TECHNICAL ANALYSIS OF EVOLVING FARM ORGANIZATION

A Dissertation

presented to

the Faculty of the Graduate School

at the University of Missouri-Columbia

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

by

MATTHEW STEWART ELLIOTT

Dr. Harvey James Jr., Dissertation Supervisor

MAY 2013

The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled:

TECHNICAL ANALYSIS OF EVOLVING FARM ORGANIZATION

presented by

Matthew Stewart Elliott,

a candidate for the degree of doctor of philosophy, and hereby certify that, in their opinion, it is worthy of acceptance.

____

Professor Harvey James, Jr.

____

Professor Fabio Chaddad

____

Professor Michael Cook

____

Professor David O’Brien

To my father, Robert Elliott, whose passion and devotion to improving farm organization had the greatest influence on me.

ACKNOWLEDGEMENTS

I would like to thank my advisor, Dr. Harvey James Jr., for his encouragement, constructive criticism, and assistance throughout the process. I would like to thank Dr. Michael Cook, Dr. Fabio Chaddad, and Dr. David O'Brien for serving on my committee, and providing me with helpful advice and constructive criticism. I would like to thank Robert Dubman, Carter Anderson, Steve Susemihl, and Bob Garino of USDA-NASS for their assistance in using and accessing the Agriculture Resource Management Survey data. I would like to thank my family, my Mom, Thomas, and Kim for their support, and patience, as I undertook my graduate school endeavor. I would most like to thank my lovely wife, Dr. Lisa Elliott, for her constant encouragement, for all her advice and feedback, and showing extreme patience during the process.

TABLE OF CONTENTS

LIST OF FIGURES

Figure Page

LIST OF TABLES

Table Page

TECHNICAL ANALYSIS OF EVOLVING FARM ORGANIZATION

Matthew Stewart Elliott

Dr. Harvey James, Jr., Dissertation Supervisor

ABSTRACT

In the 20th century, some farm organizations have evolved to include more separation of ownership and control, formality, and complexity. We examine propositions of existing theory on the effects to farm success and farm technical efficiency from agency costs in separated ownership and control farm production. Using Agricultural Resource Management Survey (ARMS) data, structural equation modeling, and stochastic frontier analysis, we found evidence that separated ownership and control farms had greater farm success and were more likely to be technically efficient than combined ownership and control farms. Our empirical results did not identify agency costs in separation of ownership and control farming as an absolute limiting factor in farm organization evolution. We suggest the differences in our findings, and propositions of existing theory on farm organization, may be a result to changes in farm organization in the 20th century that have increased the complexity of understanding farm performance, farm manager behavior, and agency costs.

Chapter I

Introduction: Illustration of Evolution of U.S. Farm Managers' Property Rights in the 20th Century

The evolution of farm firm organization has long been an interest to academic scholars, policy makers, farm producers, farm related stakeholders, and rural communities. Though farm production has long been an endeavor of civilized societies, how farm production is organized remains starkly different and evolving at different rates across societies. Differences in farm organization have represented distinct differences in societal beliefs given uncertainty. Some farm organizational forms have persisted, some forms have not, other forms continue to evolve and adapt along a path that is still dependent and influenced by early social beliefs and institutions that govern farm production. At times, the evolution of farm organization has been encouraged, and at other times, the evolution of farm organization has been constrained. A clearer understanding of the factors that influence evolution in U.S. farm organization is the central focus of this study. Specifically, we describe the evolution of U.S. farm organization that has increased separation of ownership and control and reduced vaguely defined property rights from increasing adoption of more formal, incomplete contracts in farm production. We then examine, using two methods of technical analysis, if farm firms that have increased separation of ownership and control are (1) more subject to agency costs (2) create efficiency advantages that are not available to farms that have remained more combined ownership and control and utilize spot markets.

Some agriculture economics discussion of farm organization has revolved around legal, tax, and estate implications of different farm organization types. Some farm discussion has focused on organization types to resolve horizon problems that can occur as farms transition from one-generation to the next. Discussion that is more recent has focused on the adoption and diffusion of formal production and marketing contracts, or novel forms of cooperative organization, compared to spot markets. Organizational economists have long been intrigued with the incentives and risk sharing attributes that exist with different land and labor contracts (i.e. cash, share, or wage) in farm production under different assumptions on asymmetric information and uncertainty. Organizational economists have also focused on the largely informal nature of agriculture production relationships, where trust, reputation, and kinship are frequently cited factors to explaining efficiency-- despite vaguely defined property rights-- and the persistence of more closely combined ownership and control farm organization. However, less discussion has occurred on the changes in farm managers' property rights from more separation of ownership and control, and formality, which has occurred at the nexus of incomplete contracts for the farm firm in the 20th century.

Examinations of current farm firm organization and the similarities and differences to the large modern corporations are a recurrent theme. Similarities are that agriculture production can assume the same advantages that large corporations exhibit when farms separate ownership and control, such as: risk sharing, asset specific investment, investing according to the market value rule, and labor specialization, but farms can also exhibit the same agency costs that disadvantage large corporations. A difference drawn is that farm production has greater uncertainty in production, due to weather, than other enterprises organized under a modern corporation. This has led to conclusions that farm production has remained small and ownership and control more closely combined due to agency costs that are difficult to control when there is greater uncertainty in output. Another difference between farm organization and the modern corporation has been that farms are simple entities or enterprises and does not possess the complexity that the modern corporation does. The implicit assumption of simplicity of the farm organization has led earlier studies to use comparative statics to understand optimal farm organization choice, and has assumed that the farm manager has a choice to determine optimal farm organization.

In this paper, we suggest that some farms have evolved over the 20th century to be a different organizational form: these differences include more separation of ownership and control and more formality to capture the advantages that large corporations can obtain. We also suggest that the growing interdependency of individual farm firm performance, and interdependency in making changes in current farm organization, creates more complexity in determining optimal farm organization and optimal farm performance than what the existing literature suggests. We suggest the current literature may be misguided in predicting the evolution of the farm firm because of the assumptions on farm firm simplicity (lack of interdependency) and limiting discussion to optimal farm organization choice and transactions costs to land and labor resources.

WHAT IS THE FARM FIRM?

Consistent with Fama and Jensen (1983ab) we define a firm as a nexus of incomplete contracts that govern a set of production processes. The farm we define as the nexus of residual and control rights associated with resources used in the production (i.e. planting, growing, and harvesting of crops and/or the breeding, husbandry, and feeding of livestock) and marketing/consumption of crops and livestock. An incomplete contract is where actions cannot be stated for all possible contingencies (Brickly, Smith, and Zimmerman, 1996)—thus an emerging rationale for ownership (Hart, 1988). Our interest in this paper is not in the typical Transaction Cost Economics discussion (TCE) of whether transactions should be governed under a market, hybrid, or firm (e.g. Williamson, 1979; 1991ab). Rather, we take as given, that incomplete contracts and ownership have supplanted market mechanisms, in a significant way, for multiple transactions in farm production. We illustrate typical transactions that would fall within how we define the farm firm in Figure 1.1. However, Figure 1.1 does not represent the extent or bounds of the farm firm. We also acknowledge that some transactions may also be governed using a classical contract and/or market mechanism, though there are also well documented cases of incomplete contracts, presently and in the past, which govern these same transactions surrounding the nexus of contracts that constitute the farm firm. It is in the general evolution of these incomplete contracts that we focus on in the remaining portion of this chapter.

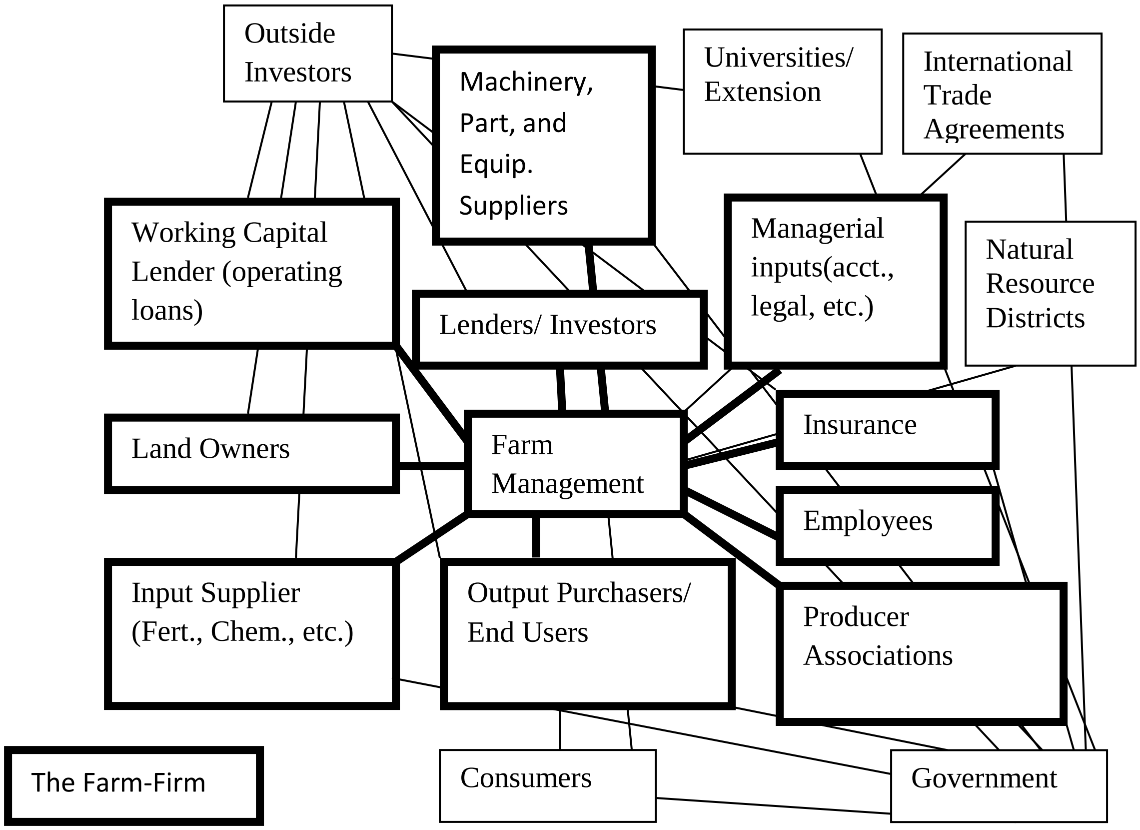


Figure 1.1. Example of a nexus of incomplete contracts that make up the farm firm

HOW U.S. FARM MANAGERS PROPERTY RIGHTS HAVE EVOLVED IN THE 20TH CENTURY

We illustrate the evolution of a farm manager's property rights through a hypothetical U.S. farm firm during the 20th century. The evolution of property rights we describe occur because of the adoption of incomplete contracts, and the subsequent tinkering of incomplete contracts in the 20th century. Not all farms evolved to the same degree of separation of ownership and control, nor tinkered with the contracts to reduce vaguely defined property rights. Thus, there are differences in the degree of separation of ownership and control, and formality, among the farm population that we can measure and examine efficiency differences. We use symbols to represent bundles of property rights; because property rights can be vaguely defined, unknown, or would require great length in describing. It is in the evolution of property rights allocations, their effect on farm firm performance and property right stability, that we are interested.

A fairly accurate representation of a pre-20th century U.S. farm firm resembled a central nexus of incomplete contracts (farm management) where most, if not all, of the finite ownership rights (both control and residual) to the resources that produce crops and livestock, and the subsequent production from those resources, was possessed by a farm manager. In these farms, the farm firm manager, ostensibly, owned the land, did the work, built the machines used in the production, produced and distributed fertilizer from livestock manure or ash, mitigated risk with strategies such as diversity of production, saved part of their own production or herd to expand production in future periods, and consumed the produce for an indefinite period of time (Figure 3 shows an illustration where the complete set of ownership rights, we will label "C" where C={all control rights} and "R" where R={all residual rights}, are maintained by the farm management) (See Cochrane, 1993; Hambidge, 1941). Any surplus farm production was traded using spot markets and price mechanisms. Thus, we will label this type of nexus of contracts as a Stage 1 Farm firm (See Figure 1.2). Granted, some farms prior to the 20th century had already evolved to more separated ownership and control organizations, such as farms that were involved in early agriculture cooperatives, used share contracts, were members of an early mutual insurance company, or farms that were associated with the Grange movement (Lawless, 2002; Schnieberg et al., 2008). However, as concluded in the report by the Commission for Country Life in 1909 on the problems with farm and rural prosperity, mutual farm organization was generally deficient and ‘farmers stood alone against organized interests’ (p.19) in the early part of the 20th century.

Farm Management

O={C, R}

O = Complete set of Ownership Rights

C = All Control Rights

R = All Residual Rights

Figure 1.2. Stage 1 Farm Firm

EVOLUTION IN SEPARATION OWNERSHIP AND CONTROL

Changes in policies, technological developments in farm mechanization, and improving knowledge about the nature of the farm business compelled farm managers to more separate ownership and control rights to improve performance. Farms in the early 20th century had already begun to separate ownership and control using increased rates of tenancy, both cash and share, to improve capital-labor ratios through specialization and mechanization (Winters, 1974). Winters (1977) suggests that tenancy, share or cash, was a response to more intensive agriculture and specialization in Iowa, and resulted in the increased rates of tenancy by the end of the 19th century. U.S. Agriculture Census data illustrates that the percentage of farms that classified themselves as a share tenancy, and part ownership farms, continued to increase in the U.S. into the early 20th century. Share tenancy, itself, peaked in the 1930 Agriculture Census as a tenure type (See Figure 1.3). The percentage of farm acres under share tenancy governance also showed a similar peak in 1930 and a steady decline after (See Figure 1.4).

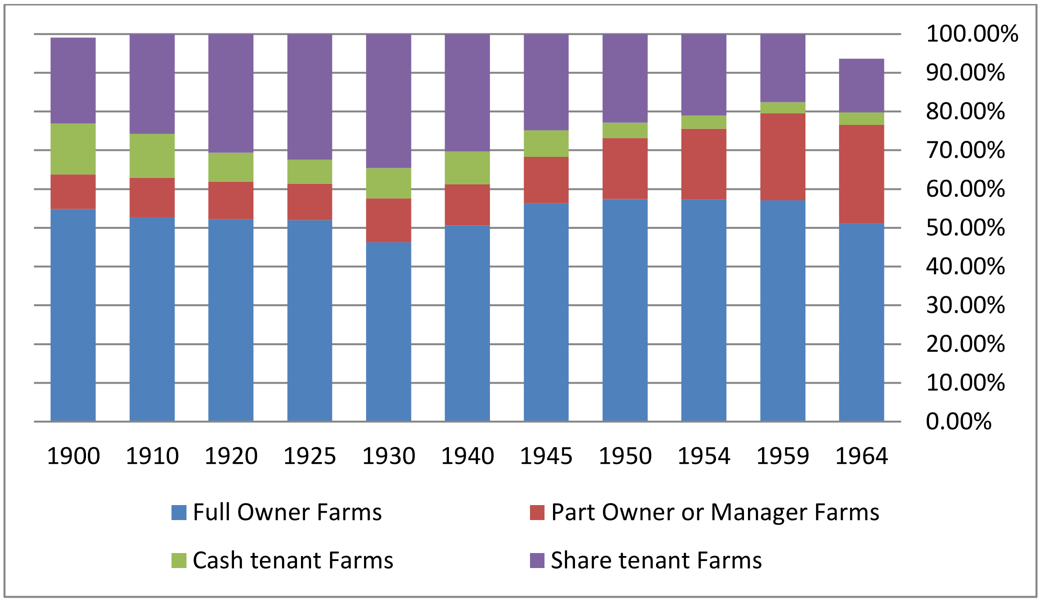


Figure 1.3. Percentage of farms by farm tenure type (U.S. Agriculture Census survey)

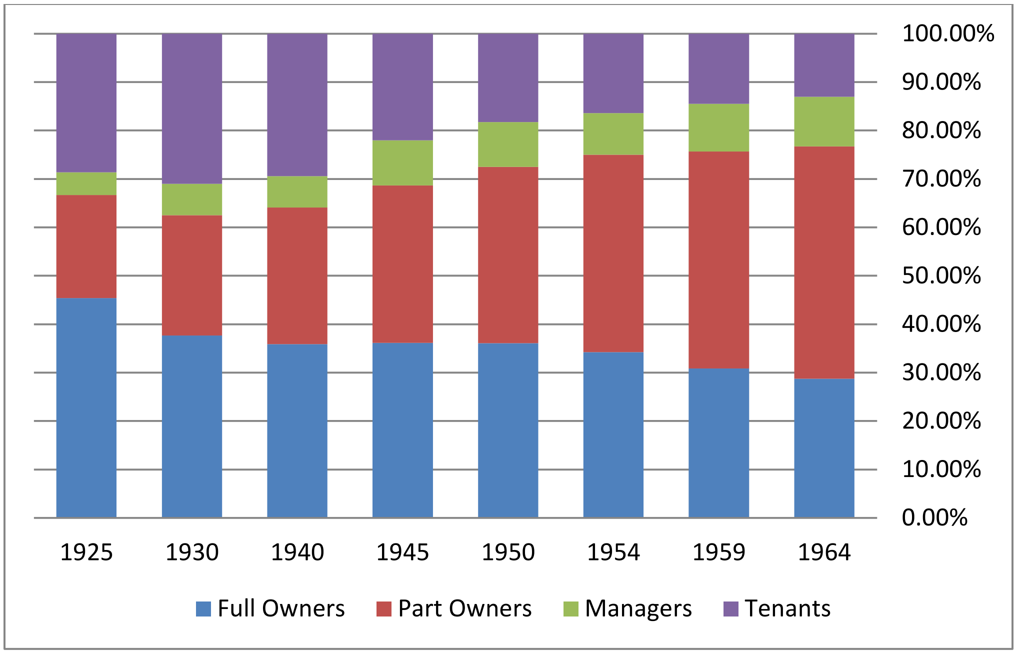


Figure 1.4. Percentage of farms acres by farm tenure type (U.S. Agriculture Census Survey)

The increased adoption of share contracts created an evolution to more separated ownership and control for a portion of farms in the U.S. We can illustrate the separation of ownership and control from an adoption of the incomplete share contract by tracking the residual and control property rights that are allocated between the landlord and the farm management. In a share contract, the landlord reserves a portion of the control rights (e.g. right to sell the land, right to access the land, some may have reserved the right to determine crop choice (See Winters, 1974), and portion of the residual rights (e.g. 1/3 share of produce) to the original "land owner". We assume that no specification on duration of the share contract exists, making the contractual relationship incomplete in at least this aspect. A portion of the control rights (α where α={right to utilize the land for farm production}) within the complete set of control rights (C) are distributed to the farm management to operate the farm, and a portion of the residual rights (β, for example, β ={ 2/3 share of production}) are also distributed for the management of the farm.

