets out to accomplish. Problems with income stability due to price risk and frequent production transactions continues to be one of the essential factors responsible for some producers to accept contract production over independent or cooperative production. On the contrary, independent production continues to be the most widely used business arrangement in the U.S hog industry. Thus, it is of interest to know the factors influencing producers' choice of business arrangement.

5.2 The Purposes of the Study

This study is of interest because it brings together some the most influential economic and non-economic factors used in agricultural production to examine business arrangement choice. The primary objective of this study was to determine the effect of transaction costs, risk, autonomy, social capital, production characteristics and demographic variables on hog producers' choice of business arrangements. The specific objectives of this study were to: identify alternative business arrangements currently being used in the U.S. hog industry; identify the determinants that influence hog producers' choice among different types of business arrangements; develop a survey to collect information on the various business arrangements used by hog producers in the U.S.; and determine the influence of economic and non-economic factors on the choice of business arrangements by hog producers.

5.3 General Procedures

Objective One was accomplished through a comprehensive literature search of agricultural related journal articles and magazines. Through this search, six alternative business

arrangements currently being used in the U.S. hog industry were identified. The six alternative business arrangements include the following: independent production, cooperative farming, contract with incentives payments, tournament contract, flat-fee contract, and vertical integration. These business arrangements are arranged in order from the highest level of autonomy and income risk to the lowest level.

Objective Two, identify potential determinants that influence producers' choice among different types of business arrangements, was satisfied through an investigation of previous studies (e.g. Gillespie et al., (1998), Hobbs (1997), Grimes and Rhodes (1992)) and implementation of economic theory.

Business Arrangement Choice = f(Farm/Locational Characteristics, Farm Financial Characteristics, Producer Attitudes, Social Capital, Production Characteristics)

Choice Among Contracts = f(contract and producer characteristics).

The dependent variables are business arrangements chosen by the producer. The independent variables are factors hypothesized to influence their decisions. There were eight production characteristics variables, two autonomy variables, one risk variable, two transaction cost variables, three social capital variables and seven socioeconomic variables included in the business arrangement choice model. Only five variables were used in the contract choice model.

Objective Three, develop a survey form to collect information on the various business arrangements used by hog producers in the U.S., was accomplished through a national mail survey. The survey consisted of a six section questionnaire that identified several economic and non-economic variables. These six sections are identified in the business arrangement choice model above. A hybrid of Dillman's Total Design Approach was used as a method to increase the survey response rate. The hybrid method consisted of an initial mailing of the survey followed by a postcard reminder two weeks later, then a second mailing of the survey.

Objective Four, determine the influence of economic and non-economic factors on the choice of business arrangements by hog producers, was achieved through the estimation of two empirical models. These two models were derived from a logistic function having polychotomous and dichotomous variables. The polychotomous or multinomial model consists of four alternative choices, while the dichotomous or binomial model consists of two alternative choices (Kennedy, 1998). The multinomial logit and binomial logit models were constructed to link the decision or outcome to a set of factors, at least in the spirit of regression (Maddala, 1997; Greene, 1997; Judge et al., 1988).

5.4 Results Summarized

A total 4,986 surveys were mailed. A total of 1,031 surveys were returned completed. Excluding producers who indicated they were no longer in business, the return rate was 21 percent. The information collected from the survey was then separated into six different categories to simplify discussion. Those categories included farm characteristics, financial characteristics, producer attributes, social capital, producer and locational characteristics, and contract production characteristics. A descriptive analysis of the survey data revealed that, of the 1,031 completed surveys, 684 were completed by independent producers, while 66, 81, 118, 21 and 61 were from cooperative, flat-fee, incentive payment/tournament, vertical integration and other producers, respectively.

5.5 Summary of Descriptive Analysis

In the farm characteristics category, larger percentages of flat-fee contract, cooperative, and incentive payment contract producers were involved in sole proprietorships, partnerships, and family corporations, respectively. Cooperative producers had higher percentages of persons involved in non-family corporations and cooperatives than did producers under other business arrangements. The average number of hogs sold was higher among incentive payment contract

producers than it was for the other business arrangements. Over 80% of the contract producers surveyed were involved in finishing hogs at weights ranging from 200 to 300 pounds. Cooperative producers had more breeding sows, on average, than any other business arrangement. Contract producers sold more feeder pigs per farm than independent producers. However, cooperative and incentive payment contract producers were more likely to have feeder pig operations than were independent producers. More farm enterprises (i.e. more diversification) were owned by independent producers than by any other business arrangement. On average, independent producers had been raising hogs longer than producers under any other business arrangement. Cooperative producers, on average, used more acres for their hog operations than producers under contract. Corn was raised by a higher percentage of independent producers than by incentive payment contract or cooperative producers. Sixty-eight percent of the flat-fee contract producers surveyed indicated that there were other flat-fee contract producers in their counties, while 81% of the incentive payment contract producers indicated that there were other incentive payment contract producers present in their counties. Thirty-one percent of the incentive payment contract respondents were from one of the southern states of the U.S. The average number of times per year independent and cooperative producers placed hogs on the market was 32 and 48, respectively, which were greater than for contract producers. Flat-fee contract producers worked more hours off-farm than did cooperative or independent producers. The average number of full-time workers employed on a hog farm was higher for cooperative hog farms than for other hog farms. The average number of full-time workers employed on a hog farm was higher for cooperative farms than contract farms.

Independent producers had lower debt-asset ratios than did cooperative, flat-fee or incentive payment contract producers. Cooperative producers had higher values of total farm assets than did producers under other business arrangements. The percentage of producers with

total net household income for 1999 greater than or equal to $100,000 was higher for incentive payment producers than for independent or flat-fee contract producers.

The producer attitudes category revealed that a larger percentage of flat-fee contract producers felt that autonomy was either not important at all, or not very important than did other business arrangements. A higher percentage of independent producers felt that autonomy was very important than did cooperative, incentive payment, or flat-fee contract producers. Independent producers rated their bio-security systems lower than any of the other business arrangements. Independent producers consulted sources for information on market prices for hogs more often than did other business arrangements.

In the social capital category, a higher percentage of cooperative producers thought that relationships with lending institutions were more important relative to producers under other business arrangements. Relationships with lending institutions were more important to cooperative than they were to independent or flat-fee contract producers. From a contract perspective, incentive payment contract producers felt relationships with lending institutions were more important than did flat-fee contract producers. Relationships with feed merchants were more important to cooperative and independent producers than they were to contract producers. Cooperative, independent and incentive payment contract producers felt relationships with veterinarians were more important than flat-fee producers. Relationships with non-farmers were more important to incentive payment contract producers than they were to independent producers. Cooperative producers valued relationships with a packer/slaughterer more than did independent, flat-fee contract, or incentive payment contract producers. Also, relationships with a packer/slaughterer were important more to independent producers than they were to contract producers. Flat-fee contract producers valued relationships with neighboring farmers more than did independent, cooperative or incentive payment contract producers.

The producer and locational characteristics category showed that independent producers were older than flat-fee contract or cooperative producers. The percentage of producers who completed high school was higher for incentive payment contract producers than flat-fee contract producers. Cooperative producers held more bachelor and graduate degrees than independent and incentive payment contract producers.

Contract production characteristics revealed that, on average, incentive payment contract producers had been producing under contract longer than flat-fee contract producers. A higher percentage of flat-fee contract producers than incentive payment contract producers were with neighboring farmers. A higher percentage of incentive payment contract producers than incentive payment contract producers were required to purchase new or renovate existing facilities.

5.6 Summary of Results of the Multinomial Logit and Binomial Logit Analyses

From the multinomial logit analysis, cooperative, flat-fee contract and incentive payment contract producers were likely to finish more hogs than independent producers. Independent and cooperative producers were more likely to have a larger breeding sow herd than contract producers. When comparing the two contracts, incentive payment contract producers were more likely to have a larger breeding sow herd than flat-fee contract producers.

Farms owned by independent, cooperative and incentive payment contract producers were more diversified than farms owned by flat-fee contract producers. Corn was more likely to be produced by independent producers. Flat-fee contract producers were more likely to raise corn than incentive payment contract producers.

In counties where flat-fee contracts were used, there were more likely to be independent, cooperative, or flat-fee contract operations present. Cooperative and incentive payment contract production were more likely to be present in counties where incentive payment contracts were

used. The number of producers under incentive payment contract production is higher in the southern states. Cooperative producers were likely to sell hogs more times per year than flat-fee contract producers. Producers with off farm jobs were more likely to be contract producers relative to independent producers. Market prices were checked more frequently by independent producers than by incentive payment contract producers.

A higher debt-asset ratio was associated with a higher probability of being an independent producer relative to a contract producer. A higher debt-asset ratio was associated with a higher probability of being a cooperative producer relative to an incentive payment contract producer. A higher total value of assets was associated with a higher probability of being a flat-fee contract producer relative to an independent or incentive payment contract producer. A net household income greater than or equal to $100,000 was associated with a higher probability of being an incentive payment contract producer relative to a flat-fee contract producer.

Autonomy rated as not very important was associated with a higher probability of being a contract producer relative to being an independent or cooperative producer. Autonomy rated as very important was associated with a higher probability of being an independent producer relative to a cooperative producer. A higher level of bio-security was associated with a higher probability of being a flat-fee contract producer relative to an independent or cooperative producer. More risk averse attitudes were associated with a higher probability of being a cooperative producer relative to an incentive payment contract producer.

A higher rating of the importance of relationships with neighboring farmers was associated with a higher probability of being a flat-fee contract producer relative to producers under other business arrangements. A higher rating of the importance of relationships with lending institutions was associated with a higher probability of being an incentive payment

contract producer relative to an independent or flat-fee contract producer. A higher rating of the importance of relationships with feed merchants was associated with a higher probability of being an independent or cooperative producer relative to a contract producer.

Age was included in the model. Surprisingly, age was not significant in any of the runs. Reasons for this insignificant are not known. Independent and cooperative producers tended to be more educated than incentive payment contract producers.

In the binomial logit analysis, a higher number of years under contract was associated with a higher probability of being a flat-fee contract producer relative to an incentive payment contract producer. Involvement in a contract with a neighboring farmer was associated with a higher probability of being a flat-fee contract producer relative to an incentive payment contract producer. The requirement of the producer to purchase new or renovate existing facilities was associated with a higher probability of being an incentive payment contract producer relative to a flat-fee contract producer.

5.7 Conclusions

This study shows that the choice of business arrangement by producers in the U.S. hog industry is greatly influenced by factors such as farm/locational characteristics, producer attitudes, farm financial and producer characteristics. Results of this study show that contract producers continue to raise more finishing hogs but flat-fee contract producers are less likely to be involved in the farrowing segment. One of the reasons for this is that farrowing requires a higher skill level and is more labor intensive than a finishing operation. Because most flat-fee contracts are short-term, time and other production factors are not as conducive for sow breeding operations as would be the case for finishing operations.

Results indicate that the number of other enterprises on the farm is greater among independent, cooperative, and incentive payment contract producers. Independent and

cooperative producers use diversification to shield themselves from risk. Incentive payment contract producers diversify to avoid low farm returns, which may come as a result of low feed efficiency, high mortality rates, and/or low weaning rates. Flat-fee contracts minimize price risk.

Corn is the one of the main inputs used in the production of hogs. Findings from the multinomial logit analysis reveal that corn production is higher among independent producers than producers under other business arrangements. Independent producers are self-reliant and may grow corn primarily for hog feed, whereas different firms may supply the corn used in cooperative and contract production.

In counties where flat-fee contracts are used, results indicate that incentive payment contracts are less likely to be present, and in counties where contracts with incentive payment are used, it is less likely that flat-fee contracts will be present. However, the most interesting results here are that in counties where flat-fee contracts are used, independent and cooperative producers are more likely to be present, and in the counties where incentive payment contracts are used, cooperative producers are more likely to be present. Approximately 40% of the flat-fee contracts surveyed were with neighboring farmers. Thus, the presence of independent and cooperative production in counties where flat-fee contracts exist suggests that a relatively high percentage of flat-fee contracts are with neighboring farmers who are independent and cooperative producers. These results indicate possible complementary relationships between independent, cooperative and flat-fee contract production.

Location continues to be a driving force for structural change in the hog industry (Gillespie et al., 1998, Reimund et al., 1981). Results indicate that a significant number of incentive payment contract producers are located in the southern states. This increase in the number of contract producers in the South is most pronounced in North Carolina, which is presently the second largest hog producing state in the United States. The South is growing in

hog production because labor is relatively inexpensive, growers are experienced in contracting, and the overall business environment is more favorable, partially due to the absence of anti-corporate farming laws.

Findings from this study show that contract producers worked more hours off-farm than independent producers. The production, marketing, and management responsibilities associated with independent production are greater than they are for contract production. An independent producer's time is divided between raising hogs, growing and/or purchasing feed, managing the farm and supervising workers, and marketing hogs. In contrast, most contract producers' responsibilities consist of raising hogs and managing the farm and/or supervising workers. Thus, fewer responsibilities give contract producers time to work more hours off-farm.

Transaction costs may partially explain the greater acceptance of production contracts. Results indicate that independent producers check market prices more frequently and sell hogs more frequently than producers under other business arrangements. The more frequently producers check market prices and market animals, the higher are their transaction costs.

Results from the multinomial logit analysis reveal that independent and cooperative producers have higher debt than contract producers of the same size. This is partially due to the loans acquired to purchase production inputs. Production inputs purchased by independent and cooperative producers may include animals, feed, medication, labor, buildings, machinery, etc. Of these inputs, feed accounts for the largest percentage of producer's total production costs. Feed makes up approximately two-thirds of the total production cost (Barkema and Cook, 1993). Because most producers do not have the available cash to pay for the total costs of production inputs, many independent and cooperative producers rely on loans, which in turn increases debt. On the other hand, for most contract producers, the contractor supplies feed and other inputs,

such as animals, medication, and veterinary service, thus the contractee need not debt finance to obtain these inputs.