In addition to the increase in share crop adoption during the early 20th century, there was a larger movement to develop and join agriculture cooperatives. Cooperatives were exempted from the constraints of the Sherman Anti-trust Act of 1890, by the passage of the Capper Volstead Act in 1922. Cooperative development was encouraged and supported by the Cooperative Extension Service, a partnership of Land Grant Universities and the USDA, outlined in the Smith-Lever Act of 1914. These early 20th century institutional changes led to a large increase in the number of marketing and supply cooperatives that early 20th century farm managers were members. Interest in being an agriculture cooperative member was largely a response to the perceived monopolistic behavior of investor owned entities in the supply chain (see Figure 1.5). The numbers of farmer cooperatives declined into the latter half of the 20th century, due to exit and consolidation. However, the amount of sales attributed to cooperatives continued to increase throughout the 20th century (Gross sales for both marketing and supply cooperatives were 0.4 billion dollars in 1913 and steadily increased to 142.4 billion by 2007).

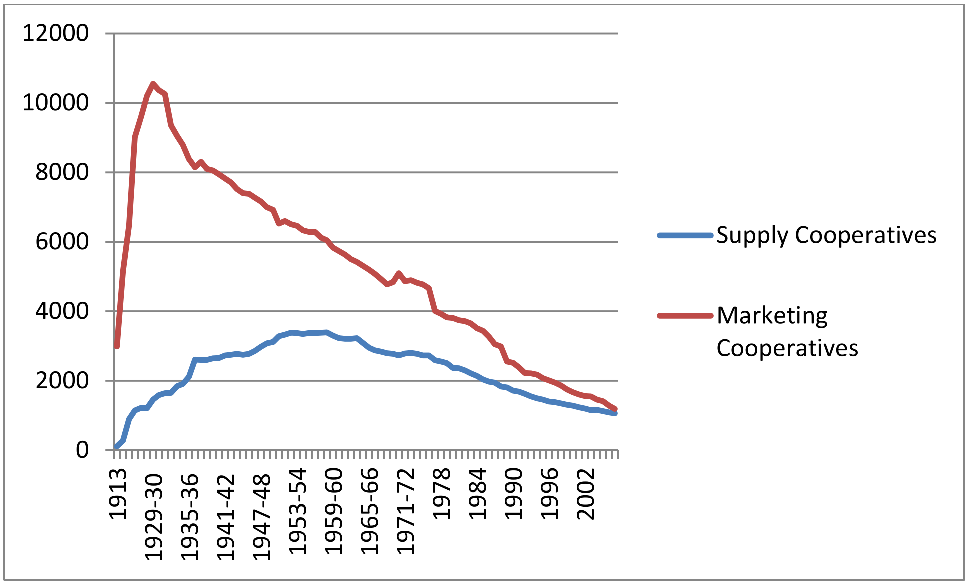


Figure 1.5. Number of Cooperatives in U.S. since 1913 (U.S.D.A.- Rural Development)

Property right changes occurred to a farm manager who changed delivery of their produce from a spot market with an investor owned firm, or private firm, to delivering their annual share (β) of the produce to an agriculture-marketing cooperative, for example. Deliveries of produce to an agriculture-marketing cooperative is often processed and bulked together with neighboring farm managers produce and traded for currency. In a cooperative exchange for the produce, the farm management reserves the right of a residual return of a specific amount (δ where δ={rights to specific return price given quantity and quality}), and a specified right to an unknown amount of additional return (η where η ={e.g. rights to patronage}). The farm management also reserves limited control rights (π) to oversee the cooperative management during the bulking, processing, and marketing. These control rights often include the right to vote on bylaws, vote on board of director representation, and rights to obtain financial information on the performance of the agriculture cooperative in the bulking, processing and marketing of their production. The farm management distributes to the agriculture cooperative management their control rights (μ) to the produce, and their control rights to the assets used in bulking, processing, and marketing, and a fixed salary and performance incentives for adding exceptional value (ρ). An illustration of ownership rights distribution of our Stage 1 farm firm after they adopted the share contract and engaged in an agriculture-marketing cooperative could be construed as Figure 1.6, we will label this a Stage 2 farm firm. Naturally, the exact finite amount of ownership rights that is distributed is hard to establish, primarily because the complete set of rights are often unknown or undefined. We will reserve those issues for further discussion in the next sections.

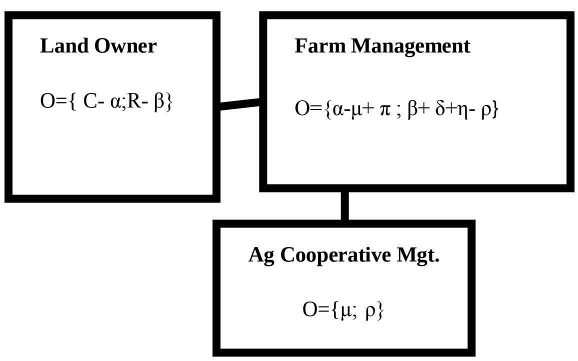


Figure 1.6. Stage 2 Farm Firm

In addition to agriculture cooperatives, further separation of ownership and control of farm manager property rights occurred with development of producer associations and mandated check-offs. Different dates of association development and implementation of the check-offs occurred across regions and commodities. For example, the National Association of Wheat Growers began in 1950, and a voluntary assessment, or check-off, for Kansas wheat was implemented by state statute in 1957 that was controlled by a Kansas wheat commission. Another example is the National Live Stock Growers Association that began as early as 1898, which later developed into the National Cattlemen's Beef Association. Beef check-offs begin in some states in the 1950s, but later evolved into a national Beef Promotion and Research Act in 1985 that mandated national beef check-offs with continued state beef association control over collection and distributions of funds. Many more commodity associations, and their related commodity boards that managed check-off funds, begin to develop in the latter half of the 20th century. Producer elected boards and association representatives, generally possess a bulk of control rights to check-off funds. Most check-off funds are used to obtain asset specific information from commodity related research and to transmit asset specific information on the commodity attributes (advertising) to improve product demand.

Changes in property rights at the farm manager level, with the development of growers association and mandated check-offs, can be illustrated by an increase separation of residual rights to production (λ={ rights to check-off}). In return for the check-off dollars, the farm management does reserve some control rights to oversee association representatives or commodity board representatives. The farm manager also may have control rights to propose and approve tasks for the association to pursue (τ). The farm management grants the association control rights (θ) in promoting their produce and pursuing policies and research opportunities that would be beneficial to the farm management performance. Examples of control rights the association may have would be rights to represent the farm managements' interest in international trade agreements, government farm policy, and to discuss research collaboration with Universities. To ensure all farmer managers participate in the association, and do not free ride on the benefits from a portion of farmers allocating check-off funds, a common rule is that all farm manager residual returns are automatically deducted for all produce with a check-off program that is traded for currency within a regional area. If check-off funds are not deducted, the buyer and seller will be assessed a civil penalty (φ).

Ownership and control rights of some farm managers separate further during the 20th century with the development of institutions to facilitate risk sharing. An early 20th century form of risk sharing was the rapid increase of mutual property and casualty insurance companies. Hansmann (1985) posits asymmetric information and limited competition gave rise to local mutual insurance companies from more efficient risk sharing compared to stock insurance companies (See also Smith and Sturtzer, 1990; 1995; Born et al., 1995). Some have suggested, local farm mutual insurance companies allowed for better monitoring of moral hazard by farm manager policyholders and better monitoring of mutual insurance management who had control rights over pooled resources and underwriting gains. Examples of farmer mutual insurance firms that began at in the early 20th century include Farm Bureau Mutual Insurance Companies (1930s), State Farm (1922), Farmers Mutual Insurance Company of Kansas (1896), Farmers Mutual Hail Company of Iowa (1893), etc. These companies offered risk-sharing policies to reduce random losses in value to farm vehicles, machinery, buildings, and protect farm assets from liability claims. A few early mutual insurance companies provided crop insurance, but were overwhelmed with claims during years of widespread production problems; as a result, self-organization of crop insurance generally failed absent of government-backed programs (Glauber et al., 2002). Some mutual insurance companies also required that the farm manager participate (membership dues) in farm lobby organizations, similar in task to grower associations who had lobbying functions. The mutual insurance benefits, from lower premiums and reduced moral hazard, then acted as a selective incentive to reduce free riding in larger collective action problems, like lobbying for beneficial farm policies (Olson, 1985).

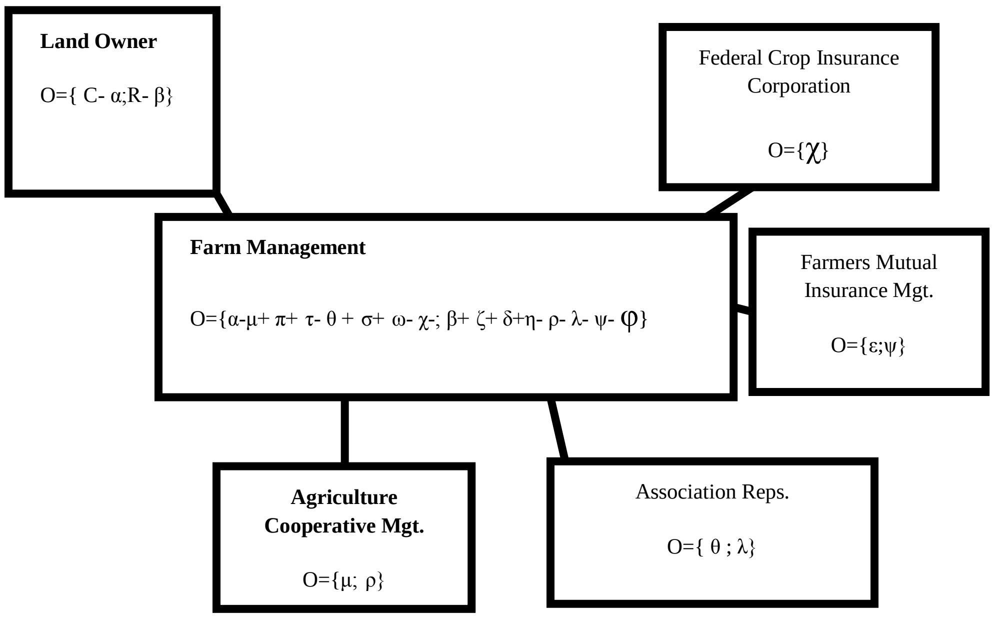
Changes to farm managers' property rights occurred if they determined their risk would be reduced-- therefore their performance improved-- if they collaborated in a mutual insurance agreement with other farm management. The contractual agreement would pool a small portion of their residual return (ψ) with other farm management residual returns. The farm management would reserve some control rights to oversee the mutual insurance management, and reserve their right to redeem some of the pooled resources at a pre-specified date in the form of dividends or reduced premiums on future insurance policies (σ). The mutual insurance management will be conveyed control rights (ε) to manage the pooled residual returns, along with rights to stipulate policies about actions and decisions that increase risk and the right to monitor farm management action to ensure compliance. We illustrate the insurance and association contractual arrangements in Figure 1.7; we will label Stage 3 Farm Firm.

Other changes to property rights of the farm manger to facilitate risk sharing occurred with the increased adoption of federally subsidized crop insurance policies in the latter part of the 20th century. Federal crop insurance was enacted as a small pilot project in 1938, but did not achieve wide participation by farm managers until the adoption of the Federal Crop Insurance Act in 1980, which authorized subsidies to encourage more widespread farm manager participation, particularly among lower risk farms (Glauber et al., 2002). For a short-term period, participation in federal crop insurance was mandated if the producer received additional direct government farm payments, but participation in federal crop insurance was not mandated after the '1996 Farm Bill'. The factors found to increase adoption of federal crop insurance policies include the increased degree of separation of ownership and control and larger farm size (Sherrick et al., 2004).

In the Federal Crop Insurance Act, a farm manager was granted the rights to federally subsidized crop insurance premiums (ζ). In exchange for the subsidized premiums, the Federal Crop Insurance Corporation (FCIC), who oversees the administration of the act, reserves the power to approve premium rates and approve crop insurance policies that maintain a specified loss ratio. The farm manager grants the FCIC control rights to crop production information and other information that can 'improve actuarial soundness' (χ)[1]. Farm managers are also granted limited control rights over the FCIC in (1) four required appointed board members from different producer regions and farm types, and (2) a requirement of the FCIC 'in the administration [of the Federal Crop

[1] Agriculture Adjustment Act of 1938 & Federal Crop Insurance Act § 7 U.S.C. 1506, p.82.

Insurance Act] to the maximum extent possible, establish or use committees or producer associations'(ω)[2]. In the event of a loss, the farm manager retains the right to indemnities (ζ), unless the farm manager acts with neglect, lack of effort on reseeding, or does not 'follow good farming practices' (χ)[3].



[2] Agriculture Adjustment Act of 1938 & Federal Crop Insurance Act § 7 U.S.C. 1507, p.84.
[3] Agriculture Adjustment Act of 1938 & Federal Crop Insurance Act § 7 U.S.C. 1508, p.86.

C= Control rights to farm resources not allocated

R= Residual rights to farm resources not allocated or possessed by other agents in nexus of contracts

α= control right to utilize farm land for farm production

β= residual right to share of residual return for farm production (i.e. 2/3 share of produce)

λ= residual rights to check-off

η =residual rights to patronage

π= control rights farmer reserves to oversee cooperative management (i.e. voting rights, membership rights, board of directors representation)

δ= residual rights to specific return price given quantity and quality of produce (β)

τ= control rights to oversee association representatives and rights to approve tasks association representative to pursue

θ= control rights association representatives have to promote or utilize checkoff funds to promote farm products, advise policy makers on policy and international trade agreements, and pursue research opportunities with Universities.

μ= control right to produce and processing assets given to cooperative management to bulk/ process and trade for currency

φ= right of government enforcement agency to make claim on farm management residual returns if found to shirk on check-off (λ) (i.e. civil penalty)

ψ= residual return given to farmers mutual insurance management for insurance coverage

σ= control rights to mutual insurance firm that farmer retains to oversee mutual insurance management (member voting rights), residual rights to unallocated indemnities if mutual insurance firm is profitable (i.e. dividend, lower premium the following year, etc.)

ε= control rights given to mutual insurance management to ensure farmers compliance of insurance policies and manage pooled residual returns for indemnities and administrative expenses.

χ = control rights to crop production and financial information that can improve actuarial soundness of federal crop insurance programs, and control rights to production practices to comply and be eligible for crop insurance benefits.

ζ= residual rights to indemnities in the case of a crop loss, and the rights to federally subsidized premiums for crop insurance.

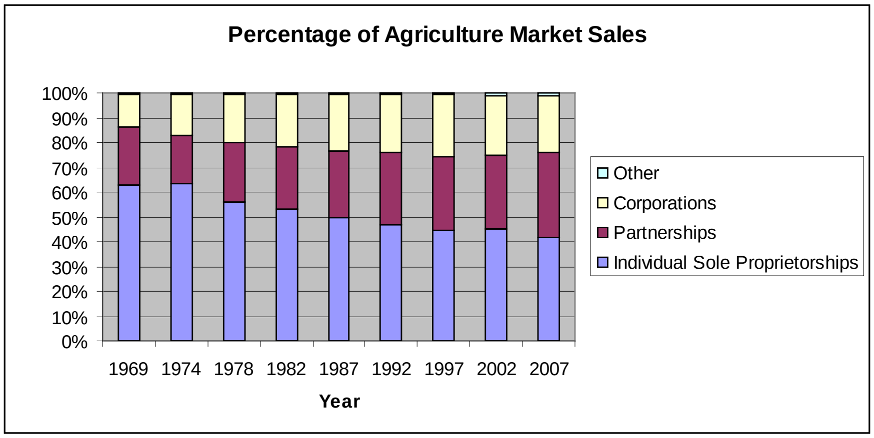
Figure 1.7. Stage 3 Farm Firm

For the sake of brevity, we will not examine all the changes in the farm managers' ownership and control rights in every possible link in the nexus of incomplete contracts of the farm firm. However, other contract relationships evolved in the 20th century, which further altered the set of ownership and control rights of the farm manager. Examples include the establishment of the rural electric cooperatives, stewardship agreements with seed manufacturers, organizations to manage collective natural resources (e.g. irrigation districts), contracts with non-owner employees, and the Farm Credit System to name a few. Our focus here was not to describe the complete property rights changes of the farm firm. Rather, we wanted to illustrate how on the one dimension of separation of ownership and control, our proposed U.S. farm firm evolved from a more combined ownership and control firm in Stage 1, to a significantly less combined ownership and control firm in Stage 3 (Farm Management ownership rights in stage 1$\{C;R\} \neq$ Ownership rights stage 3 $\{\alpha - \mu + \pi + \tau - \theta + \sigma - \chi ; \beta + \delta + \eta - \rho - \lambda - \psi - \varphi + \zeta\}$). The evolution was described using simple-- though reasonably accurate and common—incomplete contractual agreements during the 20th century. We suggest that some farm firms generally have evolved to have less combined ownership and control than they historically did. Where the degree separation of ownership and control can be measured by estimating the farm managements' missing elements of the set of ownership rights in Stage 3 to the ownership rights in Stage 1. Certain elements of the Stage 3 ownership rights will not have existed in the set of ownership rights at Stage 1, for example control rights to monitor the agriculture cooperative management and residual rights to patronage were not available to the farm management in stage 1, thus these are additional elements to the set. However, from the set of the original farm managers ownership in stage 1, we hypothesize there will be missing elements at stage 3 (e.g. missing ownership rights to farm management at Stage 3={C- α, μ, θ, ε, χ; R- β, ρ, λ, ψ, φ}). The missing elements were distributed to other agents. The number of missing elements in the original set can represent the degree that the farm firm has evolved to have less combined ownership and control. The motivation to evolve was a result of farm managers trying to improve performance, thus survivability. The mechanism was through adoption of incomplete contractual agreements that explicitly or implicitly distributed ownership rights. The actual degree of evolution, and the exact current make up of a representative farm firm, we will leave for future research. We acknowledge that different forms of contractual agreements currently exist, or have further evolved (e.g. See Chaddad and Cook, 2004 on demutualization), and are far more intricate than what we described here.

EVOLUTION IN THE FORMALITY OF CONTRACTS

Not only did farm managers' property rights evolve in separation of ownership and control, but the property rights also evolved in the degree of formality. An example of changes in formality of property rights could be a change in the share contract, adopted in stage 2 farm firm, to a more formalized family corporation. In a portion of the share contract agreements that existed in early U.S. agriculture census surveys, there existed kinship relationships between different generations (e.g. father as a landlord and son as a sharecrop tenant). Changes in strategies to arrange multiple owner farms began occurring in the mid-20th century with more formalize arrangements between multiple farm owners and managers. Changes in the tax code in the 1950s allowed for

Corporations and "S" Corporations to become a more desirable organizational arrangement for multiple owner and larger farms (Raup, 1973), particularly when there is an emphasis on reducing liability, reducing estate taxes, and achieving efficient horizon investment (e.g. Harl, 1984; Boehlje and Eisgruber, 1972). An impetus in changes in organizational strategies could be in reducing vaguely defined rights, and/or formalizing tacit understandings, regarding continuation of the existing share contract agreement across generations that may create 'dialectical tensions' (Pitts et al., 2009). Issues may arise because the landlord may have multiple children that, presumably, would be granted an equal share of the fee simple ownership rights to the capital used in production. Or issues could be related to entrenchment concerns with the older landlord/ manager, which create complex, competing desires on allocation of farm resources and investment to preserve future farm residual returns at efficient, extended horizon levels. Vaguely defined property rights may alter farm managers' current investment without a long-term commitment to the share contract, and deter extended horizon investment, thus altering the performance of the farm firm in the long-run (see Harl, 1984). More formalizing and defining vaguely defined property rights can achieve increased short-term investment and facilitate efficient extended horizon investment. In the latter part of the 20^{th} century, multiple-owner farm organization types, with more formal property right allocations, governed over 50% of farm sales (See Figure 1.8).



c

Figure 1.8. Percentage of Agriculture Market Sales by Organization type (United States Agriculture Census)

We illustrate the farm manager property rights as formal (F), informal but enforceable (I), and vaguely defined (V) in the stage 2 farm firm from before (See Figure 1.6). To illustrate the evolution of formality of property rights, the set of property rights from before are identified in subsets as either Informal (a, e), formal (b, f), or vaguely defined (d,g).

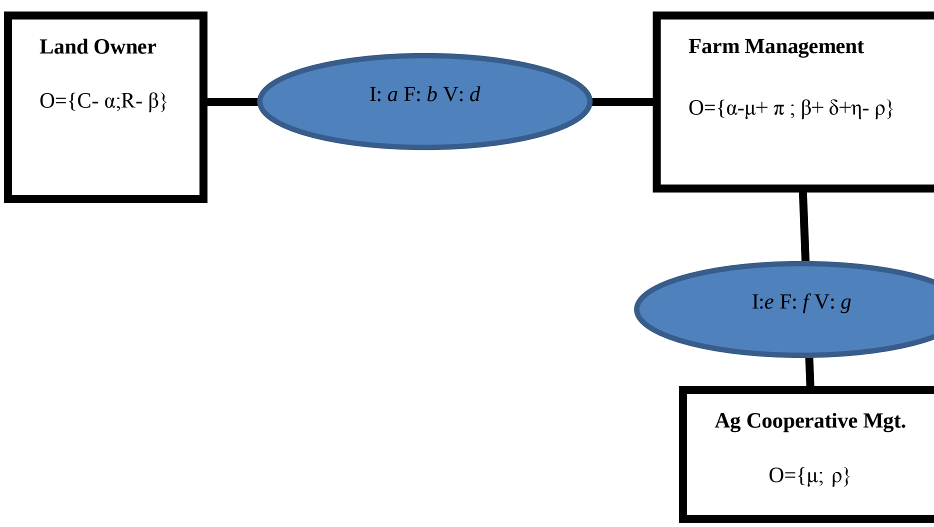


Figure 1.9. Stage 2 Farm Firm with informal, formal, and vaguely defined rights

When a landowner decides to transfer their ownership rights into a closed corporation, they would transfer the landowner rights, reserved under the share agreement, to a corporation with a name "Land Owner Inc.". The corporate contractual agreement separates the long-term ownership rights from the life cycle of the landowner, thereby reducing vaguely defined property rights. The rights that were vaguely defined are reduced by the corporate contractual agreement by increasing either the subset of formal {F}, or an informal {I} property rights, by some unknown amount ($h+i$, where h is the increase in formal rights and i is the increase in informal rights) that were created by issues of generational transfers. We will assume, the improved informal enforcement could be the result that the corporate contractual agreements have many implicit understandings of property rights that have been enforceable in preceding cases by a court of law (I: a+i). We will also assume the corporate contractual agreement would stipulate management of the farm firm to be within the family, determined by majority voting of the shareholders, and control rights and residual rights to the management would operate as they did before under the share crop agreement. As a result, we have a more formally defined incomplete contract than the share contract under the ownership of a landlord that we had before i.e., (b+h). But now the control rights and residual rights of the land-owner {C- α ;R- β} would be distributed in proportion to the investors with outstanding shares of the corporation. We will assume the distribution would be to an outside Land Owner Inc. shareholder and the farm management in equal proportion. Depending on the dilution and concentration of these shares can affect the level of control the owners can have on the management (See Bahls, 1994 for a discussion on family farm minority ownership issues). To illustrate dilution and proportion of share we will use parameter "*n*" *for* number of shares, and parameter *"o"* for number of shares owned, where shareholder rights will be some proportion of $o/n(\{C- \alpha ;R- \beta\}$. For simplicity, we will ignore issues of transfer of control rights and residual rights to an owner with majority voting shares at this time. In addition, we will assume that a corporate contractual agreement reduces vaguely defined property rights, without introducing any vaguely defined rights of its own. This may be an erroneous assumption, but for purposes of understanding the evolution of farm managers' property rights will be maintained.

A second example of the evolution in formality of farm managers' property rights, in the 20th century, was the transition from a traditional cooperative model to a New Generation Cooperative (NGC) model. Cooperative failure rates were often high after the initial increase in the early 20th century. Factors that were frequently cited for cooperative failure were lack of business volume and insufficient equity arising from "free rider" type behavior and poor cooperative member commitment (Sexton and Iskow, 1988; Staatz, 1987). In the latter part of the 20th century, tinkering with the vaguely defined property rights of traditional agriculture cooperative incomplete contracts assisted in the reemergence of cooperatives; and allowed some traditional cooperative forms to transition to better performing and more sustainable entities from the original justification for agriculture cooperative to defend against opportunistic oligopolies (Cook, 1995). Surviving agriculture cooperatives found organizational justification, through asset specific investment, asset specific product attributes, risk sharing, reputation effects, and extended horizon investment, compared to investor owned firms (Cook, 1995) that could not replicate the agriculture cooperative strategy by a change in opportunistic behavior. Important attributes of an NGC were more defined membership rights on patronage of the cooperative, and more defined residual rights of the farm manager in the agriculture cooperative. NGC cooperative enterprises were often engaged in a more value-added, offensive strategy (Cook and Iliopoulos, 1999; Coltrain et al., 2000). The new contractual agreement more formally define the residual rights and control rights of the farm-manager owners and agriculture cooperative management. Common in the NGC agreements were that farm managers were conveyed rights to transfer their unallocated equity rights at their discretion (Υ), but not redeem at an undefined time as they had before (υ). To give the transferrable rights more value, the agriculture cooperative benefits were restricted from non-members, thus reducing "free-riding". In return, the agriculture cooperative management was granted control rights to a formally specified quantity of patronage by the farm manager, or the farm-manager faces penalties and fines (κ). The NGC contract more formalizes the ownership rights (j) and reduces vaguely defined property rights by some unknown amount (k).

In both the adoption of the corporation and the adoption of a NGC form of agriculture cooperative organization, the original contracts contained vaguely defined rights long-term and were incomplete regarding objectives and contingencies. The vaguely defined property rights affected the current and future performance of the farm firm, thus stakeholders became motivated to tinker with property rights allocations at a subsequent date to improve performance by more defining, informally or formally, vaguely defined property rights. Changes in the formality of the contracts also caused changes in the separation of ownership and control for the farm manager, which we illustrate in Figure 1.10 and we refer to as the Stage 4 farm firm.

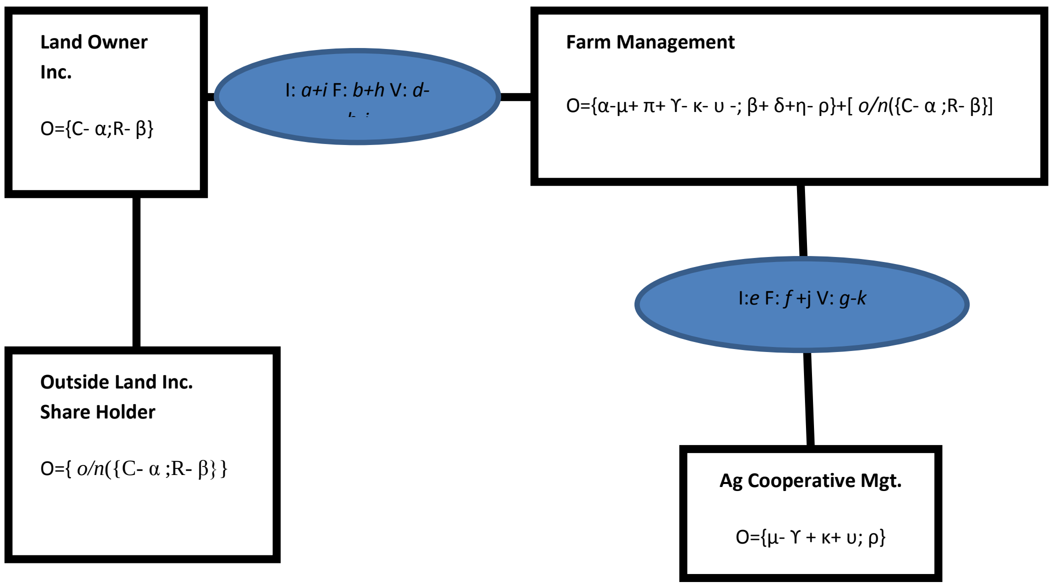


Figure 1.10. Stage 4 farm firm

A third example in the evolution of formality of contracts is the more recent adoption of formal production and marketing contracts by farm managers in the latter part of the 20th century. The increase use of production and marketing contracts allowed efficiencies to be gained from risk sharing, identifying niche markets and capturing premiums, controlling farm manager inputs, and better coordination of farm manager production and delivery (e.g. MacDonald et al., 2004; Martinez, 2002; Boehlje, 1999; Barkema et al., 1991; Ahearn, Yee, and Huffman; 2002; Lajili et al.; 1997). Production and marketing contracts more formally stipulate control of inputs in production, methods of production, and market periods. Contracting increased beginning mid-20th century, from governing 12 percent of farm production in 1969 (MacDonald et al., 2004) to around 40 percent of farm production at the end of the 20th century (O'Donoghue et al., 2011). Production contracts are characterized as the contractor (processor, marketer, or end user) of the produce owning the production from the beginning stages of production and the farm manager being paid a fee. The farm manager fee can be fixed or can include some combination of a fixed fee with performance incentives. A marketing contract is characterized as the farm manager still maintains the ownership rights to the production, but has granted some control rights to a processor, marketer, or end user, through a more formalized price, quality, and delivery period prior to the harvesting or finishing of the produce.

EVOLUTION IN COMPLEXITY

An additional dimension of farm organization evolution during the 20th century has been the increased degree of complexity. MacDonald et al. (2004) contend that current farm structure is more complex and a greater percentage of output is produced by farms that involve more owners and decision makers and "an expanding web of interactions between farm households and the surrounding non-farm community". Zahniser et al. (2002) suggest the evolution in business arrangements in farm production has increased the complexity: "farmers have adapted their business arrangements to respond to changing economic conditions and to better pursue their personal, household, and business goals…the business structure of farming is far more complex now than in the past". Hoppe et al. (2001) succinctly explain why the complex business arrangements of farms requires a broader focus on farm organization than just farm organization type (i.e. small family, partnership, corporation): "The complexity of today's farm business structure suggests that a farm's form of business organization alone is not sufficient to assess the extent of business linkages or the degree to which production or market integration may exist".