As the U.S. hog industry continues to become more vertically coordinated, autonomy is likely to become less important to hog producers. Results reveal that autonomy is more important to independent producers than it is to producers under other business arrangements. Independent producers are self-governing, self-reliant individuals who utilize their educational skills/knowledge to make business decisions. Autonomy is most important to independent producers because they value their freedom to make production, marketing, and management decisions more than producers under other business arrangements who are willing to sacrifice autonomy in exchange for financial stability.

Risk preference as measured by the investment choice elicitation procedure was not significant in explaining business arrangement choice. However, there are dimensions of risk other than production and price risk that may influence business arrangement choice. One of the risk factors that contract producers face is contract renewal. In some instances, there are no guarantees that contracts will be renewed. Some contractual agreements are short-term in that they are established between neighboring farmers only when hog prices are "good" and a producer has an excess number of pigs and needs assistance raising them. If there is no excess or surplus of hogs to be finished, some flat-fee contract producers may have no income to meet financial obligations. Although the technology adopted by producers helps reduce production risk, and flat-fee contractual agreements eliminate hog price risk, flat-fee contract producers still incur contract risk under seasonal or year-to-year contracts. Contract risk may help to explain why a risk preference elicitation procedure that analyzes choice of investment does not explain choice of business arrangement.

The nature of social capital in the hog industry appears to be changing as the industry moves toward more contracting. As U.S. hog farms continue to reduce in number and increase in size, relationships with lending institutions have become more important. Results reveal that relationships with lending institutions are most important to incentive payment contract producers. The reasons for the importance of these relationships are not fully understood, given that incentive payment contract producers, on average, had lower debt than producers under other business arrangements. Perhaps relationships with lending institutions are likely most important to incentive payment contract producers because of the financial obligations associated with the purchase of new facilities or renovation of existing facilities. Most incentive payment contract producers depend on lending institutions for loans to purchase state-of-the-art facilities (Hurt, Boehlje, and Hale, 1995). The benefits of these relationships may result in a greater likelihood of loan approval or a more favorable interest rate.

Because feed is one of the essential inputs in hog production, relationships with feed merchants will continue to be of great importance to independent and cooperative producers. Independent producers, as well as members of some cooperatives rely on feed merchants to meet their production demands for feed. Relationships with feed merchants that are built on consistency, loyalty and reliability are beneficial to producers in that they may give rise to higher quality services, short-term credit, and/or other benefits.

Short-term contracts that evolve due to an overflow of animals are often agreements established between neighboring farmers via flat-fee contract. Findings from this study show that relationships with neighboring farmers are more important to flat-fee contract producers than they are to producers under other business arrangements. Flat-fee contracts are normally established such that the owner of the animals pays the grower a set price per pound, per animal, or a set price based on the space occupied by each animal. Because some flat-fee contract

producers depend on neighboring farmers for constant flows of animals to grow-out so that they may meet their financial obligations, relationships with neighboring farmers are believed to be more important to flat-fee contract producers.

Income is generally associated with years of education. When comparing producers' education and net household income greater than or equal to $100,000, results reveal that independent and cooperative producers have more years of education, but incentive payment contract producers have higher net incomes. One explanation for this may be the technology requirement by many incentive payment contractors. Technology adoption generally is associated with an increase in operation size and economies of size. Some independent and cooperative producers refuse to adopt technology because its adoption involves a large investment and debt financing. Hog operations run by incentive payment contract producers are larger, on average, than those run by independent and cooperative producers. This, coupled with the greater prevalence of off-farm employment among contract producers, likely explains the finding that the less educated incentive payment contract producer had higher income.

Approximately 60% of the contract producers who responded to the survey were incentive payment contract producers. Results reveal that incentive payment contract producers have more years of experience producing hogs under contract than flat-fee contract producers. Flat-fee contracts are likely to be short-term contracts established by large producers with an over supply of hogs and under capacity of space during "favorable" price periods. However, it is also likely that incentive payment contracts have been longer term because the discounted future returns associated with incentive payment contract production are greater than for flat-fee contract production as growers improve their production efficiency. The success of the producer becomes beneficial to the contractor, as well. As efficiency increases for incentive contract producers, profit increases for contractors. Therefore, one may conclude that incentive payment

contracts are long term because of the monetary benefits producers and contractors stand to gain from them.

The U.S. hog industry is experiencing tremendous growth due to the adoption of technology. Results indicate that incentive payment contract producers are more likely to purchase new facilities or renovate old facilities than flat-fee contract producers. New and improved production facilities give rise to greater levels of production efficiency. State-of-the-art facilities are important to incentive payment contract producers because their payments are highly correlated with their production efficiency. Feed efficiency and lower mortality rates yield higher income for producers. Other factors such as grow-out time and weaning percentage may also be influenced by production facilities. These factors have a direct effect upon payments. For some flat-fee contracts, state-of-the-art facilities are required, but production efficiency is not emphasized to the extent of incentive payment contracts.

In short, this research shows that independent producers are, in general, more likely to be breeding sow operators, diversified, corn producers, located in the same counties as flat-fee contract producers, frequent checkers of market prices, have higher debt, value autonomy and relationships with feed merchants more, and be relatively more educated than incentive payment contract producers. Cooperative producers are also more likely to be breeding sow operators, diversified, corn producers, and located in the same counties as flat-fee contractees. They are also likely to have accumulated greater assets, have higher debt and greater farm assets, be risk averse, be concerned about autonomy and relationships with feed merchants, and be relatively more educated than incentive payment contract producers. Flat-fee contract producers are more likely to be finishers located in counties with independent and cooperative producers, work more hours off-farm, and be owners of greater farm assets. They are less likely to value autonomy and more likely to value relationships with neighboring farmers. Finally, incentive payment contract

producers are generally larger, lower debt finisher or breeding sow operators who work more hours off-farm, value autonomy less and relationships with lenders more than other business arrangements. They are likely to be located in counties with cooperative producers.

5.8 Implications

The structure of the hog industry is changing rapidly. Some of the major driving forces of this structural change in the hog industry include change in technology, shift in location of production, industry growth and development, and adjustment to risk and transaction costs (Gillespie et al., 1998, Reimund et al., 1981). Thus, as technology adoption continues, we can expect to see more contract production and more independent producers becoming members of cooperatives in order to compete with vertically coordinated firms. As alliances are formed in different regions of the U.S. that require the adoption of new technology, the size of hog farms is expected to increase. Evidence of this change has been shown in the average numbers of finished hogs by independent producers in comparison to contract producers. Larger farms will lead to an increase in the total asset value per farm, but the number of enterprises held per farm will likely decline. Transaction costs incurred by newly formed cooperatives and production contracts will decline through the sharing of information, market agreements, and resources. These agreements and mergers could potentially lead to reductions in price risk and more stabilized earnings for newly formed cooperatives.

In addition, we can expect to see larger finishing operations run by cooperative and incentive payment contract producers. Through the merger of some independent producers into cooperatives, cooperative production could potentially expand, producing more finishing hogs on a larger scale. This expansion is also expected to occur with contract production. Contract production has always and is expected to continue to be characterized primarily by finishing operations. One explanation for this is the uniformity and consistency associated with finishing

hog operations. Because breeding sow operations are labor intensive and require a higher quality of labor, it is expected that independent, cooperative, and incentive payment contract producers will continue to have more breeding sow operations than flat-fee contract producers. Short-term contracts will less likely involve operations that are labor intensive and require great management skills. Thus, vertically coordinated firms are expected to continue to use incentive payment contracts to produce pigs for finishing operations and manage the breeding sow operations in-house.

The continuation of this change will also have an impact on producers' preferences as they relate to exercising complete control over production, marketing, and management decisions. An increase in the number of contract producers will reduce the array of responsibilities held by producers due to the mandated inputs used in production and the management exercised by the contractor. Thus, the responsibility of making production as well as marketing and management decisions will no longer be solely made by the producer but by the contractor also. For independent producers, autonomy will still be very important, but to those producers who may decide to form cooperatives, a portion of their autonomy will be sacrificed for other benefits. Cooperatives will be formed to increase farm size and compete with contractors.

Social capital will continue to evolve in the business relations of hog producers. Relationships of hog producers with lending institutions will become more important as the number of incentive payment contract producers increases. These relationships are driven by the adoption of technology and an increase in farm size. Independent and cooperative producers' relationships with feed merchants will continue to be important. The larger independent and cooperative farms become, the more they will rely on feed merchants. However, given the

current reduction in the number of independent producers, it is expected that these relationships would be on the decline.

One of the most interesting questions that is at the center of agricultural debates is, "will the hog industry follow the poultry industry and become 100 percent vertically integrated." The answer to this question is not easy to predict. It has become increasingly difficult for small farmers to compete with larger vertically integrated/coordinated firms. In 1999, low hog prices delivered "deadly" blows to many small hog farmers, forcing them out-of-business. However, most of the larger, vertically integrated firms were able to continue producing hogs (Iowa State University Cooperative Extension Service, 1991–2000). As vertically integrated/coordinated firms become larger, it will only become more difficult for smaller independent producers to survive unless they too begin to form appropriate strategic alliances.

On the other hand, over sixty percent of the U.S. hog farmers are independent producers, and the majority of their farms are located in the Midwestern states. Some counties within the Midwestern states have anti-corporate farming laws. In order for the hog industry to become 100 percent vertically integrated, anti-corporate farming laws must be weakened or eliminated, or alternative vertically coordinated business arrangements will need to be formed that provide the benefits of the typical integrator-contractee relationship, but are in accordance with the anti-corporate farming laws.

5.9 Limitations of the Study and Further Research Needs

The current study is limited to producers who had sold 200 or more hogs. In an attempt to capture more contract producers in the surveys returned, we disregarded producers who had sold 199 hogs or less. Presently, there are approximately 85,760 hog producers in the U.S. Five thousand hog farmers were surveyed using a stratified sample. Eight hundred thirty-three surveys were mailed to six different size categories. The sample population is biased toward the

larger size category (10,000 or greater), which is not entirely representative of the U.S. hog farm population. The numbers of hog farms having 200 to 999 head, 1,000 to 1,999 head or 2,000 to 2,999 head are greater than the numbers of hog farms with 10,000 or more head.

Another important assumption constraining this study is related to the choice of cooperative farming. There are several types of cooperative farmers; this study did not specifically focus on any one in particular. Emphasis was placed on the general structure of cooperative farming, which is based on the combining of resources and the sharing of production, marketing and management decisions.

This study is limited to six business arrangements. One of these business arrangements was disregarded due to low respondents and another was combined with another business arrangement because of their similar characteristics. Outside of these four business arrangements, there are others that are used by U.S. hog producers that are unidentified and unexplained in this study.

An investigation of the effects that independent variables used in this study have on the contract choice in a nested multinomial logit framework is of great interest. The nested portion of the logit model involves the different contracts, namely, flat-fee contract, incentive payment contract, and tournament contract. A nested multinomial logit approach coupled with a larger sample size would enhance the results and provide more information for academia, government agencies, and U.S. hog producers.

This study represents a pioneering application that includes independent variables that have not been analyzed together in one study. The survey design is believed to have had an impact on the 21% response rate. In that sense the proposed methodology is promising and could be adopted to analyze other studies that involve polychotomous dependent variables.

Based on the outcomes of the current study, the following general recommendations are made for future research.

1. Design a survey that proposes hypothetical questions to producers concerning their behavior and attitude toward hog production if they were operating under a different business arrangement. This information may be used to help further explain why producers accept one business arrangement over another.
2. Conduct an analysis that allows contracts to be nested. The NML is an extension of the discrete choice model that is based on variations of a two, three, or four level tree structure (Greene, 2000). The NML model is an integration of the multinomial logit and conditional logit models. This analysis gives one the latitude to evaluate contracts along with other business arrangements and individually as separate distinctive production contracts.

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APPENDIX A: DESCRIPTIVE STATISTICS OF SURVEY QUESTIONS AND EXOGENOUS VARIABLES

Table 4.1 Descriptive Statistic Results on Sole Proprietorship Used by Producers.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.541298	0.25	0.560976	0.474576			
Standard Deviation	0.248294	0.1875	0.246282	0.249354			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	5.212089382***	-4.09718***	1.207868	-0.33899	-3.21793***	1.33997
	v = degree of freedom	86.38707924	149.627	177.0583	302.801	175.2328	692.0063

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.2 Descriptive Statistic Results on Partnership Used by Producers.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.187316	0.382352941	0.195122	0.186441			
Standard Deviation	0.152228	0.23615917	0.157049	0.151681			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-3.207496989***	2.550688***	0.153449	-0.16876	2.840096***	0.022517
	v = degree of freedom	76.17692889	130.5708	174.3835	653.8223	52.29272	731.8639

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.3 Descriptive Statistic Results on Family Corporation Used by Producers.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.238938	0.132352941	0.182927	0.262712			
Standard Deviation	0.181847	0.11483564	0.149465	0.193694			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	2.40937545**	-0.85345	-1.35556	1.224907	-2.25893**	-0.54402
	v = degree of freedom	90.42085726	149.5551	189.4886	305.2318	185.5874	525.5454

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.4 Descriptive Statistic Results on Non-Family Corporation Used by Producers.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.025074	0.102941176	0.04878	0.042373			
Standard Deviation	0.024445	0.092344291	0.046401	0.040577			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-2.085524405**	1.234799	0.21244	-0.96628	1.468185	-0.88751
	v = degree of freedom	70.70729241	119.0158	168.5898	956.9319	27.85582	829.2706

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.5 Descriptive Statistic Results on Cooperative Used by Producers.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.001475	0.132352941	0	0.016949			
Standard Deviation	0.001473	0.11483564	0	0.016662			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-3.182758433***	3.220696***	-1.42635	1.000738	2.697734***	-1.29233
	v = degree of freedom	67.17760765	67	117	677	78.51956	116.9951

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.6 Descriptive Statistic Results on the Number of 250 Pounds Hogs Sold.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	2522.841481	7794.852941	3899.95	10926.8103			
Standard Deviation	22321401.78	433440992.6	29552918	1828914878			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-2.082797899**	1.5008693	-1.76446932*	-2.1958012**	-0.669665	-2.1323964**
	v = degree of freedom	67.71442236	74.81912	122.501991	28949.919	94.461843	122.59841

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.7 Descriptive Statistic Results on Producers Who Have Finishing Operations.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.368731563	0.514705882	0.8414634	0.80508475			
Standard Deviation	0.241618155	0.249783737	0.1334027	0.25861821			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-2.29954704**	-4.4882952***	0.58870537	-10.615199***	-3.7916837***	-8.6443886***
	V = degree of freedom	80.95833913	121.51258	199.8086	873.81665	59.806809	357.56738

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.8 Descriptive Statistic Results on the Number of Breeding Sows.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	262.5480059	758.7014925	48.597561	297.347458			
Standard Deviation	7325136.514	2991510.777	101741.02	1113050.41			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-2.119523732**	3.3388091***	-2.40775354**	1.9494574*	1.9959988**	-0.2446262
	v = degree of freedom	104.4003781	70.898741	146.676695	10740.915	1.9560712	121.88156

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.9 Descriptive Statistic Results on the Producers Who Have Breeding Sow Operations.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.05899705	0.044117647	0.0365854	0.03389831			
Standard Deviation	0.055516398	0.04217128	0.0352469	0.03274921			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	0.56156749	0.2324506	0.10103049	0.9907343	0.3410805	1.3238901
	v = degree of freedom	86.26710215	139.34684	172.146436	491.08948	78.430522	759.43743

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.10 Descriptive Statistic Results on Pigs Sold at 50 pounds.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	356.8142645	1322.794118	2178.6585	2183.5431			
Standard Deviation	3556902.552	30039517.19	55152990	46677088.7			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-1.444815771	-0.8107616	-0.00472614	-2.2128221**	-0.9406525	-2.8853749***
	v = degree of freedom	68.64756159	147.99771	166.650062	225.83037	273.38787	865.69592

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.11 Descriptive Statistic Results on the Producers Who Have Feeder Pig Operations.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.182890855	0.323529412	0.2682927	0.21186441			
Standard Deviation	0.14944179	0.218858131	0.1963117	0.16697788			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-2.398244834**	0.7373063	0.91429197	-1.6702292*	1.640436	-0.7164383
	v = degree of freedom	76.73686762	141.72028	166.947643	453.7048	84.906244	856.61375

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.12 Descriptive Statistic Results on the Producers Who Have Farrow to Finishing Operations.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.58259587	0.367647059	0.0121951	0.03389831			
Standard Deviation	0.272676447	0.232482699	0.0120464	0.03274921			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	3.477316381***	5.9525656***	-1.05344955	24.342227***	5.4894677***	21.046028***
	v = degree of freedom	84.06740764	72.942179	196.558432	25517.544	-0.9405801	201.44853

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.13: Descriptive Statistic Results on the Producers Who Have Farrow to Wean Operations.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.156342183	0.25	0.0853659	0.16101695			
Standard Deviation	0.131899305	0.1875	0.0780785	0.13509049			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-1.723826694*	2.7030898***	-1.65201803*	2.09597**	1.4244697	-0.1277346
	v = degree of freedom	77.03991411	111.61917	198.456466	1251.3431	34.282011	395.25634

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.14 Descriptive Statistic Results on the Number of Enterprises.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	3.333333333	2.779411765	2.5925926	2.92372881			
Standard Deviation	2.871189774	3.730752595	2.1673525	3.51113186			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	2.278551965**	0.655223	-1.39698185	4.2299791***	-0.4961155	2.2217143**
	v = degree of freedom	78.01446616	124.99416	197.08564	780.73575	59.822553	420.80629

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.15 Descriptive Statistic Results on the Number of Years Raising Hogs.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	26.79464286	20.76470588	18.469136	19.2136752			
Standard Deviation	173.169138	159.0622837	125.36016	149.774856			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	3.743524396***	1.1672155	-0.44510156	6.2328926***	0.8165095	6.1395119***
	v = degree of freedom	82.78812964	137.22604	185.762203	527.49944	82.331842	572.21744

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.16 Descriptive Statistic Results on the Number of Acres Used in the Operation.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	623.2567976	803.3538462	496.93243	479.157895			
Standard Deviation	781342.7135	1141605.029	330727.2	519683.624			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-1.344579591	2.1235495**	0.1935063	1.7542206*	2.2269857**	1.9331216*
	v = degree of freedom	76.76034072	99.276485	196.307781	2188.1818	14.759279	429.58385

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.17 Descriptive Statistic Results on Whether Corn Is Produced on the Farm.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.865781711	0.705882353	0.8024691	0.65254237			
Standard Deviation	0.11620374	0.207612457	0.1585124	0.22673082			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	2.815881865***	-1.3678319	2.41486955**	1.3801255	0.7562667	4.6612173***
	v = degree of freedom	74.93964928	136.03387	193.372255	549.69865	87.437537	476.21877

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.18 Descriptive Statistic Results on Whether Soybeans are Produced on the Farm.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.81120944	0.691176471	0.7530864	0.65254237			
Standard Deviation	0.153148685	0.213451557	0.1859473	0.22673082			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	2.069264388**	-0.84197	1.55344593	1.1639669	0.543096	3.4240282***
	v = degree of freedom	77.24612716	140.76416	186.735501	469.25413	98.954582	562.26109

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.19 Descriptive Statistic Results on the Total Number of Techonologies and Management Practices Adopted.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	2.573746313	3.955882353	1.9756098	2.37288136			
Standard Deviation	4.869930213	6.130406574	1.8530637	3.18299339			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-4.430109213***	5.8974471***	-1.78429042*	3.4660099***	4.625425***	1.0868318
	v = degree of freedom	78.38106136	100.56973	198.326361	2038.9785	17.833428	394.9756

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.20 Descriptive Statistic Results on Percentage of Flat-fee Contracts Used in the County.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.39528	0.485294118	0.682927	0.347458			
Standard Deviation	0.239034	0.249783737	0.216538	0.226731			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-1.4186682	-2.48718**	4.966698***	-5.25759***	1.842784*	1.002854
	v = degree of freedom	80.80315134	140.6007	178.9205	471.48	89.85963	664.921

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.21 Descriptive Statistic Results on Percentage of Incentive Contracts Used in the County.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.373156	0.602941176	0.5	0.813559			
Standard Deviation	0.233911	0.239403114	0.25	0.151681			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-3.695821071***	1.270065	-4.76283***	-2.17734**	-3.03809***	-10.9068***
	v = degree of freedom	81.10467011	145.989	147.2397	382.7688	95.07156	1334.049

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.22 Descriptive Statistic Results on the Percentage of Business Arrangements Located in the Southern U.S.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.023599	0.014705882	0.134146	0.313559			
Standard Deviation	0.023042	0.014489619	0.116151	0.21524			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	0.565766472	-2.95881**	-3.1517***	-2.90266***	-6.62135***	-6.72682***
	v = degree of freedom	90.52603008	104.9389	199.4279	107.8421	364.943	373.5561

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.23 Descriptive Statistic Results on the Average Number of Times per Year Producers Sell Hogs at Local Auctions, Packing or Slaughter Houses.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	32.0739	34.34848485	18.625	12.29358			
Standard Deviation	848.2854	1028.28765	1116.734	1445.895			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-0.562131158	2.93292***	1.24476	3.487652***	4.215279**	5.382623***
	v = degree of freedom	78.83400145	146.869	189.4497	367.2747	144.2836	527.5494

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.24 Descriptive Statistic Results on the Number of Hours Worked Off-Farm.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	25.98922414	22.375	32.85	30.2765957			
Standard Deviation	442.6432028	410.046875	235.8275	416.45541			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	1.398074832	-3.5100359***	1.01681211	-3.6522376***	-2.555641**	-2.0964831**
	v = degree of freedom	82.64894392	124.57641	198.795308	788.96926	62.95119	387.62462

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.25 Descriptive Statistic Results on the Number of Full-Time Workers.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	1.122137405	3.402985075	0.7922078	1.68695652			
Standard Deviation	9.359128256	41.04655825	3.9308484	26.7367864			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-2.902702049***	3.2343842***	-1.70770955*	1.3278034	1.8833492*	-1.1520039
	v = degree of freedom	70.18810286	77.975181	162.145218	15177.804	11.193348	172.56553

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.26 Descriptive Statistic Results on the Number of Part-Time Workers.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.779141104	1.166666667	0.4473684	0.69642857			
Standard Deviation	7.530975949	3.108585859	0.6419668	1.76498724			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-1.625704443	3.108538***	-1.64993395*	2.4109644**	1.9090776*	0.5123198
	v = degree of freedom	103.9689109	90.403987	196.288118	3113.6627	14.141242	249.83181

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.27 Descriptive Statistic Results on Producer's Debt-to-Asset Ratio.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	2.498417722	3	3.109589	3.09708738			
Standard Deviation	1.487339269	1.125	1.4674423	1.52455462			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-3.664228071***	-0.5905234	0.07121681	-4.3120122***	-0.5656091	-4.8697008***
	v = degree of freedom	86.35382453	149.57282	178.490831	304.83638	174.85043	671.56147

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.28 Descriptive Statistic Results on the Total Value of Farm Assets.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	2.79705401	3.661290323	2.5131579	2.72380952			
Standard Deviation	2.819696722	3.901404787	2.486669	2.86657596			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-3.484018286***	3.8769936***	-0.90135514	1.5287982	3.2805004***	0.4342298
	v = degree of freedom	77.32341432	128.83195	183.993656	690.56437	54.643422	596.45926

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.29 Descriptive Statistic Results on the Net Household Income $\geq$ \$100,000.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	3.123762376	3.606557377	2.8243243	3.63551402			
Standard Deviation	4.01933634	2.500940607	1.6042732	2.58677614			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-2.336223762**	3.2954655***	-3.98263876***	1.8754285*	-0.1195165	-3.0665229***
	v = degree of freedom	90.79153294	129.09508	196.971815	678.73729	70.797916	418.793

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.30 Descriptive Statistic Results on Autonomy Is Not Important at All.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.019578313	0.075757576	0.2531646	0.21551724			
Standard Deviation	0.019195003	0.070018365	0.1890723	0.16906956			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-1.727168165*	-3.071808***	0.61571862	-4.8349309***	-2.8164105***	-5.1260183***
	v = degree of freedom	70.84089177	138.07948	169.903858	171.67956	426.51075	808.13485

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.31 Descriptive Statistic Results on Autonomy Is Not Very Important.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.024096386	0.121212121	0.164557	0.14655172			
Standard Deviation	0.02351575	0.106519743	0.137478	0.12507432			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-2.427020728**	-0.7611357	0.34419151	-3.3954583***	-0.4944448	-3.7012029***
	v = degree of freedom	70.0857692	149.48326	170.917077	308.5404	164.39728	791.02715

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.32 Descriptive Statistic Results on Autonomy Is Somewhat Important.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.254518072	0.454545455	0.4177215	0.37931034			
Standard Deviation	0.189738623	0.247933884	0.2432303	0.23543401			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-2.427020728**	-0.7611357	0.34419151	-3.3954583***	-0.4944448	-3.7012029***
	v = degree of freedom	70.0857692	149.48326	170.917077	308.5404	164.39728	791.02715

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.33 Descriptive Statistic Results on Autonomy Is Very Important.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.701807229	0.333333333	0.164557	0.25862069			
Standard Deviation	0.209273842	0.222222222	0.137478	0.19173603			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	6.161256264***	2.4002083**	-1.63708164	12.057905***	1.0681024	10.078814***
	v = degree of freedom	80.5749319	127.60131	192.451579	716.94345	59.591574	486.17216

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.34 Statistical Results on the Rating of Biosecurity.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	5.899212598	7.030769231	6.691358	6.95535714			
Standard Deviation	5.435511191	4.091360947	3.9911599	4.54264987			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-4.333461023***	1.0288034	-0.89416911	-3.3270015***	0.240083	-4.8970153***
	v = degree of freedom	86.45330806	144.23468	183.346569	411.66118	115.04705	603.5295

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.35 Statistical Results on the Producers Who Check Sources Twice or More Times a Week for Market Hog Prices.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.634586466	0.582089552	0.2911392	0.3539823			
Standard Deviation	0.231886483	0.243261305	0.2063772	0.22867883			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	0.838541704	3.7270194***	-0.9415548	6.4234351***	3.0715204***	5.8766441***
	v = degree of freedom	80.74734622	139.86584	181.958351	483.54768	89.436978	623.37677

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.36 Statistical Results on the Producers Who Check Sources Once a Week or Less for Market Hog Prices.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.365413534	0.417910448	0.7088608	0.6460177			
Standard Deviation	0.231886483	0.243261305	0.2063772	0.22867883			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-0.838541704	-3.7270194***	0.9415548	-6.4234351***	-3.0715204***	-5.8766441***
	v = degree of freedom	80.74734622	139.8658	181.95835	483.5477	89.43698	623.3768

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.37 Statistical Results on the Producers Who Check Sources Once a Month or More for Leanness and Back-Fat Values.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.552469136	0.523076923	0.2151899	0.26548673			
Standard Deviation	0.24724699	0.249467456	0.1688832	0.19500352			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	0.462808657	4.0680165***	-0.82552381	6.8502028***	3.5312143***	6.3896363***
	v = degree of freedom	81.31563407	131.29492	184.076099	637.59728	61.208557	593.36083