The definition of complexity is described as a whole made up of complicated interrelated parts[4]. In the organization complexity literature, complexity is generally described as the degree an organization performance is dependent on interdependent, or interacting, parts that have competing, conflicting relationships. An often-identifying trait of a complex system is non-linear behavior, because of interconnections and feedback loops. As a result, small changes to a single part can have large impacts on the behavior of the whole system (See Anderson, 1999). In our illustration of the farm mangers' property rights, the evolution to more complexity resulted in the 20th century because the farm managers property rights represent the parts of an organization that attempt to satisfy complex, competing relationships between farm managers, cooperative management, association representatives, mutual insurance management, federal crop insurance managers, landlords, family management and owners, end users, processors, and consumers in farm production. Adapting, or evolving, in a complex organization involves changing the parts of the system to improve the performance. In our study of improving performance by changing parts, we would study changes made to property rights to improve performance. Through the evolution of the farm firm in the 20th century, we can observe that adaptation to the complex organization is not always the choice of an individual farm manager, rather includes choices by other farm managers' or

[4] Webster-Merriman dictionary.

agents in the complex organization. Farm managers' and other agents, at times, have competing, conflicting interests and their behavior may change with changes to farm managers' property rights. Thus, the interdependency to performance of farm managers' choices on property rights and other agents in the farm firm creates more complexity than the existing literature presumes. This results in difficulty in determining the optimal farm organization choice because (1) uncertainty exists to how small changes to property rights affect farm mangers' performance, and (2) the choice of farm manager property rights that effect performance is often not a single labor and land transaction.

SUMMARY

The differences in the evolution of farm managers' property rights in the 20th century has created an interesting research area to examine efficiency of the different property right types of farm firms, and to understand the factors that are critical to their success. The remaining two chapters begin to explore differences in the evolution of farm managers' property rights, and factors critical to their success and efficiency. The objective of the research is to address the question: has increased separation of ownership and control, formality, and complexity improved the efficiency and performance of farm managers and owners? What are the critical factors to success that will influence future adaptation of farm managers' property rights? The evolution of farm managers' property rights has attempted to gain advantages that are typical of separated ownership and control organization, such as specialization, risk sharing, investing according to the market value, and making asset specific investments, while mitigating agency costs that occur with more separated ownership and control and costs from vaguely defined property rights. Complications in knowing the impact to all the property right evolutions mentioned occur because some adaptations have benefited all U.S. farms, and because data is not available for the precise property right sets that exist with each farm manager. However, some data is available in the Agriculture Management Resource Survey (ARMS) conducted by the National Agricultural Statistics Service (NASS) that can begin to address these research questions. We perform two forms of technical analysis, structural equation modeling (SEM) and stochastic frontier analysis (SFA), on separated ownership and control farms relative to combined ownership and control, to determine levels of performance with different organization types. We also explore some factors cited in the literature that should be affected by increased separation of ownership and control and are expected to be largely responsible for performance levels from differences in farm organization. This study aims to contribute to the larger research questions of farm organization evolution, namely, will adaptations, or evolution, to more separation of ownership and control, formal, and complex farm organization continue in the 21st century?

Chapter II

NATURE OF THE FARM: REVISITED

INTRODUCTION

Organizational economists have long proposed hypotheses about various ownership types and their effect on farmer incentives and farm success (See Dasgupta et al., 1999, and Otsuka and Hayami, 1988 for a review; Allen and Lueck, 1998). A particularly important issue explored is the effect of ownership and control on transaction costs, specifically agency costs. For example, Allen and Lueck (1998) consider the tradeoffs between agency costs and the benefits of specialization from separating ownership and control. They posit that if there are gains to be captured from specialization, then partnership or corporate farm organizational arrangements could be more efficient than farms in which ownership and control is combined-- if partners could monitor and enforce farmer effort at lower cost. But because most agriculture production is heavily influenced by nature, it becomes too costly to differentiate production deficiencies from lack of farmer effort or from effects of nature. Hence, Allen and Lueck (1998) argue that agency relationships are a central reason for why farms 'will remain small and family farms will likely be with us a long time to come' (p. 380). They further explain that cases of separated and control (SOC) firms in farming are mostly family firms and are likely the result of either offsetting lower costs to capital or from a reduction in the randomness of nature—such as indoor livestock feeding operations—which then allows specialization gains be captured.

In this study, we contribute to the literature on the organizational structure of farms by empirically examining the effect of increasing separation of ownership and control and vertical coordination (VC) on effort, capital costs, and farm success using the Agriculture Resource Management Survey (ARMS) data from 2005-2010. Specifically we ask; does combined ownership and control farming improve farm success due to improved farmer effort compared to more separated ownership and control farms? To answer this question, we use a structural equation model (SEM) that measures the latent variables of combined ownership and control (COC), effort, and vertical coordination (VC), we examine the direct and indirect effects on farm success and expenses per dollar of capital (Exp-Cap). We find that combined ownership and control (COC) has a small, but negative, relationship with effort of the primary operator, regardless if the operation is primarily a livestock or grain operation, or if it is family or non-family[5]. We also find, as expected, that vertical coordination is positively associated with effort, but little evidence that effort has a non-trivial and positive direct effect on farm success in grain farms, livestock farms, non-family and family farms. Also, we do not find any effect to cost of capital due to decreasing combined ownership and control and vertical coordination, but vertical coordination and separated ownership and control does exhibit small to medium direct positive effects to farm success.

The general finding in this empirical study is that our expectations of the relationship between combined ownership and control, effort, costs of capital, and farm

[5] 0.1-0.3 is considered small effect size, 0.3-0.5 is considered a medium effect size, and larger than 0.5 is large. Primer, A. Power. "Quantitative methods in psychology." Psychological bulletin 112.1,155-159 (1992).

success was not supported using the ARMS data set during 2005-2010 and the selected structural equation model. Future research and theoretical focus may be better directed to the advantages of separation of ownership and control and away from agency costs—or agency costs in an input of "labor effort" sense-- as the central reason for farm organization choice and evolution. This study finds more support that interlinkages to other markets and formal contracting of rewards and punishment (Braverman and Stiglitz; 1982) may improve farmer effort and improve social welfare, regardless of randomness of output due to nature. Policy implications are that social welfare may be improved from greater separated ownership and control and using interlinkages to land, labor, product, and credit markets in the farm sector. Understanding the impact of agency relationships in faming improves our ability to predict farm organization evolution or evolutionary pressures. Understanding the factors involved in farm organization evolution may better allow us to anticipate changes in rural farm economies and improve overall economic efficiency from a reduction in transaction costs. Quantifying the magnitude of incentive effects in farm organization also informs farm producers and financial/legal advisors on how to properly structure farm organization to maintain efficiency.

LITERATURE REVIEW

Separation of Ownership and Control

Separation of ownership and control was first described by Bearle and Means (1932). The literature on the efficiency effects of ownership and control build from the work of Jensen and Meckling (1976) and Fama and Jensen (1983). Firm types are distinguished by whether agents acting on behalf of the firm possess both the risk-bearing and residual rights (combined ownership and control) or only possess the control rights (separated ownership and control). The central focus is often how organizations efficiently align risk-bearing interests with managers' interests when there is separation of ownership and control, and what advantages separated ownership and control organizations offer? Further organization differences can be determined by what control rights owners and managers retain in different political/legal environments (La Porta et al., 2000) or what control rights management has distributed to non-management agents in the nexus of contracts (e.g. employees, contractors, strategic partners). The framework has been used to highlight the salient features of the modern corporation and performance, and to explain events such as corporate raiding, hostile takeovers, and organization attributes such as golden parachutes, poison pills, etc. Much of the literature examines differences in diffusion of separation of ownership and control, shareholder and board participation, and performance in larger corporations (See Short, 1994, for a review of empirical studies). Less empirical attention has focused on separation of ownership and control and performance in more closely controlled firms outside of comparing family-firms performance to that of non-family firms (e.g. Daily and Dolinger, 1992; Dyer, 2006; Chrisman et al., 2004). A line of literature has explored the features of share, cash, and wage contracts in agriculture production as a microcosm of closely held firms, and similarities to modern corporation separation of ownership and control issues (e.g. Stiglitz, 1974).

The advantages of separation of ownership and control are risk sharing, specialization in risk bearing, ability to purchase specific assets, specialization of management, and investing according to market rule[6] (Fama and Jensen, 1983). Closed corporations, partnerships, and proprietorships, however, are not expected to have the advantage of investing according to the market investment rule (Fama and Jensen, 1985). The theoretical identified disadvantage in separation of ownership and control is that managers that have the decision making rights (agents) will not act to maximize the interests of the risk bearing owners (principals) -- agency costs. In order to ensure agents take actions that maximize ownership interests, owners would have to invest in measurement and monitoring (considered agency costs). Some of the advantages and disadvantages have been formalized in a principal-agent model (see Eisenhardt, 1989, for a review of agency theory) and applied to understand farm organization. Early economic literature focused on explaining the inefficiency of share cropping due to agency costs (Marshall, 1920). Subsequent literature then examined why sharecropping was a persistent observation in agriculture economies (e.g. Cheung, 1969; Eswaran and Kotwol, 1985; Reid, 1973, 1977; Stiglitz, 1974; Allen and Lueck 1992, 1993) and co-existed with cash rent and wage contracts (See Dasgupta et al., 1999, and Otsuka and Hayami, 1988, for a review).

[6] Investing according to the market value rule is related to efficiencies gained from extending horizons of agents with risk bearing rights. In a perfectly competitive market, with zero transaction costs, common stock corporations will value current investments that reduce costs of production in the future appropriately. In contrast, when residual claim holders do not have the equivalent horizons to that of the organization's investments, they may discount current investments that require future payoffs beyond their horizon. If there are zero agency costs, and perfect markets, then extending horizons of residual claim holders through unrestricted/ tradable residual claims will enable efficient current investments with future payoffs.

Many scholars have used the principal-agent framework in farm organization discussion to explain why sharecropping is inefficient (Marshall, 1920). Scholars have used the principle-agent framework to show how share, cash rent, and wage contracts can co-exist due to risk adversity and transaction costs (Cheung, 1969). How contract choice can signal and match tenant and landowner entrepreneurial endowments (Hallagan, 1978). Which contract will be the dominant contract using screening models and exogenous factors of technology, opportunity income, and attributes of the landlord and tenant (Eswaran and Kotwol, 1985). How the relative costs of moral hazard of the landlord and tenant can determine whether share contracts or cash rents are more efficient (Allen and Lueck, 1992), and how share contracts can persist despite lower risk (Allen and Lueck, 1995). Some empirical studies have shown that risk preferences are not the primary reason for optimal contract choice (Rao, 1971; see Allen and Lueck, 1995, for a review). Allen and Lueck (1998) extended the principle-agent transaction cost framework to show how agency costs are more important in understanding discrete farm organization choice than the benefits from management specialization or lower capital costs in more separated ownership and control farms. The implication is that moral hazard costs are key determinant of what determines discrete farm organization choice. If moral hazard costs can be reduced-- either from efficient monitoring and enforcement of farmer effort, reduction of exogenous variables that create uncertainty, or from cooperative information sharing-- then separated ownership and control farming is likely to emerge because of lower capital costs and gains from specialization. Otherwise, combined ownership and control is likely to persist. Allen and Lueck (1998) suggest this is why we observe more separated ownership and control in indoor livestock feeding operations; where there are reduced costs of monitoring because of less exogenous influences, and in families where repeated interactions can create cooperative principal-agent information sharing.

Braverman and Stiglitz (1982) examine the same principal-agent land tenancy framework of earlier authors and explore interlinkages of labor, technology, products, and capital markets. They model how these interlinkages can be employed by the landlord to induce greater tenant effort through rewards and punishment or limiting access to products that are associated with undesirable behavior. As a result, landlords can improve tenant effort even when information is asymmetric, or there is uncertainty in output. They also explain how interlinkages can improve the welfare of both the tenant and landlord, despite the common claim that additional landlord controls will lead to tenant exploitation and subsistence agriculture. Reid (1973, 1977) explains that share tenancy when co-existent with rent and wage contracts can be as efficient, given parties can weigh the output and inputs under each governance structure. This allows the examination of performance in competing governance structures and substitution of each governance type so that all equally perform well.

Impact of Family on Farm Firm Success

There is evidence that family firms tend to exist in large numbers and survive because of some superior economic factor (e.g. McConaughy et al., 1998; Anderson and Reeb, 2004) called “familiness” (Habbershon et al., 2003). Most have attributed “familiness” to being able to control agency costs in principal-agent dilemmas (Fama and

Jensen, 1983) and extending horizons according to the market investment rule (James, 1999). The reason is often cited as some form of altruism between principal and agent that alters the objective functions, or because agents perceive reciprocity from repeated interactions. However, others have noted how family firms with informal contracts can be negative to performance due to factors such as entrenchment (e.g. Gomez-Mejia et al., 2001). Additionally, family firms may be more prone to agency costs from free riding (Schultz et al., 2001) due to improper incentives in informal family contracts. In addition, investing according to the market investment rule from extended horizons may be more complex because of competing interests in generational transfers (Pitts et al., 2009). The current family firm literature and empirical evidence is not clear on what impact family has on firm success, or developed a rigorous theory of the family firm, though most conclude it has an important influence on modeled principal-agent behavior (see Chrisman, Chua, and Sharma, 2005; Chua, Chrisman, and Bergiel, 2009).

In this study, we limit family effect on farm success to the principal-agent framework and assume that family ties approaches perfect information between the principal and agent in separated ownership and control governance structures. We do not specify the precise mechanism that family improves information, or how family more approaches perfect information equilibrium in the principal-agent framework. But given that asymmetric information is generally the problem in agency theory with diverging interests, and "familiness" is expected to reduce agency issues, we logically assume that "familiness" must improve asymmetric information or aligns diverging interests. Future research may be better directed at how family firm contracts can better harness the "familiness" attribute while discouraging entrenchment or free riding.

Empirical work on impacts of Farm Organization on Farm Success and Contract Choice

There are many empirical studies of farm organization that examined factors affecting contract choice rather than how contract choice influences effort and farm success (e.g. Allen and Lueck, 1992; Allen and Lueck, 1998; Bardhan and Srivasan, 1971; Cheung, 1969; Rao, 1971). Shaben (1987) is one of a few studies that directly test input use in Indian villages for farmers with owned and sharecropped land. He found Indian farmers used less inputs in sharecropped land than owned land, suggesting monitoring and full information was not possible in sharecropping arrangements. Reid (1973) examined the demise of agriculture productivity in Post-bellum south. He concluded that the rise of tenancy was not the source of declining productivity. Bardhan and Srivasan (1971) examined the incident of sharecropping in areas given variations in wage rates and irrigation in India. They theorized that as labor technical progress is made (i.e. where less labor and more land is required) sharecropping is reduced, conversely, when land augmenting is improved (i.e. where less land is required and more labor), share cropping is increased. Allen and Lueck (1998) use a logit and ordinary least squares estimation that examined family farm and capital levels given enterprise type (livestock), number of crop cycles, and irrigation. Other types of empirical studies that are interested in the factors to farm success have included organization variables in measuring farm performance and found significantly positive effects for multi-owner organization and smaller shares of farmer ownership (e.g. Garcia et al., 1982; Mishra, El-Osta, and Johnson, 1999).

Generally, larger farms have been found to have greater farm profitability and success (e.g. Strickland, 1983; Johnson et al., 1986). Ahearn, Yee, and Huffman (2002) find that increased farm consolidation and vertical coordination has improved total farm productivity. Gorton and Davidova (2002) empirically examined corporate farms versus family farm in Central Eastern European countries and found "no clear cut evidence" in differences in farm efficiency. Mishra, Teagegue, and Sandretto (2004) find that sole proprietorships and coops improve farm success of small farms.