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.38 Statistical Results on the Producers Who Check Sources Once Quarterly for Leanness and Back-Fat Values.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.205246914	0.353846154	0.1898734	0.21238938			
Standard Deviation	0.163120618	0.228639053	0.1538215	0.16728013			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-2.475646793**	2.2655839**	-0.39233917	0.3341699	2.0460267**	-0.1753991
	v = degree of freedom	77.18662069	131.04229	180.968187	643.90001	58.017421	637.07361

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.39 Statistical Results on the Rating of Labor Quality.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	5.916535433	7.212121212	6.3291139	6.50442478			
Standard Deviation	6.81980532	4.318640955	6.2967473	7.25882998			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-4.776626646***	2.35742**	-0.47140013	-1.3999931	2.0014682**	-2.1974413**
	v = degree of freedom	90.35205563	149.999	183.994222	274.48568	209.93528	596.72015

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.40 Descriptive Statistic Results on the Percentage of Producers Who Were Identified as Risk Averse for a Particular Investment.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.785016	0.828125	0.730769	0.766355			
Standard Deviation	0.168766	0.142333984	0.196746	0.179055			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-0.890770239	1.452508	-0.56861	1.054135	1.027991	0.44402
	v = degree of freedom	84.26278427	149.9121	170.9368	288.6015	183.1748	787.127

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.41 Descriptive Statistic Results on the Importance of Relationship with Lending Institutions.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	3.428139183	3.686567164	3.45	3.65811966			
Standard Deviation	0.647256598	0.334595678	0.6225	0.39593834			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-3.371544767***	2.1149071**	-1.98915242**	-0.2364732	0.3127056	-3.5030718***
	v = degree of freedom	95.996508	147.77502	149.890004	223.03031	266.98545	1246.8726

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.42 Descriptive Statistic Results on the Importance of Relationship with Feed Merchants.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	3.233082707	3.358208955	2.9240506	3			
Standard Deviation	0.57574764	0.349298285	0.677776	0.96551724			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-1.617270988	3.7502348***	-0.59220053	3.2369148***	3.103839***	2.4526144**
	v = degree of freedom	91.43983556	146.99763	193.22712	215.93759	284.27327	477.94707

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.43 Descriptive Statistic Results on the Importance of Relationship with Veterinarians.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	3.434848485	3.388059701	3.0625	3.2991453			
Standard Deviation	0.494240129	0.446424593	0.7835938	0.77375995			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	0.547845151	2.5640911**	-1.86425584*	3.671535***	0.7761867	1.589783
	v = degree of freedom	83.06729532	148.67363	175.647451	234.04989	261.33404	715.01513

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.44 Descriptive Statistic Results on the Importance of Relationship with Non-Farmers.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	3.35347432	3.373134328	3.4	3.48717949			
Standard Deviation	0.597110286	0.532412564	0.415	0.52333991			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-0.21065287	-0.2366255	-0.89462822	-0.6035851	-1.0297902	-1.8338541*
	v = degree of freedom	83.28596023	136.81487	188.287112	534.47486	83.576516	539.80021

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.45 Descriptive Statistic Results on the Importance of Relationship with Packer/Slaughterer.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	3.240487062	3.432835821	2.6625	2.68965517			
Standard Deviation	0.67580372	0.454444197	1.0985938	1.31747919			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-2.194903663**	5.4361692***	-0.17326695	4.8175215***	5.5628664***	4.9948156***
	v = degree of freedom	88.91192308	141.50474	185.943218	184.33151	353.97486	573.12811

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.46 Descriptive Statistic Results on the Importance of Relationship with Neighboring Farmers.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	3.50678733	3.417910448	3.6	3.64957265			
Standard Deviation	0.488264641	0.482067276	0.34	0.31309811			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	1.005728051	-1.7178591*	-0.60116926	-1.3361855	-2.3470253**	-2.4583368**
	v = degree of freedom	81.64296614	132.94195	171.625992	605.21064	56.710544	769.54386

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.47 Statistical Results on the Producer's Age.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	48.41728763	44.54545455	43.691358	46.7372881			
Standard Deviation	146.0285536	155.7327824	92.163999	111.430982			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	2.446039213**	0.4622387	-2.11794707**	4.0835985***	-1.2187167	1.5600342
	v = degree of freedom	80.51435648	125.76318	186.333879	760.43096	49.226274	563.68794

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.48 Statistical Results on the Producer Who Completed Less Than High School.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.044378698	0.030769231	0.0487805	0.06779661			
Standard Deviation	0.042409229	0.029822485	0.046401	0.06320023			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	0.607955517	-0.5683082	-0.57297743	-0.1755924	-1.1863356	-0.957513
	v = degree of freedom	87.90000985	149.81635	191.542146	259.12247	231.39389	500.08191

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.49 Statistical Results on the Producer Who Completed High School.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.334319527	0.261538462	0.2560976	0.37288136			
Standard Deviation	0.222549981	0.193136095	0.1905116	0.23384085			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	1.292983013	0.0757176	-1.77989869*	1.5190716	-1.6034361	-0.8023366
	v = degree of freedom	83.75378947	144.53951	187.046834	406.97913	121.62566	556.90266

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.50 Statistical Results on the Producer Who Completed Some College.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.355029586	0.323076923	0.4634146	0.33898305			
Standard Deviation	0.228983579	0.218698225	0.2486615	0.22407354			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	0.53598843	-1.775345*	1.77192827*	-1.8669904*	-0.2224018	0.3392978
	v = degree of freedom	82.15822281	147.77004	170.356371	349.88212	132.94608	796.11738

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.51 Descriptive Statistic Results on the Producer Who Completed a Bachelor's Degree.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.218934911	0.323076923	0.2073171	0.1779661			
Standard Deviation	0.171002416	0.218698225	0.1643367	0.14629417			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-1.768330685*	1.6021827	0.51533496	0.2445822	2.1738549**	1.0606433
	v = degree of freedom	78.19642132	135.42457	169.640296	560.05698	62.626852	806.81607

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.52 Descriptive Statistic Results on the Producer Who Completed a Master's Degree.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.032544	0.046153846	0.02439	0.033898			
Standard Deviation	0.031485	0.044023669	0.023795	0.032749			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-0.516665908	0.710761	-0.39905	0.444431	0.402972	-0.07522
	v = degree of freedom	77.21232225	122.0067	191.9473	861.7611	45.95052	493.5147

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.53 Descriptive Statistic Results on the Producer Who Completed a Ph.D. Degree.

	Independent (I)	Cooperative (C)	Flat-fee (F)	Incentive (IN)			
Mean Value	0.014793	0.015384615	0	0.008475			
Standard Deviation	0.014574	0.015147929	0	0.008403			
		I vs C	C vs F	F vs IN	I vs F	C vs IN	I vs IN
	t - distribution	-0.037860619	1.030776	-1.00426	3.190639***	0.40302	0.656219
	v = degree of freedom	80.88043214	67	117	72919.6	4.656429	115.1295

*** indicates significance at the 0.01 level. ** indicates significance at the 0.05 level. * indicates significance at the 0.10 level.

Table 4.54 Statistical Results on Number of Months Producers Have Been Producing Under Contract.

		Flat-fee (F)	Incentive (IN)
	Mean Value	43.21951	55.491525
	Standard Deviation	1244.684	2100.6906
			F vs IN
	t - distribution		-2.136881**
	V = degree of freedom		197.98882

** indicates significance at the 0.05 level.

Table 4.55 Statistical Results on the Percentage of Producers Who Had Contracts with Neighboring Farmers.

		Flat-fee (F)	Incentive (IN)
	Mean Value	0.390244	0.1016949
	Standard Deviation	0.237954	0.0913531
			F vs IN
	t - distribution		4.759143***
	V = degree of freedom		124.89453

*** indicates significance at the 0.01 level.

Table 4.56 Statistical Results on the Percentage of Producers Who Were Required to Obtain New or Renovated Facilities.

		Flat-fee (F)	Incentive (IN)
	Mean Value	0.414634	0.6864407
	Standard Deviation	0.242713	0.2152399
			F vs IN
	t - distribution		-3.929754***
	v = degree of freedom		169.41487

*** indicates significance at the 0.01 level.

Table 4.57 Statistical Results on the Percentage of Producers Who Were Provided Feed by the Contractor.

		Flat-fee (F)	Incentive (IN)
	Mean Value	0.878049	0.90678
	Standard Deviation	0.107079	0.08453
			F vs IN
	t - distribution		-0.63891
	v = degree of freedom		162.5114

Table 4.58 Statistical Results on the Percentage of Producers Who Were Provided Animals by the Contractor.

		Flat-fee (F)	Incentive (IN)
	Mean Value	0.8658537	0.91525424
	Standard Deviation	0.1161511	0.07756392
			F vs IN
	t - distribution		-1.08479779
	v = degree of freedom		152.674618

Table 4.59 Statistical Results on Medication Provided by the Contractor.

		Flat-fee (F)	Incentive (IN)
	Mean Value	0.8658537	0.89830508
	Standard Deviation	0.1161511	0.09135306
			F vs IN
	t - distribution		-0.69334081
	v = degree of freedom		162.291215

Table 4.60 Statistical Results on Producers Who Had Raised Hogs Prior to Accepting a Contract.

		Flat-fee (F)	Incentive (IN)
	Mean Value	0.8902439	0.90677966
	Standard Deviation	0.0977097	0.08453031
			F vs IN
	t - distribution		-0.37856612
	v = degree of freedom		167.95216

Table 4.61 Statistical Results on Average Acres Used for Hog Production.

		Flat-fee (F)	Incentive (IN)
	Mean Value	496.9324	479.1579
	Standard Deviation	330727.2	519683.6
			F vs IN
	t - distribution		0.193506
	v = degree of freedom		196.3078

APPENDIX B: TESTING FOR HETEROSKEDASTICITY USING THE HETEROSKEDASTICITY EXTREME VALUE LOGIT AND MULTIPLICATIVE

Table 5.1a. Results From the Multinomial Logit Model Before Testing for Heteroskedasticity. (Cooperative vs Independent).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	1.46662	0.8522
HOG250	0.00002	0.0002
BREEDSOW	0.00003	0.9552
TOTALFD	0.09186	0.3988
DARATIO	0.00067	0.8855
AUNOTIMP	0.26462	0.0003
AUVERIMP	0.26440	0.0003
BIOSECUR	0.00071	0.9066
AGE	0.00092	0.1227
COMPHS	0.58785	0.2776
BACHELO	0.29636	0.4400
CORN	0.27857	0.0101
MKTPRICE	1.23940	0.2260
VALFARAS	0.00056	0.9619
NEIGFARM	0.00821	0.7581
RISKAVER	0.34070	0.2446
FFLATFEE	0.29330	0.9625
FCONTRWI	0.29510	0.0028
HINCOME	0.41906	0.8131
SOUTH	0.67409	0.9303
LENDINST	0.16478	0.3221
FEEDMERC	0.16470	0.3161
TIMEHSYR	0.00085	0.1680
NHWOFFFA	0.00751	0.4542

Table 5.1b. Results From the Multinomial Logit Model After Testing for Heteroskedasticity Using the HEVL (Cooperative vs Independent).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	1.46662	0.8522
HOG250	0.00002	0.0002
BREEDSOW	0.00003	0.9552
TOTALFD	0.09186	0.3988
DARATIO	0.00067	0.8855
AUNOTIMP	0.26462	0.0003
AUVERIMP	0.26440	0.0003
BIOSECUR	0.00071	0.9066
AGE	0.00092	0.1227
COMPHS	0.58785	0.2776
BACHELO	0.29636	0.4400
CORN	0.27857	0.0101
MKTPRICE	1.23940	0.2260
VALFARAS	0.00056	0.9619
NEIGFARM	0.00821	0.7581
RISKAVER	0.34070	0.2446
FFLATFEE	0.29330	0.9625
FCONTRWI	0.29510	0.0028
HINCOME	0.41906	0.8131
SOUTH	0.67409	0.9303
LENDINST	0.16478	0.3221
FEEDMERC	0.16470	0.3161
TIMEHSYR	0.00085	0.1680
NHWOFFFA	0.00751	0.4542

Table 5.2a. Results From the Multinomial Logit Model Before Testing for Heteroskedasticity.
(Flat-Fee Contract vs Independent).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	1.43251	0.4382
HOG250	0.00002	0.0005
BREEDSOW	0.00075	0.0025
TOTALFD	0.10458	0.0126
DARATIO	0.00054	0.0243
AUNOTIMP	0.22325	0.0000
AUVERIMP	0.22311	0.0000
BIOSECUR	0.00142	0.0456
AGE	0.00110	0.4511
COMPHS	0.65866	0.5340
BACHELO	0.34011	0.2549
CORN	0.28381	0.0038
MKTPRICE	1.12260	0.4315
VALFARAS	0.00067	0.0157
NEIGFARM	0.17420	0.0064
RISKAVER	0.31166	0.6442
FFLATFEE	0.30551	0.0003
FCONTRWI	0.29736	0.9243
HINCOME	0.59879	0.1062
SOUTH	0.71456	0.8333
LENDINST	0.17672	0.6881
FEEDMERC	0.13307	0.0000
TIMEHSYR	0.00051	0.1683
NHWOFFFA	0.00692	0.0910