Summary of Literature and Direction for Current Study

The literature examined above generally shows that separated ownership and control farming is believed to have inefficiencies due to agency costs. These agency costs are often identified as lower effort of the farmer. It is expected that family connections may alleviate some agency costs. In a principal-agent framework, we presume families alleviate agency costs by improving asymmetric information between the principle and agent, allowing separation and ownership and control to emerge in family connected businesses. The advantages of separation of ownership and control offered are risk sharing, management specialization, asset specific investment, and investing according to the market value rule. Some of the literature has discounted risk sharing as an advantage in farm production. A reduction in exogenous uncertainty to production is expected to alleviate some of the agency costs. Alternatively, the literature suggests that contracts can be structured to reduce agency costs through rewards and punishment even though the contract does not reduce exogenous uncertainty or improve information. Missing from the literature is direct empirical validation of the theoretical framework. Much of the framework has multiple variables and exceptions given changes in parameters in the model. We try to fill this void by developing an SEM model that structures the relationships we presume to exist and fit that structure to existing farm data. SEM may better measure the unobservable variables that have hampered previous empirical studies. Since effort and separation of ownership and control are not easy variables to accurately, proxy given available large data sets. Using latent variables, in an SEM, may better identify the variable of interest-- assuming there are measurable variables that are indicative of the latent variable of interest. This study is also unique in that it includes the ultimate dependent parameter that is of interest—farm success. By using SEM, this study may better examine the indirect and direct effects organization choice has on farm success and farmer effort. This study is also unique in that it examines the relationship of vertical coordination on famer effort as well as the share of ownership in the farm operation. Most other studies focus on contract choice and risk, or measure input ratios and contract type. We do not specifically examine share contracts, rent contracts, and wage contracts and farm success; rather we examine the degree of separated ownership and control compared to combined ownership and control. This is because most farms have elements of all forms of contracts and how to disaggregate inputs or behavior traits to each type would be difficult with this data set. Furthermore, this study is unique in that it uses a large sample of farms in the U.S over a wide geographic area, farm type, and period. Given such a large sample, over a large geographic area and time, we expect to be able to account for the normal random distribution of weather influences in the analysis that may bias the results of smaller studies. As a result, we can focus on the impacts of organization on farm success and effort assuming weather effects resemble a random normal error distribution with zero mean. The large sample size also enables us to make inferences on relatively infrequent organization types like non-family farms with confidence. The unit of analysis is also on the aggregate annual labor of the primary operator and their ownership in the operation. This study is different in that it does not try to identify per land unit, or per crop basis, input amounts. Most previous studies have consisted of smaller sample sizes and more specific regions and crop type.

Current structure of Farm Organization

In the 2007 Agriculture Census, 86.5% of U.S. farm firms were organized as sole proprietorships. However, in the last 40 years, the percentage of agriculture sales that are attributed to sole proprietorship firms has steadily declined to approximately 50% of total sales in 2007. At the same time, firms organized as partnerships and family corporations have steadily gained a larger percentage (See Figure 2.1). Further evidence indicates that current farm structure is more complex and a greater percentage of output is produced by farms that involve more owners and decision makers than the “one farm, one farmer, one household…one owner” type (Hoppe et al., 2001; Zahniser et al., 2002)

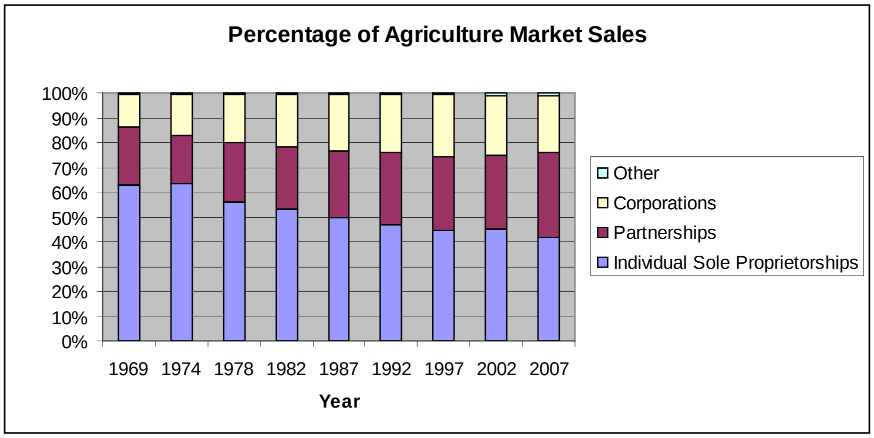


Figure 2.1. Percentage of Agriculture Market Sales by Farm Organization type

In addition to changes in sales by farm organization type, there has also been an increase adoption of production and marketing contracts and novel forms of cooperative organization. These changes in the agriculture industry have enabled organizations to shift from homogenous quality standards and spot markets to governance structures that improve coordination between producer supplies and consumer demands (e.g. MacDonald et al., 2004; Martinez, 2002; Boehlje, 1999; Barkema et al., 1991; Ahearn, Yee, and Huffman; 2002; Lajili et al.; 1997). MacDonald et al. (2004) estimated that production contracts now govern 36% of the value of agriculture production compared to 12% in 1969. 'Contracts can reduce price risk, production variability, ensure markets, and provide higher returns for producers, while processers can ensure the flow of products, obtain differentiated products, ensure traceability for health concerns, and guarantee certain methods of production' (MacDonald et al.; 2004). Contracts have largely been utilized in the livestock industry—particularly hogs and poultry.

The other structural change to improve coordination between the agriculture producer and consumer is the New Generation Cooperative (NGC). Between 1988 and

1996, Cook and Tong (1997) found that more than 80% of upper Midwest cooperative startups had "non-traditional" organizational characteristics— characteristics that distinguish NGCs from traditional cooperatives (Cook and Illioupolous, 1999). Coltrain, Barton, and Boland (2000) distinguish NGCs from traditional cooperatives as a strategy for farms to maintain their independence, but also pool resources and more vertically coordinate with consumers' demands for value added differentiated products.

From a contract theory perspective, both production contracts and new cooperative designs make greater specifications on farmer effort and capital investment level (Ahearn, Yee, and Huffman; 2002). To the extent these greater input specifications are enforceable, it is expected that farmer input levels will increase despite a principal-agent relationship where there is greater degree of separation of ownership and control.

CONCEPTUAL FRAMEWORK

The general framework of separated ownership and control farming involves a simple production function where quantity of production (Q) is dependent on some random factor (Θ) and a function of capital (K) and labor (L) input with some technology.

$$Q = \Theta F(L,K)$$

In separated ownership and control arrangement, the tenant or share owner acts as an agent of the farm owner. This agent will maximize his utility with respect to the amount of effort inputted and their return from Q plus or minus some fixed sum. The farm owner's objective function is to maximize their return of Q and satisfy the agent, or tenant, participation constraint. The agent's return (Y) is determined by a share (α) of Q and/or a fixed component β if the agent is receiving a wage or negative β if cash rent (i.e. $Y= \alpha Q + \beta$). The agent's utility is some function of income and labor effort ($U=F(Y,L)$) where the expected utility of the tenant/agent is obtained by maximizing the return function ($Y= \alpha Q + \beta$) to obtain: $EU_1\ \alpha\Theta F(L,K) + EU_2=0$. Here we assume that the agent is risk adverse or risk neutral and their marginal disutility increases as labor effort and income increase. Moral hazard of the agent is created because Θ is random and results in costs in contractually stipulating and enforcing L. Thus the choice of L is made by the agent and the marginal productivity of labor ($F(L,K)$) is not equated with the expected marginal substitution utility of income and labor ($-EU_2/\Theta\ EU_1$) when there is separation of ownership and control ($\alpha<1$).

Allen and Lueck (1998) extended the main concepts of the inefficient share cropping model to explain the discrete choice of farm organization. Their model specification eliminates differences in risk adversity between residual claimants and agent management as an explanation to efficiencies from separated ownership and control. Instead, Allen and Lueck (1998) offset the agency costs disadvantages of separation of ownership and control with gains from specialization and lower capital costs due to pooled resources. They parameterize labor specialization as a ratio of the number of laborers times the length of the stage of production divided by the number of tasks. They add the labor specialization parameter to the sharecropping model to offset the expected negative effort levels as ownership share decreases (i.e. $\alpha \rightarrow 0$). Each task in a stage of production has a degree of labor specialization that can be obtained. Labor effort is then aggregated over the length of the stage and number of stages in a cycle. Allen and Lueck (1998) also add improvement in capital costs as the number of partners grows, until it reaches a minimum capital cost level in “Factory corporate” farms and a maximum capital cost in “family farms” where number of laborers is 1. Others reasons that the expected agency costs of increasing separated ownership and control in farm production are offset can be due to reducing the uncertainty of Θ, or by agent willingness to cooperatively share information thereby making labor input observable by owners at low cost.

In all versions of the principle-agent framework on farm organization, the expected results are that effort of the farmer will improve in combined ownership and control farms. In separated ownership and control farms, labor effort is expected to decrease, and only be offset by specialization gains. Most of the literature presumes this is why combined ownership and control farming has persisted and dominated in many agriculture economies. Only when there are family ties, or the randomness of nature is controllable, does the principle-agent framework allow for emergence of more partnership or non-family corporate organization types.

Hypothesis 1: Primary Operator Effort has a positive direct effect on Farm Success

Regardless of changes in uncertainty or asymmetric information between a principle and agent, we expect effort of the farmer, or operator, to be positive with farm success (FS). Any input in labor effort is expected to improve output and result in returns to either the farm labor and management (RLM) or return to capital (RC3). It is conceivable that all farms exhibit optimal labor effort input so as to observe no effect from increasing labor effort. However, existing theory does not expect to observe inefficient labor effort from an oversupply of labor input, or a negative direct effect on farm success, particularly in separated ownership and control farms.

Hypothesis 2: *Combined ownership and Control and Vertical Coordination has no direct effect on Farm Success*

The assumption here is that Separated Ownership and Control and vertical coordination only effect farm success through incentives that improve farmer inputs- specifically effort and lower capital costs. Only indirect effects through effort and costs of capital are expected to improve farm success. The proposed separated ownership and control efficiency offsets, such as specialization of labor and management or capital costs, are presumed to be observed in indirect positive effects on farm success through capital costs or effort of the farmer. The supposition is that any gains to labor input and quantity output ratio due to specialization will result in more labor time that can be employed to produce more quantity output. In addition, any gains in lower costs to capital will be employed to produce more output or to improve returns to management and labor or owners.

Hypothesis 3: *Combined Ownership and Control is expected to have a direct positive effect on expenses per capital.*

Allen and Lueck (1998) suggest that capital costs are improved by increasing separated ownership and control because equipment is utilized more intensely/efficiently over land and pooled resources can self-finance easier than if there is a single owner/worker.

Hypothesis 4: *Combined ownership and control should have no covariance with effort in family farms.*

The assumption here is that families share information on the optimal input level of effort in a principal-agent framework. It is expected that agent effort chosen will be similar to the level of effort that would be optimal under a combined ownership and control where the agent bore the full cost of their shirking.

Hypothesis 5: *Combined ownership and control should have a positive covariance with effort in non-family farms.*

It is expected that the principal agent relationship in non-family farms more reveals asymmetric information about effort levels, and these levels are not observable without cost. Thus, it is expected that combined ownership and control in non-family farms will have a positive covariance with effort, since it is expected the agent will invest more into effort when they more fully bear the costs of their actions.

Hypothesis 6: *Combined ownership and control should have a more positive covariance with effort in Grain farms than in Livestock Farms.*

It is expected that the principal-agent relationship in Grain farms have more exogenous uncertainty in output. Therefore, it is expected that agent effort is not as readily observable and the relationship more approaches asymmetric information about effort levels. Given this dynamic, it is expected that combined ownership and control will have a greater positive covariance on farmer effort because the farmer more bears the costs of sub-optimal effort. However, livestock farms are expected to have less exogenous uncertainty, therefore making agent effort more observable and agent effort level easier to monitor and enforce. Thus, combined ownership and control is not expected to improve effort levels as much in livestock farms as grain farms.

Hypothesis 7: *Vertical Coordination has negative covariance with combined ownership and control.*

It is expected that farmers in a combined ownership and control choose optimal amounts of input—specifically effort. It is not expected that vertical coordination is necessary with combined ownership and control farms to more formally specify input levels that would create a Pareto superior equilibrium. Thus, combined ownership and control farms are expected to have a negative covariance with vertical coordination. Conversely, we expect SOC farms to develop labor specialization where more idle time would be available. Hence it may be necessary to contract more optimal effort levels to maintain maximum production.

Hypothesis 8: *Vertical Coordination has no covariance on effort in family farms and a positive covariance on effort of a farmer in non-family farms.*

It is expected that the Principal-agent relationship in non-family farms has more asymmetric information and family farms more approach perfect information. Therefore, formal contracts that specify input levels through VC will not increase farmer effort levels as much in family farms, because those levels will already be chosen. However, in grain farms, agent effort is not as observable and the relationship more approaches asymmetric information about effort levels. Given this dynamic, it is expected that COC will have a greater positive covariance on farmer effort because they more bear the costs of sub-optimal effort. However, livestock farms are expected to have less exogenous uncertainty, therefore making agent effort more observable and agent effort level easier to monitor and enforce. Thus, COC is not expected to improve effort levels as much in livestock farms as grain farms.

Hypothesis 9: *Vertical Coordination has no covariance on effort in family farms and a positive covariance on effort on a farmer in non-family farms.*

We expect that family farms will already have near perfect information on operator effort and therefore operators will have already inputted optimal effort. Thus, we do not expect to observe any covariance with VC and family farms. We do expect to observe a positive covariance with non-family farms and vertical coordination, however.

Hypothesis 10: *Vertical Coordination has more positive covariance on effort in Livestock farms than on Grain Farms.*

We expect that VC will be more able to contract sub optimal effort in Livestock farms than Grain farms, because Livestock production has less exogenous uncertainty than Grain production.

METHOD/DATA

In this study, we are primarily interested in three sources of separation of ownership and control. The first is separation of residual claims and control rights to factors of production (land, machinery, buildings). The second is separation in residual claims and control rights to the production (production contracts, marketing contracts, and cooperative involvement). Third, is the separation in residual claims and control rights to upstream and downstream supply and market assets. Separation of residual claims of ownership and capital we suggest can best be captured by organization type selected for the operation and the percentage of the operation the operator owns (i.e. sole proprietorship, partnership, corporation). The adoption of production and marketing contracts and cooperative investment can best capture the separation of residual claims and control for output and market assets.

SEM Model

We examine the impacts of combined ownership and control (COC) and vertical coordination (VC) on effort and farm success (FS) by developing a structural equation modeling (SEM) model. Modeling effort and COC on FS using a SEM model may better reveal the effects of ownership on farm success because it is anticipated that COC affects effort, which effort then directly effects FS. Therefore, COC effect on FS should occur through an indirect path via effort to FS, and not a direct path to FS. Since the variables we are interested in (Effort, FS, COC, VC) are not exactly measured or difficult to assess using self-reported ARMs data with a great deal of measurement error, we suggest a latent variable structure would be better at capturing the variables of interest and testing the existing theory of organization on farm success and farmer effort. The model takes pertinent variables of the literature and tries to construct associated paths that will reveal the relationships that is predicted by the theory (See Figure 2.2 for an illustration of the SEM model).

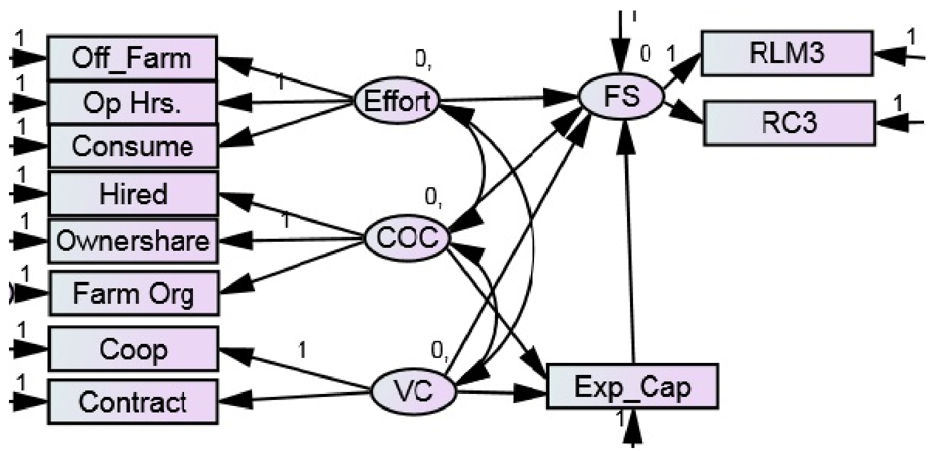


Figure 2.2 SEM model

The first latent variable we measure is effort of the primary operator on the farm. Though the theory as outlined by Allen and Lueck (1998) describes effort both as a function of time and specialization or efficiency on a specific task, we will only be able to measure effort associated with time. The ARMs data does not contain questions or variables related to experience or specialization of a particular farm task. Our latent variable (effort) is measured by the total annual hours of the primary operator worked on the farm (Op Hrs.), whether the primary operator had an off farm occupation (1=yes, 0=no) (Off_Farm), and the ratio of the value of consumption reported for the household divided by the value of farm sales reported in the previous year (Consume)[7]. The measurement variable of "Op. Hrs" is expected to be positively correlated with effort,

[7] ARMs survey asked respondents to choose a value code of 1-34 that indicated dollar ranges.

while “Consume” and “Off_Farm” are expected to have a negative relationship. It is expected that hours worked on farm will result in improvement of output or productivity of capital (social, human, or factor) thus improving farm success (FS).