Table 5.2b. Results From the Multinomial Logit Model After Testing for Heteroskedasticity Using the HEVL
(Flat-Fee Contract vs Independent).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	1.43251	0.4382
HOG250	0.00002	0.0005
BREEDSOW	0.00075	0.0025
TOTALFD	0.10458	0.0126
DARATIO	0.00054	0.0243
AUNOTIMP	0.22325	0.0000
AUVERIMP	0.22311	0.0000
BIOSECUR	0.00142	0.0456
AGE	0.00110	0.4511
COMPHS	0.65866	0.5340
BACHELO	0.34011	0.2549
CORN	0.28381	0.0038
MKTPRICE	1.12260	0.4315
VALFARAS	0.00067	0.0157
NEIGFARM	0.17420	0.0064
RISKAVER	0.31166	0.6442
FFLATFEE	0.30551	0.0003
FCONTRWI	0.29736	0.9243
HINCOME	0.59879	0.1062
SOUTH	0.71456	0.8333
LENDINST	0.17672	0.6881
FEEDMERC	0.13307	0.0000
TIMEHSYR	0.00051	0.1683
NHWOFFFA	0.00692	0.0910

Table 5.3a. Results From the Multinomial Logit Model Before Testing for Heteroskedasticity.
(Incentive Payment Contract vs Independent).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	1.19374	0.0659
HOG250	0.00002	0.0000
BREEDSOW	0.00018	0.0146
TOTALFD	0.08298	0.4773
DARATIO	0.00046	0.0085
AUNOTIMP	0.21457	0.0000
AUVERIMP	0.21440	0.0000
BIOSECUR	0.00062	0.9548
AGE	0.00248	0.4579
COMPHS	0.51147	0.0149
BACHELO	0.31072	0.0492
CORN	0.27502	0.0074
MKTPRICE	0.96264	0.0064
VALFARAS	0.00050	0.5709
NEIGFARM	0.15902	0.2907
RISKAVER	0.27608	0.2908
FFLATFEE	0.26603	0.0309
FCONTRWI	0.30577	0.0000
HINCOME	0.36959	0.3839
SOUTH	0.43047	0.0001
LENDINST	0.17029	0.0270
FEEDMERC	0.13308	0.0000
TIMEHSYR	0.00049	0.5412
NHWOFFFA	0.00657	0.0235

Table 5.3b. Results From the Multinomial Logit Model After Testing for Heteroskedasticity Using the HEVL
(Incentive Payment Contract vs Independent).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	1.19374	0.0659
HOG250	0.00002	0.0000
BREEDSOW	0.00018	0.0146
TOTALFD	0.08298	0.4773
DARATIO	0.00046	0.0085
AUNOTIMP	0.21457	0.0000
AUVERIMP	0.21440	0.0000
BIOSECUR	0.00062	0.9548
AGE	0.00248	0.4579
COMPHS	0.51147	0.0149
BACHELO	0.31072	0.0492
CORN	0.27502	0.0074
MKTPRICE	0.96264	0.0064
VALFARAS	0.00050	0.5709
NEIGFARM	0.15902	0.2907
RISKAVER	0.27608	0.2908
FFLATFEE	0.26603	0.0309
FCONTRWI	0.30577	0.0000
HINCOME	0.36959	0.3839
SOUTH	0.43047	0.0001
LENDINST	0.17029	0.0270
FEEDMERC	0.13308	0.0000
TIMEHSYR	0.00049	0.5412
NHWOFFFA	0.00657	0.0235

Table 5.4a. Results From the Multinomial Logit Model Before Testing for Heteroskedasticity.
(Flat-Fee Contract vs Cooperative).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	1.80391	0.6637
HOG250	0.00004	0.7768
BREEDSOW	0.00076	0.0028
TOTALFD	0.12724	0.0888
DARATIO	0.00081	0.1046
AUNOTIMP	0.27473	0.0040
AUVERIMP	0.27456	0.0040
BIOSECUR	0.00154	0.0789
AGE	0.00123	0.5924
COMPHS	0.79865	0.8447
BACHELO	0.41675	0.1551
CORN	0.13121	0.1078
MKTPRICE	1.47974	0.6938
VALFARAS	0.00082	0.0566
NEIGFARM	0.17401	0.0068
RISKAVER	0.43235	0.2053
FFLATFEE	0.39417	0.0056
FCONTRWI	0.39100	0.0305
HINCOME	0.67928	0.1072
SOUTH	0.90269	0.8171
LENDINST	0.22370	0.6645
FEEDMERC	0.13308	0.0462
TIMEHSYR	0.00049	0.0506
NHWOFFFA	0.00657	0.4436

Table 5.4b. Results From the Multinomial Logit Model After Testing for Heteroskedasticity Using the HEVL
(Flat-Fee Contract vs Cooperative).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	1.80391	0.6637
HOG250	0.00004	0.7768
BREEDSOW	0.00076	0.0028
TOTALFD	0.12724	0.0888
DARATIO	0.00081	0.1046
AUNOTIMP	0.27473	0.0040
AUVERIMP	0.27456	0.0040
BIOSECUR	0.00154	0.0789
AGE	0.00123	0.5924
COMPHS	0.79865	0.8447
BACHELO	0.41675	0.1551
CORN	0.13121	0.1078
MKTPRICE	1.47974	0.6938
VALFARAS	0.00082	0.0566
NEIGFARM	0.17401	0.0068
RISKAVER	0.43235	0.2053
FFLATFEE	0.39417	0.0056
FCONTRWI	0.39100	0.0305
HINCOME	0.67928	0.1072
SOUTH	0.90269	0.8171
LENDINST	0.22370	0.6645
FEEDMERC	0.13308	0.0462
TIMEHSYR	0.00049	0.0506
NHWOFFFA	0.00657	0.4436

Table 5.5a. Results From the Multinomial Logit Model Before Testing for Heteroskedasticity.
(Incentive Payment Co. vs Cooperative).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	1.62870	0.2368
HOG250	0.00001	0.2392
BREEDSOW	0.00018	0.0141
TOTALFD	0.10654	0.8610
DARATIO	0.00075	0.0779
AUNOTIMP	0.26084	0.0190
AUVERIMP	0.26064	0.0197
BIOSECUR	0.00087	0.9473
AGE	0.00255	0.1995
COMPHS	0.67744	0.3695
BACHELO	0.38828	0.0313
CORN	0.11317	0.8630
MKTPRICE	1.37436	0.4119
VALFARAS	0.00068	0.7081
NEIGFARM	0.15921	0.3061
RISKAVER	0.40436	0.0876
FFLATFEE	0.35731	0.1156
FCONTRWI	0.39252	0.0006
HINCOME	0.48390	0.6411
SOUTH	0.69487	0.0187
LENDINST	0.21831	0.3370
FEEDMERC	0.18819	0.0480
TIMEHSYR	0.00093	0.1095
NHWOFFFA	0.00885	0.2888

Table 5.5b. Results From the Multinomial Logit Model After Testing for Heteroskedasticity Using the HEVL
(Incentive Payment Co. vs Cooperative).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	1.62870	0.2368
HOG250	0.00001	0.2392
BREEDSOW	0.00018	0.0141
TOTALFD	0.10654	0.8610
DARATIO	0.00075	0.0779
AUNOTIMP	0.26084	0.0190
AUVERIMP	0.26064	0.0197
BIOSECUR	0.00087	0.9473
AGE	0.00255	0.1995
COMPHS	0.67744	0.3695
BACHELO	0.38828	0.0313
CORN	0.11317	0.8630
MKTPRICE	1.37436	0.4119
VALFARAS	0.00068	0.7081
NEIGFARM	0.15921	0.3061
RISKAVER	0.40436	0.0876
FFLATFEE	0.35731	0.1156
FCONTRWI	0.39252	0.0006
HINCOME	0.48390	0.6411
SOUTH	0.69487	0.0187
LENDINST	0.21831	0.3370
FEEDMERC	0.18819	0.0480
TIMEHSYR	0.00093	0.1095
NHWOFFFA	0.00885	0.2888

Table 5.6a. Results From the Multinomial Logit Model Before Testing for Heteroskedasticity.
(Flat-Fee Contract vs Incentive Payment Co.).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	1.49280	0.3752
HOG250	0.00001	0.4454
BREEDSOW	0.00076	0.0181
TOTALFD	0.11578	0.0528
DARATIO	0.00061	0.9801
AUNOTIMP	0.20971	0.3537
AUVERIMP	0.20967	0.3465
BIOSECUR	0.00123	0.1115
AGE	0.00259	0.3257
COMPHS	0.72449	0.2919
BACHELO	0.40718	0.4540
CORN	0.11770	0.0621
MKTPRICE	1.18936	0.1079
VALFARAS	0.00075	0.0739
NEIGFARM	0.15954	0.0683
RISKAVER	0.36539	0.7879
FFLATFEE	0.35772	0.0000
FCONTRWI	0.38680	0.0000
HINCOME	0.63673	0.0363
SOUTH	0.66855	0.0592
LENDINST	0.15950	0.0694
FEEDMERC	0.00217	0.2180
TIMEHSYR	0.00059	0.5669
NHWOFFFA	0.00805	0.7615

Table 5.6b. Results From the Multinomial Logit Model After Testing for Heteroskedasticity Using the HEVL
(Flat-Fee Contract vs Incentive Payment Co.).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	1.49280	0.3752
HOG250	0.00001	0.4454
BREEDSOW	0.00076	0.0181
TOTALFD	0.11578	0.0528
DARATIO	0.00061	0.9801
AUNOTIMP	0.20971	0.3537
AUVERIMP	0.20967	0.3465
BIOSECUR	0.00123	0.1115
AGE	0.00259	0.3257
COMPHS	0.72449	0.2919
BACHELO	0.40718	0.4540
CORN	0.11770	0.0621
MKTPRICE	1.18936	0.1079
VALFARAS	0.00075	0.0739
NEIGFARM	0.15954	0.0683
RISKAVER	0.36539	0.7879
FFLATFEE	0.35772	0.0000
FCONTRWI	0.38680	0.0000
HINCOME	0.63673	0.0363
SOUTH	0.66855	0.0592
LENDINST	0.15950	0.0694
FEEDMERC	0.00217	0.2180
TIMEHSYR	0.00059	0.5669
NHWOFFFA	0.00805	0.7615

Table 5.7a. Results From the Binomial Logit Model Before Testing for Heteroskedasticity. (Flat-Fee Contract vs Incentive Payment Co.).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	0.53156	0.8149
HOG250	0.00417	0.0933
BREEDSOW	0.40128	0.0000
TOTALFD	0.33061	0.0046
DARATIO	0.00022	0.5628
AUNOTIMP	0.53034	0.9379

Table 5.7b. Results From the Binomial Logit Model After Testing for Heteroskedasticity Using the Multiplicative. (Flat-Fee Contract vs Incentive Payment Co.).

Exogenous Variables	Standard Errors	P-Values
INTERCEPT	0.53156	0.8149
HOG250	0.00417	0.0933
BREEDSOW	0.40128	0.0000
TOTALFD	0.33061	0.0046
DARATIO	0.00022	0.5628
NHWOFFFA	0.53034	0.9379

APPENDIX C: PEARSON CORRELATION COEFFICIENTS OF THE EXOGENOUS VARIABLES FOR THE MULTINOMIAL LOGIT MODEL

Table 6.1 Statistics of the Exogenous Variables Used in the Multinomial Logit Model.

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
United States (state)	946	22.61	9.98	21386	1.00	50.00
Number of Breeding Sows (breedsow)	944	283.53	2375	67650	0	70000
No. of 250 Pound Hogs Produced (hog250)	939	4060	16874	3812474	0	400000
Number of Enterprises (totalfd)	945	3.18	1.74	3004	0	11.00
Corn Produced on the Farm (corn)	945	0.82	0.38	777.00	0	1.00
Debt-to-Asset Ratio (daratio)	872	2.65	1.24	2317	1.00	5.00
No. of Hours Worked Off Farm (nhwofffa)	946	10.03	18.07	9487	0	80.00
Autonomy Is Not Very Important (aunotimp)	925	0.07	0.25	63.00	0	1.00
Autonomy Is Very Important (auverimp)	925	0.57	0.49	531.00	0	1.00
Flat-fee Contracts Used in the Co. (fflatee)	946	0.42	0.49	398.00	0	1.00
Flat-fee Contracts Used in the Co. (fcontrwi)	946	0.46	0.50	431.00	0	1.00
Freq. of Checking Market Price (mrkprice)	924	0.57	0.50	524.00	0	1.00
No. of Times Hogs Sold per Year (timesyr)	883	28.71	31.79	25347	0	365.00
Total Value of Farm Assets (valfaras)	854	2.83	1.71	2413	0	7.00
Rating of Biosecurity (biosecur)	893	6.19	2.30	5524	0	10.00
Producer Age (age)	936	47.52	11.85	44482	17.0	87.00
Producer Completed High School (comphs)	941	0.95	0.21	897.00	0	1.00
Producer Holds Bachelor's Degree (bachelor)	941	0.27	0.44	250.00	0	1.00

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
Net Household Income ≥ 100,000 (nhincome)	848	3.16	1.59	2681	1.00	7.00
Imp. of Relations with Farmers (neigfarm)	927	3.53	0.68	3269	1.00	5.00
Imp. of Relations with Lenders (lendinst)	925	3.48	0.77	3217	0	4.00
Imp. of Relations with Feed Merch. (feedmerc)	927	3.19	0.79	2954	0	5.00
Self Assess. of Risk Preference (choicinv)	863	2.81	1.13	2424	1.00	5.00

Table 6.2 Pearson Correlation Coefficients of the Exogenous Variables for the Multinomial Logit Model.