The second latent variable we measure is the degree of combined ownership and control (COC). Ownership and control increases due to both having many owners that do not operate the business, and also by having many hired employees that do not own the business and work under a wage system; we measure “COC” using the “Hired” variable, the percentage of ownership share the operators household held (0-100%)(“Ownshr”), and the type of farm organization the operator identified as being (1= proprietorship, 2= partnership and trusts, 3=S and C corporations)(Farm org). We expect “COC” to have a negative relationship with the variables “Hired” and “Farm Org” and a positive relationship with ownership share (“Ownershare”). We do not expect combined ownership and control to directly affect farm success (FS) but we do expect combined ownership and control (COC) to improve effort, which improves (FS), but also to have an increase in the costs of capital (Exp_Cap) which then decreases farm success (FS).

The third latent variable we measure is vertical coordination (VC). Vertical coordination is measured by whether the farm has any equity in a cooperative (coop) and uses contracts (marketing or production) and for livestock and grain (1=yes, 0=no) (Contract). If the farm uses contracts for livestock and grain, and they use marketing and production contracts, then the number of contracts is added with a possible score of zero to four. We expect both variables “Contract” and “Coop” to have a positive relationship with “VC”. We expect vertical coordination through more formal contracting will improve effort and then improve farm success (FS). We also expect vertical coordination to decrease costs to capital (Exp_Cap), which then improves farm success (FS). We do not expect vertical coordination to have a direct effect on farm success. The model examines the relationships of the latent variables on each other and the direct and indirect effects on farm success (FS) and cost of capital (Exp-Cap). We measure farm success (FS) by calculating return to labor and management (RLM3) and return to capital (RC3)[8]. We measure cost of capital by calculating the ratio of gross expenses by the total value of capital. We proxy efficiencies from larger amounts of capital would appear as an improving ratio of expenses or costs of managing or obtaining that capital.

The model was fitted to all the data as a whole and to groups of data. We examined the model fit and path coefficients of the same model between farms that are primarily grain farms, primarily livestock farms, and whether the operator identified the operation as family or non-family. The hypotheses we will test are the expected signs on the path relationships to confirm the relationships the existing theory expected. The path parameters we examined were from the standardized correlation matrix of the model. We expected to observe significant relationships in specific directions; however, theory has not specified magnitude of effect other than implying importance in understanding persistence and choice in farm organization. Theory has implied that magnitude of effect would increase with increased degree of separation of ownership and control. Given this, and the large sample of data, we did not think it was necessary to perform Chi square

[8] We also included another variable to farm success as gross profit on cash revenue. This variable was positively correlated with the other two variables, but did nott have as high of a loading on the farm success latent variable. The gross profit on cash revenue variable also caused more problems with the model, and didn’t add much unique information to our latent factor farm success, therefore we dropped the variable.

significance tests to determine significant differences. Given the large data set, unless the parameters were nearly equal, the Chi square significance tests would likely show significance differences in parameter estimates if we constrained them to be equal.

Table 2.1 Hypotheses: Path coefficient expected signs for Family, Non-family, Grain Farms, and Livestock Farms under assymetric Information and exogenous uncertainty assumptions.

Group	Family	Non-Family	Grain Farms	Livestock Farms
Structural Paths	Full Information	Asymmetric Information	More Exogenous Uncertainty	Less Exogenous Uncertainty
Effort → FS	+	+	+	+
COC → FS	No effect	No effect	No effect	No effect
VC → FS	No effect	No Effect	No Effect	No Effect
COC → Exp-Cap	+	+	+	+
Exp-Cap → FS	-	-	-	-
Effort – COC	No effect	+	More + Covariance than Livestock Farms	Less +Covariance than Grain Farms
VC –COC	-	-	-	-
VC—Effort	No effect	+	Less + covariance than Livestock Farms	More + covariance than Grain Farms

Data

All of the data is from the ARMs phase II and III survey. The survey years chosen were 2005-2010. A few of the variables used in the survey were not in ARMS survey before 2005. Calculations all were made from the data given by the respondents or calculated by ERS-USDA. Return to Labor and Management (RLM3) is the dollar value return ($1,000's) returned to labor and management after expenses. It was calculated by adding net farm income, hired labor expense, interest on debt, and rent (share, cash, or AUM), minus market value of land, buildings, and equipment (rented and owned) multiplied by four percent as an arbitrary opportunity cost to capital. Return to Capital (RC3) is the percentage of return per capital. It is calculated as net farm income minus charge for unpaid operator and management labor and unpaid non-operator labor, plus interest expense and rent (share, cash, AUM), divided by market value of land, buildings, and equipment (owned or rented). We excluded farms that reported their value of capital deployed as less than $75,000. The financial figures are estimated with the intent to determine average capital efficiency of different farm operations. The ARMS survey attempted to calculate net farm income using an accrual accounting method with reported inventory and market values, market sales, and occurred and deferred expense.

Where there was missing data, we imputed with the mean. Missing values and imputation amounted to a small amount, except for value code of household consumption as a ratio of value code of previous years farm sales (consume). Missing values for the variable "consume" amounted to nearly half the sample. Eliminating the variable "consume" from the model did not alter the path coefficients very much since it does not have a high loading on to the latent variable "Effort". Given that the theory proposes the alternative to farm effort is to engage in off-farm work or to leisurely consume goods, we felt it helpful to include a variable that proxies for household consumption despite the lower loadings and large number of missing responses. Different methods of handling missing data would likely not change the model parameters or model fit with great magnitude[9].

We also excluded operators that indicated they were retired from the sample. Though the theory does not outline effort as a function of age, effort would be expected to decrease as age increases, to the point that effort would be near zero when an operator is retired. Given our interest in this study is to examine the effects to effort as a function of the percentage of residual claims to uncertain production we excluded retired operators where their effort is not a function of ownership.

In the model design, we explored estimating the measurement portion of the model using data from all groups and then allowing the structural components of the model to be unconstrained with the different groups. This model design created inconsistent structural path results across the groups, particularly for non-family. When we allowed the measurement portion of the model to be unconstrained across all groups, essentially running four different samples, and let the structural components of the models vary as well, it resulted in more consistent path estimates in the structural component of the model across the groups. An examination of the measurement paths across the groups when they were unconstrained revealed there was not that much difference in measurement estimates from one group to the next. Thus, we determined

[9] For owners share (ownershare) there were 3,297 missing, for expenses to capital (Exp_Cap) there were 31 missing, for household consumption (Consume) there were 47,801 missing, for the ratio of hired labor expense (Hired) there were 7 missing, for return to capital (RC3) there were 5,457 missing and we imputed with the mean. For return to labor and management (RLM3), operator hours (Op. hrs), and off farm work (Off-Farm), if there was a missing variable then we considered it zero. For farm organization (Farm Org) if there was a missing response we considered it a sole proprietorship. For equity in a cooperative (Coop), use of production contracts (VC), if there was no response we considered it to indicate they did not use, or it did not apply to their operation.

that allowing the measurement and structural components of the model to be unconstrained across all groups gave more consistent and reliable results to examine our hypotheses.

Additional model modifications could be that “Effort” is dependent on “COC” and “VC” instead of a covariance relationship. When we explored this model type, there was not much difference in the parameter results then when we left the relationship of “COC”, “VC”, and “Effort” as co-variances.

Table 2.2 Means and farm counts of observed variables used in SEM model

Observed Variables in SEM model		**Mean**	**Farms**
Return to Capital (RC3)		.03	113,221
Return to Labor and Management (RLM3) ($1,000s)		175.17	
Value of Household Consumption as ratio of farm sales (Consume)		1.09	
Ratio of hired labor expense to expenses (Hired)		.11	
Annual hours operator works on farm (Op Hrs.)		2332	
Expenses to Capital ratio (Exp_Cap)		.27	
Owner share expressed as a percent		70.2	
Principal operator works off the farm (Off_Farm)	No		84577
	Yes		28644
Type of Farm Organization (Farm Org)	Proprietorships		85961
	Partnerships & Trusts		13686
	Corporations		13574
Operator indicated they own stock in a cooperative (Coop)	No		84062
	Yes		29159
Operater indicated they had Livestock or crop production and marketing contracts (Contract)	None		72909
	1.00		10094
	2.00		28594
	3.00		1148
	4.00		476

Table 2.3. Standardized Structural Path Coefficients

	Standardized Path Coefficients for Structural Component of Model				
Group	Family	Non-Family	Grain Farms	Livestock Farms	All Groups
Sample Size(N)	106,392	6,829	58,954	61,214	113,221
Effort → FS	-.07	.00	.02	-.10	-.03
COC → FS	-.29	-.27	-.35	-.21	-.29
VC → FS	.18	.03	.08	.14	.10
COC → Exp-Cap	-.04	.01	-.09	-.02	-.02
Exp-Cap → FS	.05	.04	.14	.03	.03
Effort ↔ COC	-.30	-.29	-.24	-.42	-.29
VC↔ COC	-.27	.07	-.04	-.53	-.23
VC↔Effort	.69	.54	.65	.73	.68
VC → Exp-Cap	.00	.00	.01	.00	.00
RMSEA	.025	.049	.040	.028	.026

RESULTS

We used RMSEA to determine model fit, given the very large sample size (See Table 2.3). The model fit measured by RMSEA was good, with all the models coming in below the generally accepted threshold of .08 and less than the more strict .05 that would "indicate close fit of the model in relation to the degrees of freedom" (Brown and Cudek, 1993; Loehlin. 2012). An examination of the residuals means and residual co-variances also revealed that certain residuals have large residual co-variances. Further model specification may improve the fit of the model; however, more changes would not alter the path coefficients with great magnitude or change the general hypotheses results of this study. In the interest of simplicity, and to confirm the structure of existing theory against real data, we accepted a larger standardized covariance and ignored model modification indices that would alter the parameters and improve the fit of the model[10]. A study attempting to determine the more precise relationships of how these variables interact with each other would make greater model specifications and be more sensitive to large residual co-variances.

The standardized path coefficients of the model across the groups and all groups consistently show unexpected results with regard to “COC” and “Effort” and mixed results, but trivial, with “Effort” and farm success (FS) (See Table 2.3). The expected result was that “COC” would have a positive covariance with “Effort” of the operator, and “Effort” of the operator would have a positive direct effect on farm success (FS). However, in all groups, “COC” had a negative covariance with “Effort” and there was a mixed effect of “Effort” on farm Success (FS). For example, a one standardized unit increase in “COC” is estimated to have -.24 standardized unit decrease in effort of the operator if the farm was primarily a grain farm. An increase in one standard deviation of “COC” would then decrease effort (-.24) and have a negative estimated effect on farm success (FS) of about -.0048 standardized units of farm success (indirect effect on “FS” from “COC” via “Effort”= (-.24)(1)(.02)). Given the indirect effect of “COC” on “FS” via “Effort” is near zero, we would consider it trivial, insignificant, and random for farms that are primarily grain. If we add up all the indirect effects to farm success (FS) from COC, these are the indirect effects that occur through “effort”, vertical coordination (VC), and expenses to capital (Exp_Cap), the estimated effect is -0.012, a trivial

[10] Adding a covariance path from “op. hrs.” error to “RLM3” error and “FS” error would alter the model parameters slightly. The paths would show a small positive path coefficient for the path to “RLM3” and negative small path for “FS”. This would cause the direct path coefficient from effort to farm success to have no effect for the sample with all the groups, compared to the -0.03 we displayed in our results table.

amount[11]. The indirect effects indicate that being more "COC" is actually trivially negative to farm success (FS) in grain farming. Furthermore, there was a much larger direct effect (-.35) on farm success (FS), in grain farms, from "COC". This direct effect was also negative and opposite of expectations. We hypothesized that "COC" would have no direct effect on farm success (FS) and the standardized path coefficient would be near zero. We assumed this because we expected farmer effort or capital costs would explain most of the effect to farm success from changes in ownership, this expectation was not confirmed.

We also explored vertical coordination (VC), or more formal contracting where rewards and punishments were more formally stipulated on "Effort" and farm success (FS). We hypothesized that vertical coordination would stipulate higher levels of farmer "Effort" which then would result in improved farm success (FS) via "Effort"—particularly in livestock farming where there is less exogenous uncertainty. As expected, there was a large positive effect on "Effort" when there was vertical coordination (VC) (.73). However, this increased "Effort" did not result in a non-trivial increase in farm success (FS). The estimated direct effect of "Effort" on farm success (FS) for livestock farms was negative and relatively small (-.10), hence the indirect effect on farm success (FS) from vertical coordination (VC) was again trivial and negative (-.073) from a one standard unit increase in "VC" (indirect effect of "VC" on "FS" via "Effort"= (.73)(1)(-.10). However, the direct effect on farm success (FS) from vertical coordination (VC)

[11] We used AMOS to determine all indirect effects. Amos defines indirect effects as indirect regression paths and not covariances, or spurious indirect effects. Calculations do not include indirect paths through covariances.

was small for livestock farms but was larger than the negative effect from increasing too much effort (.14). If we add up all the indirect effects from increasing vertical coordination in livestock farms it would result in no effect (.000). In addition, our model and estimates show that vertical coordination (VC) had no effect on the costs to capital in any groups. As a result, the only effect we observed from vertical coordination (VC) on farm success (FS), in livestock farms, was a small direct positive effect from vertical coordination (VC).

Generally, the expected relationships of the conceptual framework did not explain farm success (FS) with great magnitude. In contrast, the greatest effects to farm success were direct effects from “COC” and “VC” and not indirect effects via operator “Effort” or costs of capital (Exp_Cap). Moreover, the direct effects on farm success (FS) were opposite of the theory, where separated ownership and control from multiple-owner organization or vertical coordination had positive effect on farm success. This relationship was consistent when we altered asymmetric information (family vs. non-family) and exogenous uncertainty (livestock vs. grain farms). We were not able to capture the expected tradeoff using the SEM model and ARMS data set, where separated ownership and control was expected to improve costs of capital or labor specialization, but increased agency costs from farmer effort. Thus, our empirical examination of separated ownership and control farming did not find the limiting factor for increasing separation of ownership and control.

DISCUSSION

The SEM model and hypothesis results suggest that the principal-agent framework, as discussed in the literature, was not confirmed by the data. The primary reason we suggest that the framework may need to be modified is that the model assumes or leaves out that COC operators may have more disutility to effort than share farmers due to wealth effects, or that farm wage and share operators contracts are designed where they over supply effort (e.g. rewards or punishment). Our results seem to suggest that primary operators with combined ownership and control farms, on average, put in less effort than SOC farms—this is consistent in Grain, Livestock, Non-Family, and Family farms. The literature is clear that share tenants, partial owners of farms, or wage laborers are expected to have a disutility to effort. Though there has not been adequate modeling of the optimal contract choice when the full owner has a disutility of effort stronger than additional income, this is particularly prevalent if they feel their income is unrelated to additional effort, which seems to be the case in our model where we found little evidence that increasing effort improved farm success. Though that reasoning seems straight forward, it raises complications with concluding that COC farms are expected to persist due to agency costs, if optimal effort is contractible and enforceable to some reasonable degree. For that reasoning, we find evidence in the SEM model to support more observed SOC farms, regardless of exogenous uncertainty.

Across all groups, we found vertical coordination and separated ownership and control increased the effort of the operator. This may suggest that effort is self-enforcing or contractible and enforceable to some degree. We cannot assess precisely why higher levels of effort were chosen, however. The separated ownership and control farms may have some associated benefit pay attached to ensure increased effort levels of partial owners. For example, operators in separated ownership and control farms—whether under a wage contract or some type of share contract—may have some fixed payment that is explicitly based on hours worked or quantity of production (see production contracts on poultry and hogs), or implicitly based on 'hard work now will be rewarded later' (e.g. inheritance, altruism, promotion). Given the incentive design, it could be expected that share operators would not only supply optimal level of efforts, but may over supply effort to the extent their disutility of effort equals the implicit or explicit marginal benefit they perceive to gain. Here we could see how a share contract, from a landowner perspective, would be a superior form of contract; where the share farmer has some perceived additional implicit fixed benefit. The landlord, or "non-farmer owners" would not have to pay the implicit additional benefit immediately for the additional farmer effort that does not increase income with certainty, but the share contract would not discourage additional effort as well.