	state	breedsow	hog250	totalfd	corn	daratio	nhwofffa	aunotimp
state	1.00000	0.01257	0.03110	0.12552	-0.03324	0.02738	0.00808	0.02404
		0.6996	0.3412	0.0001	0.3073	0.4194	0.8040	0.4652
	946	944	939	945	945	872	946	925
breedsow	0.01257	1.00000	0.10742	-0.07635	-0.11001	0.03063	-0.04609	0.02787
	0.6996		0.0010	0.0190	0.0007	0.3669	0.1571	0.3977
	944	944	937	943	943	870	944	923
hog250	0.03110	0.10742	1.00000	-0.00400	-0.07304	0.10824	-0.05448	0.14729
	0.3412	0.0010		0.9027	0.0253	0.0014	0.0952	<.0001
	939	937	939	938	938	865	939	918
totalfd	0.12552	-0.07635	-0.00400	1.00000	0.48594	-0.04830	-0.07141	-0.00954
	0.0001	0.0190	0.9027		<.0001	0.1544	0.0282	0.7721
	945	943	938	945	945	871	945	924
corn	-0.03324	-0.11001	-0.07304	0.48594	1.00000	-0.03404	-0.13286	-0.04554
	0.3073	0.0007	0.0253	<.0001		0.3156	<.0001	0.1667
	945	943	938	945	945	871	945	924
daratio	0.02738	0.03063	0.10824	-0.04830	-0.03404	1.00000	0.07195	0.04823
	0.4194	0.3669	0.0014	0.1544	0.3156		0.0336	0.1577
	872	870	865	871	871	872	872	860
nhwofffa	0.00808	-0.04609	-0.05448	-0.07141	-0.13286	0.07195	1.00000	0.06862
	0.8040	0.1571	0.0952	0.0282	<.0001	0.0336		0.0369
	946	944	939	945	945	872	946	925
aunotimp	0.02404	0.02787	0.14729	-0.00954	-0.04554	0.04823	0.06862	1.00000
	0.4652	0.3977	<.0001	0.7721	0.1667	0.1577	0.0369	
	925	923	918	924	924	860	925	925

	state	breedsow	hog250	totalfd	corn	daratio	nhwofffa	aunotimp
auverimp	-0.03806 0.2476 925	-0.06789 0.0392 923	-0.07581 0.0216 918	0.08331 0.0113 924	0.05393 0.1013 924	-0.15432 <.0001 860	-0.04963 0.1315 925	-0.31385 <.0001 925
fflatee	-0.08422 0.0096 946	0.02180 0.5036 944	-0.03468 0.2885 939	-0.09871 0.0024 945	0.07614 0.0192 945	0.11283 0.0008 872	0.07784 0.0166 946	0.02747 0.4040 925
fcontrwi	-0.05116 0.1159 946	-0.01876 0.5649 944	0.05955 0.0681 939	-0.08325 0.0105 945	-0.04100 0.2080 945	0.06605 0.0512 872	0.01230 0.7055 946	0.09518 0.0038 925
mrkprice	-0.04249 0.1969 924	0.03485 0.2905 922	0.02767 0.4026 917	0.09353 0.0045 923	0.10826 0.0010 923	0.00370 0.9137 859	-0.09798 0.0029 924	-0.14394 <.0001 909
timesyr	-0.04230 0.2092 883	0.06785 0.0441 881	0.35032 <.0001 877	0.02822 0.4022 883	0.07055 0.0361 883	0.12337 0.0004 828	-0.11452 0.0007 883	-0.04422 0.1928 869
valfaras	-0.04130 0.2279 854	0.13719 <.0001 852	0.20784 <.0001 849	0.13746 <.0001 854	0.17057 <.0001 854	-0.03483 0.3192 820	-0.23808 <.0001 854	0.01372 0.6911 842
biosecur	0.00520 0.8767 893	0.07481 0.0255 891	0.08519 0.0112 886	-0.05991 0.0737 892	-0.05476 0.1021 892	0.02631 0.4508 824	-0.09948 0.0029 893	-0.03159 0.3501 877
age	-0.11369 0.0005 936	-0.04113 0.2092 934	0.01956 0.5516 929	-0.00549 0.8668 935	0.01356 0.6787 935	-0.20018 <.0001 865	-0.16044 <.0001 936	-0.00303 0.9270 917

	state	breedsow	hog250	totalfd	corn	daratio	nhwofffa	aunotimp
comphs	-0.12381	0.00127	0.00377	-0.08144	0.01494	0.03715	0.07888	-0.02324
	0.0001	0.9689	0.9085	0.0125	0.6474	0.2743	0.0155	0.4812
	941	939	934	940	940	868	941	921
bachelor	-0.00839	0.07895	0.09562	0.00736	-0.04600	0.05691	0.01975	0.03155
	0.7971	0.0155	0.0034	0.8217	0.1588	0.0938	0.5451	0.3389
	941	939	934	940	940	868	941	921
nhincome	0.01598	0.11428	0.15044	-0.04064	0.01945	-0.10596	0.04950	0.06136
	0.6421	0.0009	<.0001	0.2374	0.5720	0.0027	0.1498	0.0769
	848	846	844	847	847	802	848	832
neigfarm	-0.00546	0.02244	0.01636	0.04084	0.04160	0.00458	-0.02668	-0.01807
	0.8681	0.4956	0.6203	0.2144	0.2059	0.8935	0.4172	0.5865
	927	925	920	926	926	855	927	908
lendinst	-0.03112	0.02874	0.02872	-0.04346	0.01368	0.26606	0.01384	-0.04409
	0.3445	0.3831	0.3848	0.1869	0.6780	<.0001	0.6741	0.1846
	925	923	918	924	924	853	925	907
feedmerc	0.04318	-0.05003	0.00273	0.03423	0.04256	-0.07245	-0.00567	-0.15854
	0.1890	0.1284	0.9342	0.2981	0.1956	0.0341	0.8632	<.0001
	927	925	920	926	926	856	927	909
choicinv	-0.00157	0.06895	0.06783	-0.01655	-0.02141	0.09969	0.05461	-0.00904
	0.9632	0.0431	0.0471	0.6275	0.5301	0.0046	0.1089	0.7926
	863	861	857	862	862	806	863	849

	auverimp	fflatee	fcontrwi	mrkprice	timesyr	valfaras	biosecur	age
state	-0.03806	-0.08422	-0.05116	-0.04249	-0.04230	-0.04130	0.00520	-0.11369
	0.2476	0.0096	0.1159	0.1969	0.2092	0.2279	0.8767	0.0005
	925	946	946	924	883	854	893	936
breedsow	-0.06789	0.02180	-0.01876	0.03485	0.06785	0.13719	0.07481	-0.04113
	0.0392	0.5036	0.5649	0.2905	0.0441	<.0001	0.0255	0.2092
	923	944	944	922	881	852	891	934
hog250	-0.07581	-0.03468	0.05955	0.02767	0.35032	0.20784	0.08519	0.01956
	0.0216	0.2885	0.0681	0.4026	<.0001	<.0001	0.0112	0.5516
	918	939	939	917	877	849	886	929
totalfd	0.08331	-0.09871	-0.08325	0.09353	0.02822	0.13746	-0.05991	-0.00549
	0.0113	0.0024	0.0105	0.0045	0.4022	<.0001	0.0737	0.8668
	924	945	945	923	883	854	892	935
corn	0.05393	0.07614	-0.04100	0.10826	0.07055	0.17057	-0.05476	0.01356
	0.1013	0.0192	0.2080	0.0010	0.0361	<.0001	0.1021	0.6787
	924	945	945	923	883	854	892	935
daratio	-0.15432	0.11283	0.06605	0.00370	0.12337	-0.03483	0.02631	-0.20018
	<.0001	0.0008	0.0512	0.9137	0.0004	0.3192	0.4508	<.0001
	860	872	872	859	828	820	824	865
nhwofffa	-0.04963	0.07784	0.01230	-0.09798	-0.11452	-0.23808	-0.09948	-0.16044
	0.1315	0.0166	0.7055	0.0029	0.0007	<.0001	0.0029	<.0001
	925	946	946	924	883	854	893	936
aunotimp	-0.31385	0.02747	0.09518	-0.14394	-0.04422	0.01372	-0.03159	-0.00303
	<.0001	0.4040	0.0038	<.0001	0.1928	0.6911	0.3501	0.9270
	925	925	925	909	869	842	877	917

	auverimp	fflatee	fcontrwi	mrkprice	timesyr	valfaras	biosecur	age
auverimp	1.00000	-0.09363	-0.11394	0.11924	0.06238	-0.01984	-0.05252	0.04682
		0.0044	0.0005	0.0003	0.0661	0.5653	0.1201	0.1566
	925	925	925	909	869	842	877	917
fflatee	-0.09363	1.00000	0.29525	0.06748	0.06197	-0.05440	0.09287	-0.11042
	0.0044		<.0001	0.0403	0.0657	0.1121	0.0055	0.0007
	925	946	946	924	883	854	893	936
fcontrwi	-0.11394	0.29525	1.00000	0.01307	0.00517	0.02757	0.08139	-0.08859
	0.0005	<.0001		0.6915	0.8781	0.4210	0.0150	0.0067
	925	946	946	924	883	854	893	936
mrkprice	0.11924	0.06748	0.01307	1.00000	0.22194	0.14624	0.01327	0.05534
	0.0003	0.0403	0.6915		<.0001	<.0001	0.6950	0.0945
	909	924	924	924	870	841	876	914
timesyr	0.06238	0.06197	0.00517	0.22194	1.00000	0.26885	0.07623	0.05594
	0.0661	0.0657	0.8781	<.0001		<.0001	0.0273	0.0982
	869	883	883	870	883	811	838	875
valfaras	-0.01984	-0.05440	0.02757	0.14624	0.26885	1.00000	0.23217	0.11229
	0.5653	0.1121	0.4210	<.0001	<.0001		<.0001	0.0011
	842	854	854	841	811	854	813	847
biosecur	-0.05252	0.09287	0.08139	0.01327	0.07623	0.23217	1.00000	-0.06265
	0.1201	0.0055	0.0150	0.6950	0.0273	<.0001		0.0625
	877	893	893	876	838	813	893	885
age	0.04682	-0.11042	-0.08859	0.05534	0.05594	0.11229	-0.06265	1.00000
	0.1566	0.0007	0.0067	0.0945	0.0982	0.0011	0.0625	
	917	936	936	914	875	847	885	936

	auverimp	fflatee	fcontrwi	mrkprice	timesyr	valfaras	biosecur	age
age	0.04682 0.1566 917	-0.11042 0.0007 936	-0.08859 0.0067 936	0.05534 0.0945 914	0.05594 0.0982 875	0.11229 0.0011 847	-0.06265 0.0625 885	1.00000 936
comphs	-0.01928 0.5591 921	-0.01561 0.6325 941	0.04149 0.2035 941	0.07212 .0288 919	0.03843 0.2554 878	-0.02669 0.4370 850	-0.01567 0.6405 891	-0.02037 0.5343 933
bachelor	-0.07451 0.0237 921	0.06854 0.0355 941	0.08095 0.0130 941	0.11049 0.000 919	0.07702 0.0225 878	0.10773 0.0017 850	0.03669 0.2740 891	-0.01666 0.6112 933
nhincome	-0.08637 0.0127 832	0.03102 0.3669 848	0.06056 0.0780 848	0.00376 0.9138 830	0.05137 0.1466 800	0.31218 <.0001 813	0.08507 0.0156 808	0.13306 0.0001 843
neigfarm	0.03847 0.2469 908	-0.02210 0.5016 927	0.01991 0.5449 927	-0.01719 0.6047 909	0.00992 0.7705 867	0.02649 0.4435 839	0.06001 0.0752 880	0.01112 0.7362 920
lendinst	-0.00567 0.8646 907	0.04003 0.2239 925	0.06150 0.0615 925	0.01508 0.6504 906	0.02360 0.4881 865	-0.03006 0.3850 837	0.09250 0.0061 878	-0.02499 0.4495 918
feedmerc	0.10509 0.0015 909	0.00455 0.8899 927	-0.02862 0.3841 927	0.06309 0.0572 909	0.02165 0.5244 867	-0.02440 0.4801 840	0.03890 0.2488 881	0.00289 0.9301 920
choicinv	-0.04341 0.2063 849	0.05524 0.1049 863	0.02261 0.5071 863	0.01019 0.7672 846	0.03859 0.2711 815	0.06877 0.0527 794	0.05062 0.1451 830	-0.03254 0.3419 855

	comphs	bachelor	nhincome	neigfarm	lendinst	feedmerc	choicinv
state	-0.12381	-0.00839	0.01598	-0.00546	-0.03112	0.04318	-0.00157
	0.0001	0.7971	0.6421	0.8681	0.3445	0.1890	0.9632
	941	941	848	927	925	927	863
breedsow	0.00127	0.07895	0.11428	0.02244	0.02874	-0.05003	0.06895
	0.9689	0.0155	0.0009	0.4956	0.3831	0.1284	0.0431
	939	939	846	925	923	925	861
hog250	0.00377	0.09562	0.15044	0.01636	0.02872	0.00273	0.06783
	0.9085	0.0034	<.0001	0.6203	0.3848	0.9342	0.0471
	934	934	844	920	918	920	857
totalfd	-0.08144	0.00736	-0.04064	0.04084	-0.04346	0.03423	-0.01655
	0.0125	0.8217	0.2374	0.2144	0.1869	0.2981	0.6275
	940	940	847	926	924	926	862
corn	0.01494	-0.04600	0.01945	0.04160	0.01368	0.04256	-0.02141
	0.6474	0.1588	0.5720	0.2059	0.6780	0.1956	0.5301
	940	940	847	926	924	926	862
daratio	0.03715	0.05691	-0.10596	0.00458	0.26606	-0.07245	0.09969
	0.2743	0.0938	0.0027	0.8935	<.0001	0.0341	0.0046
	868	868	802	855	853	856	806
nhwofffa	0.07888	0.01975	0.04950	-0.02668	0.01384	-0.00567	0.05461
	0.0155	0.5451	0.1498	0.4172	0.6741	0.8632	0.1089
	941	941	848	927	925	927	863
aunotimp	-0.02324	0.03155	0.06136	-0.01807	-0.04409	-0.15854	-0.00904
	0.4812	0.3389	0.0769	0.5865	0.1846	<.0001	0.7926
	921	921	832	908	907	909	849

	comphs	bachelor	nhincome	neigfarm	lendinst	feedmerc	choicinv
auverimp	-0.01928	-0.07451	-0.08637	0.03847	-0.00567	0.10509	-0.04341
	0.5591	0.0237	0.0127	0.2469	0.8646	0.0015	0.2063
	921	921	832	908	907	909	849
fflatee	-0.01561	0.06854	0.03102	-0.02210	0.04003	0.00455	0.05524
	0.6325	0.0355	0.3669	0.5016	0.2239	0.8899	0.1049
	941	941	848	927	925	927	863
fcontrwi	0.04149	0.08095	0.06056	0.01991	0.06150	-0.02862	0.02261
	0.2035	0.0130	0.0780	0.5449	0.0615	0.3841	0.5071
	941	941	848	927	925	927	863
mrkprice	0.07212	0.11049	0.00376	-0.01719	0.01508	0.06309	0.01019
	0.0288	0.0008	0.9138	0.6047	0.6504	0.0572	0.7672
	919	919	830	909	906	909	846
timesyr	0.03843	0.07702	0.05137	0.00992	0.02360	0.02165	0.03859
	0.2554	0.0225	0.1466	0.7705	0.4881	0.5244	0.2711
	878	878	800	867	865	867	815
valfaras	-0.02669	0.10773	0.31218	0.02649	-0.03006	-0.02440	0.06877
	0.4370	0.0017	<.0001	0.4435	0.3850	0.4801	0.0527
	850	850	813	839	837	840	794
biosecur	-0.01567	0.03669	0.08507	0.06001	0.09250	0.03890	0.05062
	0.6405	0.2740	0.0156	0.0752	0.0061	0.2488	0.1451
	891	891	808	880	878	881	830
age	-0.02037	-0.01666	0.13306	0.01112	-0.02499	0.00289	-0.03254
	0.5343	0.6112	0.0001	0.7362	0.4495	0.9301	0.3419
	933	933	843	920	918	920	855

	comphs	bachelor	nhincome	neigfarm	lendinst	feedmerc	choicinv
comphs	1.00000	0.13322	-0.02729	-0.00254	0.05150	-0.05537	0.03614
		<.0001	0.4273	0.9386	0.1179	0.0924	0.2895
	941	941	848	925	923	925	861
bachelor	0.13322	1.00000	0.08597	-0.09093	-0.05257	-0.07215	0.03303
	<.0001		0.0123	0.0056	0.1105	0.0282	0.3331
	941	941	848	925	923	925	861
nhincome	-0.02729	0.08597	1.00000	-0.00545	0.01581	0.01819	0.13527
	0.4273	0.0123		0.8749	0.6487	0.5994	0.0001
	848	848	848	835	833	836	792
neigfarm	-0.00254	-0.09093	-0.00545	1.00000	0.31230	0.20940	0.07089
	0.9386	0.0056	0.8749		<.0001	<.0001	0.0383
	925	925	835	927	923	925	854
lendinst	0.05150	-0.05257	0.01581	0.31230	1.00000	0.33685	0.02287
	0.1179	0.1105	0.6487	<.0001		<.0001	0.5043
	923	923	833	923	925	923	855
feedmerc	-0.05537	-0.07215	0.01819	0.20940	0.33685	1.00000	-0.00277
	0.0924	0.0282	0.5994	<.0001	<.0001		0.9357
	925	925	836	925	923	927	854
choicinv	0.03614	0.03303	0.13527	0.07089	0.02287	-0.00277	1.00000
	0.2895	0.3331	0.0001	0.0383	0.5043	0.9357	
	861	861	792	854	855	854	863

APPENDIX D: PEARSON CORRELATION COEFFICIENTS OF THE EXOGENOUS VARIABLES FOR THE BINOMIAL LOGIT MODEL

Table 5.3. Statistics of the Exogenous Variables Used in the Binomial Logit Model.

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
mopundco	200	50.46	42.36	10092	0	216.00
contwnfa	200	0.22	0.42	44.00	0	1.00
newrefac	200	0.58	0.50	115.00	0	1.00
exraihog	200	0.90	0.30	180.00	0	1.00
numacres	188	486.15	669.15	91397	0	5000

Table 6.4 Pearson Correlation Coefficients of the Exogenous Variables for the Binomial Logit Model.

	mopundco	contwnfa	newrefac	numacres	exraihog
mopundco	1.00000	0.04877	0.24748	-0.21471	0.19765
		0.4929	0.0004	0.0031	0.0050
	200	200	200	188	200
contwnfa	0.04877	1.00000	-0.12941	0.00349	0.05633
	4929		0.0678	0.9620	0.4282
	200	200	200	188	200
newrefac	0.24748	-0.12941	1.00000	-0.06658	0.15172
	0.0004	0.0678		0.3639	0.0320
	200	200	200	188	200
numacres	-0.21471	0.00349	-0.06658	1.00000	-0.18671
	0031	0.9620	0.3639		0.0002
	188	188	188	188	188
exraihog	0.19765	0.05633	0.15172	-0.18671	1.00000
	0.0050	0.4282	0.0320	0.0103	
	200	200	200	188	200

APPENDIX E: U.S. HOG PRODUCER SURVEY

U.S. HOG PRODUCER SURVEY

Throughout this survey, you will be asked questions about your hog farm and how you make decisions with regard to the operation. Please circle the answer that best reflects your situation. Please follow the directions that are written in italics as you go through the survey.

Section I : Production Characteristics

1. My farm business is structured as a (circle one)

   a) sole proprietorship c) family corporation e) cooperative
   b) partnership d) non-family corporation

2. Do you have breeding sows in your operation? If yes, approximately how many?

   a) yes _____ (number) b) no

3. Did you raise hogs to a weight of 200 - 300 lbs for market in 1999? If yes, approximately how many?

   a) yes _____ (number) b) no

4. Did you raise feeder pigs to a weight of 40 - 60 lbs for market in 1999? If yes, approximately how many?

   a) yes _____ (number) b) no

5. How many years have you been raising hogs?

   _____ (years)

6. Approximately how many acres of land are used to support your hog operation (including land for crops that support the operation, such as corn for feed and manure disposal)?

   _____ (acres)

7. Are your hogs raised indoors or outdoors on or off "concrete"?

   a) indoors (confinement) b) outdoors on concrete c) outdoors off concrete

8. For this question, please refer to the following definitions of alternative production phases before responding.

Production Phase	*Definition*
Farrow-to-Wean	These operations provide breeding care for pigs from the time they are farrowed until they are weaned.
Feeder Pig/Nursery	These operations involve raising weaned pigs until they are ready to be transferred to the finishing operation (weighing approximately 40 to 60 pounds).
Finishing	These operations raise pigs from approximately 40 to 60 pounds to market weight of approximately 200 to 300 pounds.

In which of the above production phases are you currently involved? **(Circle all that apply)**

a) farrow-to-wean
b) feeder pig or nursery
c) finishing
d) raising breeding stock
e) farrow-to-finish

9. Of the buildings in your hog operation in which hogs are raised, how many of these buildings are less than 10 years old?

a) 0 c) 2 e) 4 g) 6 i) 8 k) 10 or more
b) 1 d) 3 f) 5 h) 7 j) 9

10. Of the buildings in your hog operation in which hogs are raised, how many of these buildings are 10 years old or greater?

a) 0 c) 2 e) 4 g) 6 i) 8 k) 10 or more
b) 1 d) 3 f) 5 h) 7 j) 9

11. What would be the total value of your hog facilities, if you were to sell them to another hog producer today?

_____ (dollars)

12. What other type(s) of farm animals and/or crops do you raise? (Circle all that apply)

a) corn
b) cotton
c) wheat
d) barley
e) soybeans
f) oats
g) sorghum
h) rice
i) tobacco
j) peanuts
k) sugarcane/beets
l) chicken
m) sheep
n) beef cattle
o) dairy cattle
p) goats
q) horses
r) exotic animals
s) vegetable production
t) fruit production
u) forestry
v) others (please list) _____
w) none

13. Of the following modern technologies and/or practices, please **circle** all of those that you are presently using on your hog farm.

a) "All in - all out" hog finishing
b) Weekly farrowing
c) High-density, fat-added diets
d) Intensive breeding to keep facilities full
e) Split-sex feeding
f) Terminal cross breeding programs
g) Artificial insemination
h) Porcine Somatotropin (pST)
i) Computer Programs

14. How many part-time employees work on your hog farm between 5 and 39 hours per week?

_____ (number)

15. How many full-time (40 hours or more per week) employees work on your hog farm?

_____ (number)

16. What is your debt-to-asset ratio? This is your total debts divided by your total assets.
a) No Debt
b) 1 to 20%
c) 20 to 40%
d) 40 to 60%
e) 61% or greater

17. Do you receive any income from an off-farm job? If yes, approximately what percentage of your total net household income for 1999 is from an off-farm job?

a) yes _____ (%) b) no

If you answered "no" in Question 17, please skip to Question 19. Otherwise, please answer Questions 18 and 19.

18. How many hours per week do you work off the farm?

_____ (number)

18. How many family members work on your farm without pay?

_____ (number)

Section II: Autonomy

1. How important is it to you for you to have complete control over all production, marketing, and management decisions in your hog operation?

a) not important at all
b) not very important
c) somewhat important
d) very important

2. Approximately what portion of the everyday production, marketing and management decisions do you make on your operation? (Please circle one)

a) I make none of these decisions.
b) I make few of these decisions.
c) I share these decisions equally with another party.
d) I make most of these decisions.
e) I make all of these decisions.

3. Approximately what percentage of the production, marketing and management decisions would you prefer to make?

a) I prefer to make none of these decisions.
b) I prefer to make few of these decisions.
c) I prefer to share these decisions equally with another party.
d) I prefer to make most of these decisions.
e) I prefer to make all of these decisions.

4. Would/Do you prefer determining the type of feed (corn and/or soybeans) used in the production process over allowing a contractor or integrator to determine the type of feed?

a) yes b) no

5. Would/Do you prefer determining the market in which to sell finished hogs over allowing a contractor or integrator to make this decision?

a) yes b) no

6. Would/Do you prefer having full control over herd size and the number of hogs to be marketed each period over allowing a contractor or integrator to make this decision?

a) yes b) no

7. Would/Do you prefer determining the type of equipment and facilities used in your production process over allowing a contractor or integrator to make this decision?

a) yes b) no

8. Would/Do prefer to determine when to place and remove your hogs, rather than having a contractor or integrator to make this decision?

a) yes b) no

Section III : Business Arrangements

The following definitions categorize some of the different types of business arrangements with which you may be currently involved in the U.S. hog industry:

Independent Producer	All inputs involved in the production process are owned or purchased and managed by you. You are responsible for all aspects of producing and marketing hogs.
Cooperative Producer	A jointly owned farm enterprise consisting of you and one or more other farmers who combine resources and/or expertise to finance, produce and/or sell hogs.
Contract with Incentives	A contractor provides you with inputs such as feeder pigs, feed, veterinary services and medication while you supply the labor, utilities, buildings, and fuel. This contract provides you with an incentive-based payment that is rewarded on the basis of feed efficiency, mortality, and/or length of time in grow-out.
Tournament Contract	This contract is the same as the contract with incentives except that farmers compete for monetary bonuses that vary with performance.
Flat-Fee Contract	This contract is the same as the contract with incentives except that it does not include bonus or incentive payments. You are simply paid a previously agreed upon base price per finished hog when the production is completed.
Vertical Integration	A firm that owns production resources and hires employees to produce hogs for the company.

Based on the above definitions, which business arrangement best describes the agreement under which you are presently producing hogs? (Please circle only one)

a) I am an independent producer.
b) I am a cooperative producer.
c) I produce hogs under a flat-fee contract.
d) I produce hogs under a contract with incentive payments.
e) I produce hogs under a tournament contract.
f) I work for a vertically integrated firm.
g) Other (please describe)_____

2. How do you feel about the business arrangement under which you are presently producing hogs?

a) dis-satisfied
b) uncertain
c) somewhat satisfied
d) satisfied
e) very satisfied

3. What type(s) of business arrangements are farmers *in your county* presently producing hogs under? (Circle all that apply)

a) Independent Producer
b) Cooperative Producer
c) Flat-fee Contract
d) Contract with Incentives
e) Tournament Contract
f) Vertical Integration
g) I do not know
h) There are no other hog farmers in my county.

If you are producing hogs under a contract, please skip to Question 6. Otherwise proceed to Question 4.

4. Have you ever considered producing under a contract?

a) yes b) no

5. If you were to accept a contract, what type of contract would you prefer?

a) a flat-fee contract
b) a contract with incentive payments
c) a contract with incentive bonuses/tournaments
d) other _____

If you are not producing hogs under contract, please skip to Question 15. Otherwise, please proceed to Question 6.

6. How long have you been producing under contract?

_____ (please indicate years and months)

7. Did you have experience raising hogs or any other livestock before signing your first production contract?

a) yes b) no

8. Is your present contract with a neighboring farmer?

a) yes b) no

9. Were new facilities or renovation of old facilities a requirement of your contract?

a) yes b) no

10. Are some of your production inputs (such as feed, veterinary services, etc.) supplied by the contractor?

a) yes b) no

11. If you answered "yes" to question 11, please circle all the inputs that are supplied by the contractor.

a) animals	e) veterinary services	i) buildings
b) medication	f) equipment	g) labor
c) feed	h) nutrition (manure) management	d) others _____

12. If your contract includes incentive or bonus payments, what are they dependent upon? (circle all that apply)

a) feed efficiency	d) lean value	g) all of the above
b) weight gain	e) efficiency of other producers	h) others_____
c) mortality	f) production cost relative to others	

13. Please rank from 1 to 5 the following reasons for why you accepted a production contract (with 1 being the most important reason and 5 being the least important).