Another possibility is that monitoring costs may not be monetized, thus unknown, but prevalent. For example, the additional hours that separated ownership and control operators are investing may be to monitor wage labor or partial owners/ partners. Alternatively, there could be partial owners who are monitoring the operator that responded to the survey. The degree there is disutility of effort from the extra effort for monitoring will determine whether there are benefits to separated ownership and control farms and vertical coordination. Regardless, though, the theory suggests any partial ownership would reduce monitoring effort as well, but it is hard to determine if the extra hours is due to additional monitoring or due to the same production activities that the operator would perform in a combined ownership and control farm, or both. It may also be that knowledge on the impacts of weather, land attributes, etc. are becoming more well known by owners, thus they can efficiently calculate labor effort from random output given those other factors. Our study does not identify precisely how effort is being enforced in separated ownership and control farms, but there is evidence that SOC operators input more effort than combined ownership and control operators (see Table 2.4).

Table 2.4. Farm organization type and operator mean hours

Farm Organization	Total annual principal operator hours worked on farm (paid and unpaid)	Percent of ownership of the operator respondent and household
	Mean	Mean
Individual Proprietorships	2226	75.55
Partnerships and Trusts	2679	52.91
Corporations	2652	58.00

If we dropped all the smaller farms (less than $250,000 in farm sales), with part-time on-farm labor out of our sample, we can then show that being more COC is positively correlated with annual hours the operator works on the farm. However, even in our large farm sample, hours worked by the operator still had no effect on farm success (FS). Hence, the extra hours that a combined ownership and control farmer put in compared to a separated ownership and control farmer did not cause COC farms to gain an advantage from lack of effort by an SOC operator.   This model and sample also still showed that SOC farming has a direct positive effect to farm success (FS), and it was not through lower capital costs. Though, we could hypothesize, the reduction in labor hours for the SOC farmer, compared to the COC farmer, was enabled through specialization of labor-- where the SOC operators perform equivalent tasks more efficiently than a COC farmer that has to perform all the tasks.

In additional analysis, we found that farm success appears to be related to volume of market sales. Perhaps the advantage of SOC has more to do with size of the farm and a culmination of factors that when combined offer a significant advantage. Regardless, if quantity of sales can be increased through additional capital and labor input, and there is not offsetting agency costs from effort of the operator-- due to contractible and enforceable input levels-- it would suggest we would have more separated ownership and control farms emerge. That seems to be evident when analyzing the growth in share of market sales of separated ownership and control farm organization (see Figure 2.1) and the increasing returns to management and labor and returns to capital when sales class increased.

We note that with increased sales, that less farm success effect was associated with returned to capital and more to farm management and labor. In addition, as farm sales increased there was more uncertainty in return to labor and management. This may suggest that the agency costs associated with separation of ownership and control has more to do with measuring and monitoring residual claims, rather than monitoring the effort of the operator per se. It is in the expropriation of returns that there may be stronger evidence to why farms remain more combined ownership and control-- or at least smaller in market sales scale-- as opposed to separated ownership and control with larger market sales.

We also note that the existing literature on farm organization using a principal-agent framework does not provide much understanding to cooperative participation or contracts outside of specialization of labor. We hypothesized that it would not be necessary for vertical coordination due to ‘lack of effort’ with combined ownership and control farms, because Pareto optimal levels of labor input would theoretically have been chosen. We expected that separated ownership and control farms would develop specialization efficiencies, and would require enforceable contracts to increase effort for more sales. As a result, specialized laborers and management would not use their more efficient “Labor effort” for leisure or consumption and off- farm work. Our results did suggest combined ownership and control farms had negative covariance with vertical coordination, which fits our expectations. But this may not be because Pareto optimal levels of inputs, such as labor effort, were chosen on COC farms. The SEM model suggests there is a direct positive effect to farm success from vertical coordination, and vertical coordination was not beneficial to farm success from an indirect effect via effort. The negative covariance of vertical coordination and combined ownership and control may be a result of disutility of effort by the combined ownership and control operator. Thus, operators in combined ownership and control farms would not engage in contracts that require additional input levels, coordination, or monitoring of downstream processors, for example. Further, vertical coordination was almost as effective at increasing effort in grain farms as livestock farms, where we assumed there was less exogenous uncertainty, and monitoring would be easier. The results suggest that vertical coordination increases market value and coordinates larger production. The implication is that vertical coordination allows Pareto superior equilibriums to be achieved. Thus, the purpose of separated ownership and control via vertical coordination may not be to contract and enforce sub-optimal input necessarily, but interlinking markets in ways that reveals greater aggregate welfare. This may be through the theorized specialization of labor and management (Allen and Lueck; 1998) where increased knowledge and experience, thus efficiency, can produce larger amounts of production with less labor effort and capital. But it could also be related to other advantages such as risk sharing and specific asset investment.

CONCLUSION

We empirically examined the existing principal-agent framework on the impact COC on farmer effort and farm success. We did so under various assumptions about asymmetric information and exogenous uncertainty, using family, non-family, grain, and livestock farms. We did not find strong evidence that combined ownership and control farm operators put greater effort in than separated ownership and control farms as the theory predicted, except in larger farms. To the contrary, we found that separated ownership and control operator effort and farm success were positively correlated. We also found that operator effort did not have more than a trivial impact on farm success. The implication is that future evolution of farm organization may lead to more separated ownership and control farms. Future research and theoretical focus in the evolution of farm organization may be better directed to determining why separated ownership and control farms have considerable variance in return to capital and return to management and labor. It is in this area we feel that agency costs or transaction costs may limit farm organization choice to more combined ownership and control.

Limitations

The limitations of this study are that we may not have the best measurement variables that are indicative of the variables of interest. For example, this empirical study largely examines effort of the operator by using hours worked on the farm, if the operator had off farm employment, and/ or consumed a larger portion of their farm sales. Though we expect hours worked to be correlated with the often-identified effort variable in the literature, it is clear there can be more components to effort than just time. Also, we limited the study to just exploring effort on the farm of the primary operator, additional analysis could examine hours worked of other operators and potentially extrapolate hours worked of hired labor using wage rates and hired labor expense values. Another limitation is that farm success can be qualified in more ways than possibly return to labor and management and return to capital. For example, some farm operators and owners may derive more utility from farming than just income from output. Moreover, the degree of vertical coordination is very imprecise. Vertical coordination can vary by more than coop patronage or engaging in production and marketing contracts. The SEM model is only as good as the measurement variables that are used to identify the common latent variable that is of interest. Hence, with more indicative measurement variables or with additional survey data more directed at the particular theoretical framework, results may be different. In addition, 2005-2010 were relatively prosperous years for farm production, analysis and results may change given larger industry economic conditions or with exogenous agriculture policy changes.

Chapter III

SEPARATED OWNERSHIP AND CONTROL GRAIN FARMING: CROWDING OUT OR BOUNDED BY AGENCY COSTS?

INTRODUCTION

This paper examines technical efficiency of separated ownership and control (SOC) grain and oilseed farms compared to combined ownership and control (COC) in the U.S. Theory has suggested specific benefits to why SOC firms can be more efficient form, and more likely to survive, despite SOC being more prone to agency costs (Fama and Jensen; 1983). However, the farm organization literature often contends that the evolution to more SOC grain farming is bounded by agency costs, allowing COC to persist and dominate (See Otsuka et al., 1992 for a review; Allen and Lueck, 1998). Though some evidence indicates that farm organization continues to evolve to include more stakeholders, and requires more complex coordination and formal, but incomplete contract, organization: 'greater technology adoption…and farm productivity…has heightened farm operators' need for education and to increase the size of their operations… larger farms have led farmers to rely more on contracting and corporate forms of organization, spreading risks over a wider set of stake-holders' (O'Donoghue, Erik J., et al., 2011). Benefits to SOC are typically described as risk sharing, specialization of risk bearing, asset specific investment, specialization of management, or investment according to the market value rule (Fama and Jensen; 1983). Allen and Lueck (1998) suggested that corporate farming offset some of the agency costs due to the specialization of management and lower capital costs. MacDonald and Korb (2008) have offered that contracting allows risk sharing and coordinating specific products and investments. Brem (2002) examines elements of both asset specificity and specialization in the transition of farms in Eastern European countries. Regardless of SOC efficiencies, Allen and Lueck (1998) concluded that COC grain farming is more likely to persist and dominate given the agency cost problem, and the inability to reduce nature's influence on grain farming that offsets gains from specialization.

While debate regarding the relative advantages and disadvantages of SOC and COC farms persist in the literature, in the policy arena, policy makers and commentators bemoan the that "corporate style farming," characterized by an SOC organizational structure, is crowding out COC farming (See Wittmaack; 2006; Stayton; 1990). The fear of SOC farming crowding out COC farming has manifested into some state "anti-corporate farming laws" that prohibit certain SOC organizational arrangements in farm production.

The term "corporate farming" can often be vaguely defined and intermingled with farming on a large scale. We believe a distinction should be made between corporate farming in a SOC sense and farming on large scale where COC is maintained. SOC we define as farm management possessing a different set of property rights than COC (Elliott, 2013). This includes the control rights and residual rights to factors of production, control rights and residual rights to the production, and control rights and residual rights to up and downstream supply and market assets. Under both COC and SOC, large-scale crop production is achievable and will allow technological efficiency from size or scale. However, SOC farms have altered the property rights of the farm management to obtain advantages of SOC through informal and formal incomplete contracts. In contrast, in COC farming, transactions are largely governed using spot markets, and control rights and residual rights distributed in incomplete contracts for farm resources are possessed by the farm management—owner manager. An examination of efficiency of farming from both an ownership and control perspective and size may bring to light the benefits and costs to each organization type, regardless of size. The implications may be important in determining policies related to corporate farming and to better understand the evolution of farm organization.

The literature documents well both the positive and negative aspects of SOC and COC (e.g. Fama and Jensen, 1983; Grossman and Hart, 1986; Williamson, 1979). The literature has also analyzed how COC or SOC, or some type of hybrid, can dominate an industry given technological factors (e.g. Hannsman; 1988). Farm organization literature has often focused on coexistence of different organization types, particularly land tenancy contract types of share, cash, wage, or owned farming (See Dasgupta et al.(1999); Otsuka and Hayami (1988) for a review; Allen and Lueck; 1998). However, there has been less work on the evolutionary process of hybrid development, classification of different hybrid types, or the long-term coexistence of competing forms of organization, particularly when there is considerable complexity in determining all the factors involved and the relative performance. Empirical analyses of competing forms of organizations in other industries are hampered since most firms possess unique resource attributes (e.g. Wernerfelt, 2006) that make large sample comparisons difficult. The agriculture sector is unique in that competing forms of organization have persisted, despite there being more homogenous resources in the production process.

Within this context, we examine the question of whether SOC farms are more technically efficient than COC farms, focusing on competing forms of organization in U.S. Grain and oilseed farm production while controlling size effects. We attempt to determine the benefits of SOC (size effects or organization effects), given evidence there is (Elliott, 2013), and ascertain whether SOC farming is crowding out more COC farming, or if COC farming persists because SOC succumbs to agency costs. We also explore whether more novel contracting that better aligns incentives or improvement in technology that can efficiently monitor agent labor has improved efficiency and reduced agency costs over time.

We argue that SOC farming can economize on transaction costs related to large-scale production and marketing. We also argue that SOC farming incurs agency costs and collective decision-making costs. COC farming, conversely, does not incur agency costs. However, COC, may not have the advantages of SOC, such as risk sharing, management specialization, efficient horizon investment, and asset specific investment. Additionally, more novel contracting and improvements in monitoring technology or monitoring abilities may allow SOC to reduce agency costs over time and improve the performance relative to COC through an increasing realization of the advantages to SOC.

The findings of our analysis are that SOC aids in reaching technological efficiencies that are not as frequently obtained under a COC structure. This is mostly due to larger farm sizes being correlated with SOC. However, we do observe efficiencies of SOC not related to size. Once efficiencies related to size are obtained, SOC efficiency relative to COC is diminished. The net result, however, is that SOC farms are more likely to be in the upper 50% of technical efficiency. This is because SOC farms have superior mean technical efficiency for farms of smaller size and because SOC farms are more frequently observed as farm size increases. The implication being that SOC farms may be more prone to survive than COC farms (i.e. crowding out effect), regardless of SOC farms not possessing the maximum technical efficiency scores or that SOC farms lose their technical efficiency advantage over COC as farms increase in size. Contrary to theory, however, we conclude that agency costs may not deter farm organization evolving to more SOC farms. Future ability of SOC firms to increase efficiency would be development of property rights allocations that reduce agency costs and collective decision-making costs, while incurring minimal monitoring and measurement costs.

LITERATURE REVIEW

How SOC affects Farms

Most discussion on the impact of separation of ownership and control began with comparing the incentive and risk attributes of land tenancy contracts. Alfred Marshall (1920) began the discussion by explaining why sharecropping was inefficient. Cheung (1969) then explained how share, cash rent, and wage contracts can co-exist due to risk adversity and transaction costs. Hallagan (1978) suggested that share, cash, and wage contracts can signal different entrepreneurial endowments between the landowner and agent farmer. Eswaran and Kotwol (1985) extend the screening model to suggest that the un-marketed resources become more important given changes to exogenous factors, thus they determine when share, wage, or cash contracts will dominate given those factors. Allen and Lueck (1993), like Eswaran and Kowtol (1985), explain how cash and share can persist despite lower risk. Allen and Lueck (1992) suggest the relative costs of moral hazard of the landlord and tenant can determine whether share contracts or cash rents are more efficient. Some empirical studies have shown that risk preferences are not the primary reason for contract choice in farm production (see Rao, 1971; Allen and Lueck (1995) for a review).

Allen and Lueck (1998) have suggested a transaction cost framework is the most important in understanding organization in farm production, thus a risk neutral principal-agent framework is a better way to determine farm organization choice. If moral hazard costs can be reduced from monitoring and enforcement of farmer effort, a reduction in uncertainty, or a reduction in asymmetric information, then SOC can emerge due to advantages of SOC. Without these changes, COC and small scale farming is likely to persist. Allen and Lueck (1998) suggest this is why we observe more SOC in indoor livestock feeding operations; where there are reduced costs of monitoring because of less uncertainty in production, and in families where there is less asymmetric information on labor input. However, Braverman and Stiglitz (1982) examine the same principal-agent land tenancy framework and explore inter-linkages of labor, technology, products, and capital markets. They model how interlinkages (rewards and punishment) to other markets can be used by the “landlord” or any factor owner to induce greater tenant effort—regardless if information is asymmetric or there is uncertainty in output. They also explain how these interlinkages can improve the welfare of both the tenant and landlord, despite additional landlord controls that can lead to tenant exploitation and subsistence agriculture. Reid (1973; 1977) explains that share tenancy, when co-existent with rent and wage contracts, can be as efficient, given parties can weigh the output and inputs under each governance structure. This allows the examination of performance in competing governance structures and substitution of each governance type so that all equally perform well.

Anti-Corporate Farming Laws

Currently, nine states have some form of “anti-corporate farming laws”: South Dakota, North Dakota, Oklahoma, Iowa, Minnesota, Wisconsin, Nebraska, Missouri, and Kansas. The exact law in each state varies and the exemptions can be extensive, but most attempt to restrict corporate, or any non-family organization of multiple persons, from owning land or corporate leasing of land used in farm or ranch production. There typically are exemptions for family farms if they meet certain requirements. There also exists exemptions in some states for non-profit, state, religious organizations, and some states exempt seed companies, research plots, and feeding confinement organizations. Family corporations are typically exempted if the outstanding shares are held by a single family with a certain degree of kinship relationship (e.g. related in the 4^{th} degree), or fewer than a specific number of family members (e.g. 15) in an organization. Other requirements for a family corporation to be exempted include that at least one member resides on the farm and receives a majority of the income from the farming operation.

Some states extend restrictions to corporate ownership of farm production, not just land, such as processor ownership of hog feeding operations or cattle feedlots (See Harbur, 1999 and Schutz, 2009 for more detailed discussions).