_____ a) The contract stabilizes my farm income.
_____ b) The contract improves management by lowering costs.
_____ c) I was better able to expand hog production capabilities.
_____ d) The contract allowed me to afford to adopt new technology.
_____ e) The contract increases my income.

14. Did the cost of obtaining information on **feed prices** influence your decision to accept a production contract?

a) yes b) no

15. What is your primary source of information about market prices for finished hogs, feeder pigs or breeding sows? (Please circle only one)

a) Extension Service
b) media: tv, radio or magazines
c) other farmers
d) farm organizations
e) computer price reports (off the Internet)
f) I do not use the above sources to obtain price information
g) I do not wish to obtain price information

16. How regularly do you consult sources of information pertaining to market prices for hogs?

a) two or more times a week
b) once a week
c) once every two weeks
d) once monthly
e) once quarterly
f) never

17. How regularly do you consult sources to obtain information on desired leanness and back fat of hogs?

a) two or more times a week
b) once a week
c) once every two weeks
d) once monthly
e) once quarterly
f) never

18. What type of arrangement do you use to transport your hogs to the market?

a) I pay for my hogs to be transported to the market.
b) I transport my hogs to the market.
c) A contractor transports my hogs to the market.

19. How many times per year do you sell hogs at local auctions, packing or slaughter houses ?

_____ (number)

20. How close is your production site to the nearest hog sale barn?

a) 1 to 40 milesb) greater than 41 miles

21. How far is your production site from the nearest packing plant or slaughter house?

a) 1 to 40 milesb) greater than 41 miles

22. How far is your production site from the nearest feed supplier?

a) 1 to 40 milesb) greater than 41 miles

23. Do you plan to increase the number of hogs or pigs you produce next year? If yes, by what percentage?

a) yes_____%b) no

24. What is the value of your total farm assets including land value?

a) $0 - $499,999
b) $500,000 to $999,999
c) $1,000,000 to $1,499,999
d) $1,500,000 to $1,999,999
e) $2,000,000 to $2,499,999
f) > $2,500,000

For questions 25 - 26, please place an X along the line that corresponds to your response. For example, [-----!-----X-----!-----!-----!-----!-----!-----!-----!-----]
0 5 10

25. On a scale of 0 to 10, how would you rate the bio-security of your hog production system (with 10 being the highest level of bio-security and 0 being the lowest)?

[-----!-----!-----!-----!-----!-----!-----!-----!-----!-----]
0 5 10

26. On a scale of 0 to 10, how would you rate the quality of labor available to assist in operating your production unit(s) (with 10 being highly skilled and 0 unskilled)?

[-----!-----!-----!-----!-----!-----!-----!-----!-----!-----]
0 5 10

Pork Checkoff Referendum

Later this summer, hog producers will vote on the Pork Checkoff Referendum. The Pork Checkoff is a mandatory legislative program that was established through the Pork Act of 1985. Under this legislation, 45 cents of every $100 generated through the sale of market pigs/hogs are used to fund programs of promotion, education and research for the purpose of strengthening the pork industry's position in the marketplace. These programs are used to expand domestic and foreign markets for pork and pork products, and to fund research that supports the advancement of the pork industry.

27. As an eligible voter, what is your opinion of the Pork Checkoff?

a) Strongly Agree
b) Agree
c) Uncertain
d) Disagree
e) Strongly Disagree

28. As an eligible voter, how would you cast your vote?

a) I would vote to continue the Pork Checkoff.
b) I would vote to discontinue the Pork Checkoff.

Section IV : Demographic

1. Are you a male or a female?

a) male b) female

2. What is your age?

_____ (years)

3. Are you married?

a) yes b) no

4. Which of the following best describes your racial or ethnic background?

a) American Indian
b) Asian or Pacific Islander
c) Black (African American)
d) Hispanic
e) White (Caucasian)
f) other _____

5. How many years of educational training have you completed?

a) less than high school
b) completed high school
c) some college or technical school
d) completed 4 yr college Bachelor's degree
e) completed college Master's degree
g) completed college Doctoral degree

6. What was your total net household income for 1999?

a) $19,999 or less
b) $20,000 to 39,999
c) $40,000 to 59,999
d) $60,000 to 79,999
e) $80,000 to 99,999
f) $100,000 to 199,999
g) $200,000 or more

7. Please rank from 1 to 3 the following reasons why you choose to farm (with 1 being the most important reason and 3 being the least important).

_____a) maximize profits
_____b) provide family with farming experience
_____c) to produce food for family consumption

NI =Not Important at All; **NVI** = Not Very Important; **SI** = Somewhat Important; **VI** = Very Important

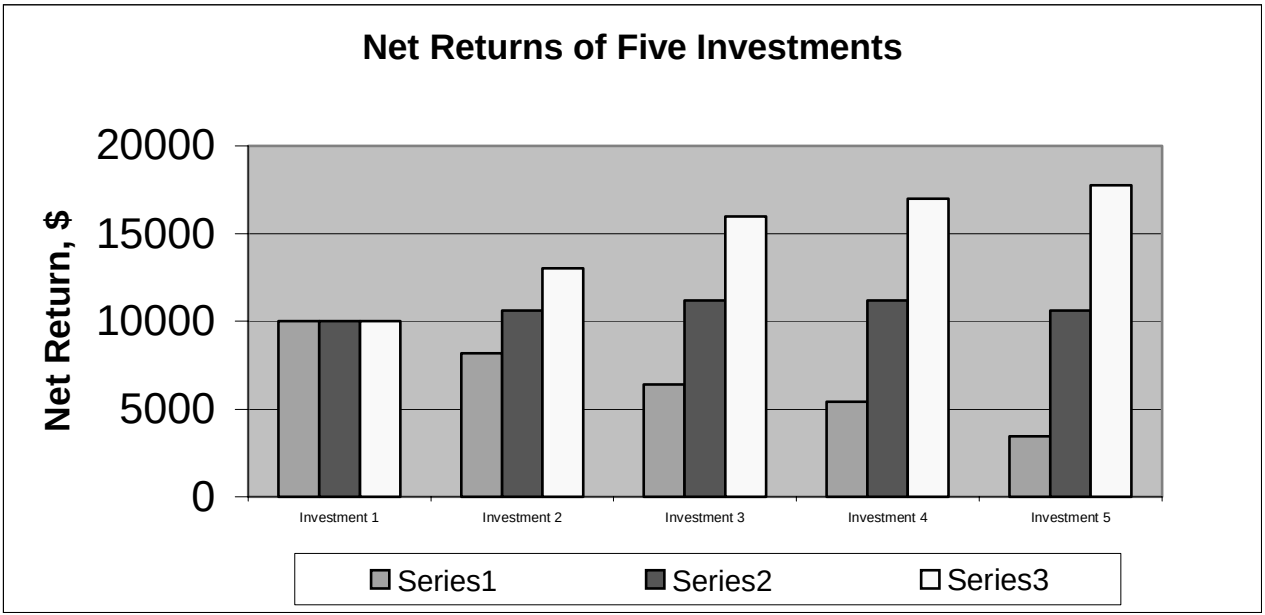
8. With respect to your social relationships and farm operation, how important are each of the following relations? (Please circle your response)

I) Relationship with neighboring farmers.	NI	NVI	SI	VI
II) Relationship with lending institutions (banks).	NI	NVI	SI	VI
III) Relationship with feed merchants (grain suppliers).	NI	NVI	SI	VI
IV) Relationship with packers and/or slaughter houses.	NI	NVI	SI	VI
V) Relationship with veterinarians.	NI	NVI	SI	VI
VI) Relationship with neighbors that are non-farmers.	NI	NVI	SI	VI

Section V : Risk Preference

1. Relative to other investors, how would you characterize yourself? (Please circle one)
a) I tend to take on substantial levels of risk in my investment decisions.
b) I tend to avoid risk when possible in my investment decisions.
c) I neither seek nor avoid risk in my investment decisions.

Suppose you have $100,000 to invest. Suppose there are five different options in which you might invest your money. These options are illustrated below both in the chart and table. With the first option, you are certain to receive $10,000, or a 10% return. Thus, at the end of the year you will have $100,000 + $10,000 = $110,000. Money in a savings account would be an example of such an investment. However, you can increase your average net return by increasing the riskiness of your investment. In Option 2, for instance, you have a 1/3 chance of receiving an average net return of $10,600. However, with this investment, you increase the riskiness since you would also have a 1/3 chance of receiving $8,170 and a 1/3 chance of receiving $13,030. Please examine the five options and answer the following question.



Investment Number	(Series 1) Lowest Net Return 1/3 Chance	(Series 2) Average Net Return 1/3 Chance	(Series 3) Highest Net Return 1/3 Chance
Investment 1	$10,000	$10,000	$10,000
Investment 2	$8,170	$10,600	$13,030
Investment 3	$6,420	$11,200	$15,980
Investment 4	$5,420	$11,200	$16,980
Investment 5	$3,440	$10,600	$17,760

2. Of these investments, please circle the investment that you would choose (Circle one):

A. Investment 1
B. Investment 2
D. Investment 3
E. Investment 4
F. Investment 5

APPENDIX F: LETTERS MAILED TO PRODUCERS SURVEYED

Department of Agricultural Economics and Agribusiness
101 Agricultural Administration Building
Louisiana State University
Baton Rouge, LA 70803-5604
(504) 388-3282
FAX: (504) 388-2716

July 20, 2000

Dear Hog Producer:

The U.S. hog industry has undergone *major* structural change in recent years. The rapid development of technology has led many hog producers to operate larger, more specialized hog operations. Along with these larger operations, a number of alternative business arrangements such as contracts have been introduced, while some independent producers have entered into alternative marketing agreements. We are conducting a study to identify the types of business arrangements that hog producers are using today and the reasons why they have chosen them. This study will help the industry determine the direction it is currently heading and the type of producer that will likely be involved in hog production in the future. This information will be valuable as the industry seeks to identify paths leading to a more competitive industry that includes viable family farming operations.

You are one of a relatively small number of hog producers who are being asked to provide information on their hog operations. Thus, your participation in this study is vital in assuring that as many producers as possible are represented. Your name was drawn such that we will have a random sample of hog producers from throughout the U.S.

You may be assured of *complete confidentiality*. The questionnaire has an identification number for mailing purposes only. This is so that we may check your name off the mailing list when your questionnaire is returned. Once the surveys have been returned, we will dispose of the mailing list. Your name will never be placed on the questionnaire.

The results of this research will be made available to all interested citizens, and to the National Pork Producer's Council, which has partially funded this research. You may receive a summary of the results by simply writing "copy of results requested" on the back of the return envelope, and printing your name and address below it. Please do not put this information on the questionnaire itself, so that we can maintain your anonymity.

After completing the survey, please place it in the enclosed business reply, self-addressed envelope, and drop it in a mailbox. We would be most happy to answer any questions you might have. Please write or call. *Thank you in advance for your assistance.*

Sincerely,

Jeffrey M. Gillespie, Ph.D.
Associate Professor
(225) 388-2759
jmgille@lsu.edu

Department of Agricultural Economics and Agribusiness
101 Agricultural Administration Building
Louisiana State University
Baton Rouge, LA 70803-5604
(504) 388-3282
FAX: (504) 388-2716

August 20, 2000

Dear Hog Producer:

About three weeks ago, I wrote to you asking for your help in a study concerning structural change in the U.S. pork industry. The intent of the study is to determine the types of business arrangements pork producers are using today and the reasons they are using them. As of today, we have not yet received your completed survey.

The LSU Department of Agricultural Economics and Agribusiness has undertaken this study because it is important that the industry understand the direction it is currently heading and the type of producer that will likely be involved in hog production in the future. The information in this study will be valuable as the industry seeks to identify paths that could lead to a more competitive industry including viable family farming operations. This research is being partially funded by the National Pork Producers Council. It is important that each questionnaire be completed and returned, as the survey was sent to a relatively small number of producers.

Remember that you are assured of complete confidentiality. The questionnaire has an identification number for mailing purposes only. This is so that we may check your name off the mailing list when your questionnaire is returned.

The results of this research will be made available to all interested citizens. You may receive a summary of the results by simply writing "copy of results requested" on the back of the return envelope, and printing your name and address below it. Please do not put this information on the questionnaire itself, so that we can maintain your anonymity.

After completing the survey, please place it in the enclosed business reply, self-addressed envelope, and drop it in a mailbox. No postage is necessary. In the event that your questionnaire has been misplaced, a replacement is enclosed. Your cooperation is greatly appreciated.

Sincerely,

Jeffrey M. Gillespie, Ph.D.
Associate Professor
(225) 388-2759
jmgille@lsu.edu

VITA

Christopher Gazzara Davis was born in Albany, Georgia, on October 25, 1966. He graduated from Dougherty High School in Albany Georgia. Christopher received his bachelor of science degree in agribusiness from Florida Agriculture and Mechanical University of Tallahassee, Florida in 1992. In 1995, he received his master of science degree in agricultural sciences from Florida Agriculture and Mechanical University.

Christopher is an instructor at the Baton Rouge Community College. He has been an adjunct professor at Southeastern Louisiana University in Hammond, Louisiana. Also, he has served as a recruiter for the food science department at Florida Agriculture and Mechanical University.

In August 1996, he enrolled at Louisiana State University in the Department of Agricultural Economics and Agribusiness. He is now a candidate for the degree of Doctor of Philosophy.