Empirical Analysis

Empirical analysis has not examined the impacts of slow organizational change in farm organization from a more holistic (i.e. Elliott, 2013) organization perspective. Most empirical analysis compares farm performance, or risk measures, with tenant contract choice (i.e. share, cash, wage) (e.g. Shaben,1987). Some studies have included organization variables in measuring farm performance and found significantly positive effects for multi-owner organization and smaller shares of farmer ownership (e.g. Garcia et al. (1982); Mishra, El-Osta, and Steele, 1999). Others have attempted to determine if there are specific managerial attributes that improve farm performance (Sonka et al., 1989; Muguera and Langemeier, 2011). Elliott (2013) used SEM modeling to show that effort of operators was positively correlated with SOC, and SOC had a direct positive effect on farm success. Larger farms have been found to have greater farm profitability and success (e.g. Strickland; 1983; Johnson et al.; 1986). Gorton and Davidova (2004) found “no clear cut evidence” in differences in farm efficiency between corporate and family farms in central European countries. Mishra, Teagegue, and Sandretto (2004) find sole proprietorships and coops improve farm success of small farms. However, similar analyses have not incorporated organizational attributes and technical efficiency over different levels of size in farm production.

Stochastic Frontier Analysis of farm efficiency

Stochastic frontier analysis (SFA) has been a common method to examine technical efficiency in farm production (e.g. Muguera and Langemeier, 2011; Constatin, Martin, and Rivera, 2009; Nuemann et al.; 2010; See Battese, 1992 for a review and discussion of methods). Many have shown how technical efficiency is improved in farming when farm size is increased (e.g. Muguera and Langemeier; 2011; Aly et al. (1987); Kalaitzandonakes, Wu, and Ma; 1992). Although some have found no significant improvement in technical efficiency due to farm size (e.g. Bagi, 1982; Garcia et al., 1982).

This study is distinct in that extends technical efficiency related to size by incorporating theoretical propositions related to farm organization. SFA analysis provides a method to distinguish the portion of technical efficiency related to non-controllable effects or randomness to output, such as weather. Aigner, Lovell, and Scmidt (1977) suggest that the efficiency estimate includes inefficiencies related to effort of laborers, which is the key tenant among much of the theoretical literature on farm organization choice and agency costs. The literature suggests that as uncertainty and SOC increase in farming we should observe inefficiency due to agency costs of the partial farm owner[12]. These agency costs may be tempered by less asymmetric information in family firms, however (Chrisman, Chua, and Sharma, 2005).

[12] Agency costs can include inefficiency in allocation of resources as well as effort of the farmer.

CONCEPTUAL FRAMEWORK

The examination of agency costs in SOC farming is developed using a principle-agent framework. The general equation is a simple production function where quantity of production (Q) is dependent on some random factor (Θ) and a function of capital (K) and labor (L) input with some technology.

$Q= \Theta F(L,K)$

In a SOC arrangement, the tenant or shareowner will maximize their utility with respect to the amount of labor effort applied and their return from Q plus or minus some fixed sum. The owner's objective function is to maximize their return of Q and satisfy the agent, or tenant, participation constraint. The tenant or agent return (Y) is determined by a share (α) of Q and/or a fixed component β if the agent is receiving a wage or negative β if cash rent (i.e. $Y= \alpha Q + \beta$). The tenant or agent utility is a function of income and labor effort ($U=F(Y,L)$) where the expected utility of the tenant/agent is obtained by maximizing the return function ($Y= \alpha Q + \beta$) to obtain: $EU_1\ \alpha \Theta F(L,K) + EU_2=0$. It is assumed the tenant/agent is risk adverse or risk neutral and their marginal disutility increases as labor effort and income increase. Moral hazard of the tenant or agent is created because Θ is random and results in costs in contractually stipulating and/or enforcing the amount of labor effort input (L). When the choice of labor effort (L) is made by the agent or tenant, the marginal productivity of labor (F(L,K)) is not equated with the expected marginal substitution utility of income and labor ($-\Theta\ EU_1/\ EU_{2)}$ when there is SOC ($\alpha<1$).

Allen and Lueck (1998) have offered that the expected agency costs of increasing SOC in farm production can be offset due to other technical efficiencies of SOC (e.g. management specialization, lower capital costs). Agency costs can also be limited by reducing the uncertainty of Θ, and/or agent willingness to cooperatively share information thereby making labor effort input observable by owners at low cost. But uncertainty in output is not expected to be controlled in grain farming and asymmetric information is more likely to exist between the principle and the agent, particularly for non-family or agents with a wage incentive.

SFA analysis estimates each parameter in the production equation $Q= \Theta F(L,K)$. The maximum technical efficiency that can be exhibited given technology and not due to measurement error or factors related to weather or luck (Θ) is called the stochastic frontier. After controlling for weather and luck, farms that underperform compared to the frontier are said to exhibit technical inefficiency. SOC farms are expected to exhibit technical inefficiency from increasing principle-agent relationships when property rights to residual claims in farm production are shared (i.e. $\alpha<1$). This technical inefficiency is expected to increase with increased degree of SOC[13]. For example, a partnership farm should exhibit more technical inefficiency than a sole proprietorship with a single farmer household and a corporate farm with a wage manager and less residual claims to output is supposed to exhibit the most technical inefficiency. The increasing technical inefficiency is expected to bound SOC farm organization, allowing COC to persist and dominate.

[13] This analysis incorporates another facet to agency costs besides effort of the farmer, and that is improving cost minimizing behavior (See Elliott, 2013 on why farmer effort may not be the best description of agency costs).

We presume that contracts and monitoring and measurement technology can be employed to reduce agency costs and allow greater technical efficiency in other aspects of SOC, such as management specialization or specific asset investment. Hence, contracts and organization are included in the technology parameter. These contracts can change overtime through changes in property rights that better stipulate rewards and punishment. This may allow incentives to be more properly aligned between the principle and agent, thus expanding the production frontier. However, we cannot specifically address the different technologies used, or what is the source of the inefficiency, nor is it certain that SOC farms can perfectly monitor and measure and control agency costs using inter-linkages to other markets or novel contract design.

The question of optimal contract design may be how to minimize labor inputs for a given output level, rather than designing contracts to increase input levels, such as labor effort. SFA analysis is also flexible to allow allocative and technological efficiencies gained by SOC that offset not utilizing the theoretical optimal organizational technology for controlling agency costs--COC. Thus technical efficiency may decrease from agency costs and increase from management specialization and asset specific investment as SOC increases for a large number of farms. Moreover, technology advances may make it less costly to monitor and measure agency costs, allowing technical efficiencies to be improved over time as well—these would be gains in technical efficiency overtime besides novel contract design.

Hypothesis 1: Technical efficiency of COC farms is greater than SOC farms

Hypothesis 2: SOC grain farming is bounded by agency costs

Hypothesis 3: Novel contract design and or improving information in principle agent relationships is allowing SOC to perform better over time as agency costs are reduced in SOC farm organization.

Hypothesis 4: COC grain farming is being crowded out

Hypothesis 5: Family farms are expected to be more technically efficient than non-family farms.

Family farms reduce the agency costs in separated ownership and control farm organization, allowing some efficiency gains from separated ownership and control and less efficiency loss from agency costs that occur in non-family organization.

METHOD/DATA

Stochastic Frontier Analysis

In this paper, we examine the relationship between organizational structure and firm efficiency using stochastic frontier analysis (SFA). We focus on a sample of grain and oilseed farms. We determined limiting our sample to grain and oilseed farms better controlled for factors not of interest in this study, and allowed us to focus on the effects of SOC on technical efficiency. Moreover, the theoretical literature has suggested agency costs should be most prevalent in SOC farms engaged in grain and oilseed production where there is greater exogenous uncertainty.

The SFA method was outlined by Aigner, Lovell, and Schmidt (1977) and Battese and Coelli (1992). Two types of technical efficiency were estimated using two different assumptions on distribution of the inefficiency and two different model specifications on the production function. The first was a basic Cobb-Douglas production function assuming inefficiency has a half-normal distribution (i.e. mu is restricted to be 0)). The second was a translog production function assuming truncated distribution. The translog production function is more flexible in it does not assume a rigid smooth substitution of factors between labor and capital, like the Cobb-Douglas production function does. The difference in assumptions on the distribution of inefficiency is the portion of variance that is expected to be related to inefficiency and to randomness. With a truncated distribution assumption, more of the random disturbance is expected to be explained by technical inefficiency. With a half normal distribution assumption, less of the disturbance is expected to be related to inefficiency. The software used to estimate the stochastic frontier was Frontier 4.1. The software program and model specifications used to do the analysis are described by Coelli (1996).[14]

The Cobb-Douglas model is specified as:

$$LnYi=B_0+ B_1LnKi+ B_2LnLi + (vi-ui)$$

[14]. This incorporates the maximum likelihood estimation of the parameters. The estimation process consists of three main steps. At the first step OLS is applied to estimate the production function. This provides unbiased estimators for the □'s (except for the intercept term and the variance estimate). The OLS estimates are used as starting values to estimate the final maximum liklihood model. First, the value of the likelihood function is estimated for different values of □between 0 and 1 given the values for the □'s derived in the OLS. Finally an interative Davidon-Fletcher-Powell algorithm calculates the final parameter estimates, using the values of the □'s from the OLS and the value of□from the intermediate step as starting values. (Coelli, 1996a)

The translog model is specified as:

$$LnYi=B_0+ B_1LnKi+ B_2LnLi + B_3LnKi^2+B_4LnL^2 + B_5LnL*LnK+ (vi-ui)$$

In these models, vi is the random component assumed to be iid with distribution of $N(0, \delta v^2)$ and Ui is the non-negative random variables which are assumed to account for technical inefficiency and are assumed to be iid. $|N(0, \delta v^2)|$. We alter the Ui to have a truncated normal distribution where the mean is no longer restricted to be 0 and inefficiency has a truncated normal distribution with mean μ. $|N(\mu, \delta v^2)|$.

Where LnYi represents the log of the production for the i-th firm measured by gross value of farm income. This includes gross cash farm sales, net changes in inputs, net changes in livestock, and crop inventory, rental value of farm operator homestead, and market value of products consumed on the farm.

LnLi, is the log of the labor hired expense plus estimated management hours and market wage rate for that area. Hired labor expense includes wages paid to operators plus primary operators' hours worked on farm times market wage rate if a proprietorship, estimated value of unpaid wage labor, and five percent of the net value of production for management fees.[15]

LnKi is the log of capital the farm operation possessed plus expenses. Capital includes estimated market value of land, buildings, machines, vehicles, and breeding stock, plus estimated value of rented land, minus estimated value of land rented to others.

[15] L=V22+V22C+V22D

Expenses include cash and non-cash farm operating expenses, including depreciation and excluding marketing expenses, minus hired labor expense. [16]

B0, B1, and B2 is the vector of unknown parameters.

Technical efficiency is estimated by the ratio of the observed output (Yi) given inputs (B_0+ B_1LnKi+ B_2LnLi) plus random normal disturbance (vi), divided by the predicted output (Y*) given inputs (Ki, Li) plus random normal disturbance (vi). The ratio remaining term is Ui and technical efficiency is equal to the exponential of (-Ui). The ratio of variance explained by inefficiency is identified as parameter γ in the Frontier program and adopted from the parameterization of Battese and Corra (1977)[17]. It essentially measures the skewness of the random distribution. If the random distribution has a normal distribution then the inefficiency effect is expected to be small, and most of the disturbance around the estimated production frontier will be explained by a noise effect and less by an inefficiency effect. If the random distribution is more skewed, then the noise effect is reduced and the inefficiency effect becomes larger (See Figure 3.1). When the inefficiency effect is large, a greater portion of the random error distribution is explained by technical inefficiency.

---

[16] K=Capital2+(V41A-V22)

Capital2=V48A+V46+V51A+P855-P857\

In the 2002-2004 sample variable P857 was not available, and was not used in the 2002-2004 sample. P857 is the estimated value of land, buildings rented to others.

[17] Frontier 4.1 parameterizes the model as $\delta_v^2 + \delta_u^2 = \delta^2$ and $\gamma = \delta_u^2/(\delta_v^2 + \delta_u^2)$.

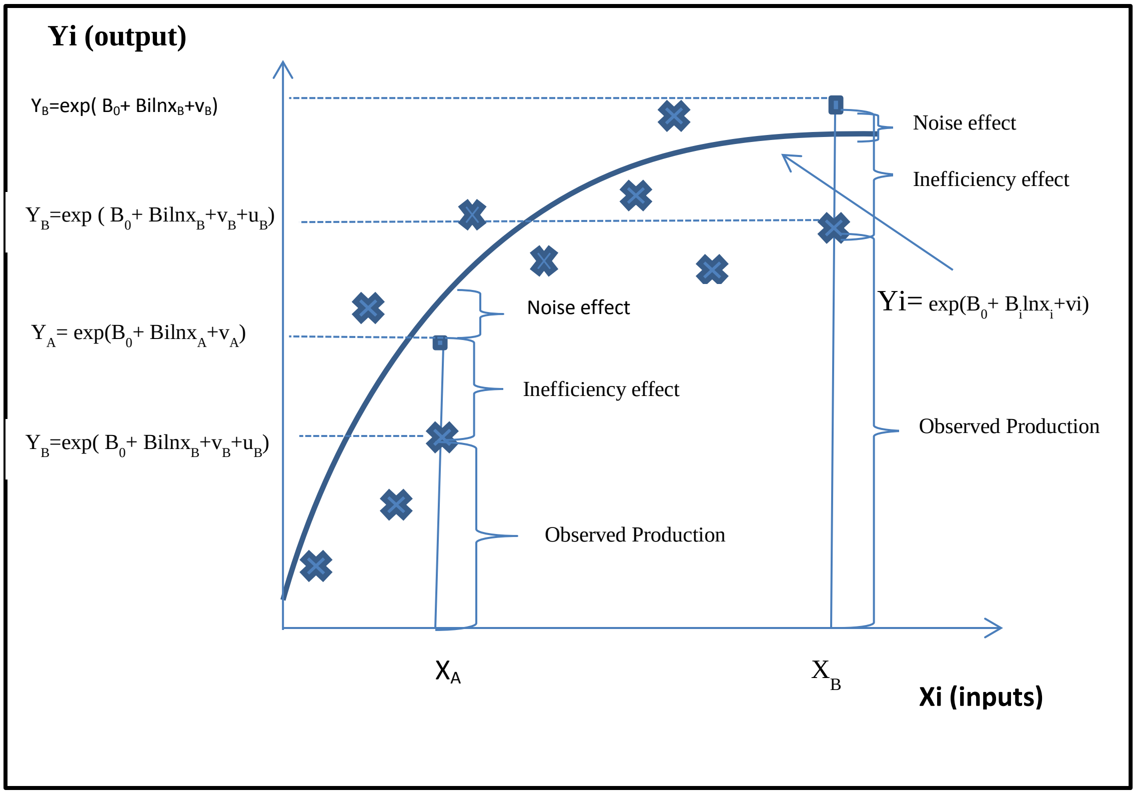


Figure 3.1. Illustration of Stochastic Frontier Analysis

Measuring Separation of Ownership and Control

We define SOC farms in our data by scoring specific attributes that likely increase the degree of SOC. Farms are scored on what type of organization they identified their operation as (a proprietorship= 1, partnership and trust= 2, or corporate farms= 3); by the number of households that share in farm income (number of households that share in farm income indicated, if no other households share then =0); the percentage of acres operated that is under a share or cash rent contract; whether the operation uses a crop marketing contract (yes=1,no=0) or crop production contracts (yes=1,no=0); and whether they own stock in a cooperative (yes=1, no=0). We scored the degree there is separation of ownership and control by simply aggregating these attributes together. For example, if a farm was a corporation (3), had 3 other household sharing (3), and 50% of their acres operated was share (.5), and all else was 0, then the SOC score would be 6.5. The scoring is more heavily weighted by the number of households that share income and farm organization structure (i.e. Proprietorship, partnership or trust, corporation), since those attributes were the most likely to increase the SOC score. The SOC score was divided into three categories we defined as more like COC, Mixed, and SOC, the scores we chose were 0-4= COC, 4-5.5= Mixed, 5.5 or greater= SOC. The division is arbitrary, but the purpose of the paper is to determine how/if technical efficiency is different between farms that are more COC or SOC. We grouped the data from 2002-2010 in three-year averages for two reasons: 1) uncontrollable factors such as weather can form a more normal distribution with multi-year data, 2) it has been suggested that determining competitive farm advantage is problematic with data of one year (Langemeier, 2010). We also wanted to examine the change in technical efficiency, given the degree of SOC, over time.

Table 3.1 shows the number of farms Grain and Oilseed farms and percentage of the total sample that is classified as COCs, Mixed and SOC in the ARMS data set for the corresponding years. In the ARMS survey, survey respondents identify their operation by the largest portion of total gross value of sales. Farms that identified themselves as farm type 01 (“Grain, oilseeds, dry beans, and dry peas (corn, flaxseed, grain, silage and forage, grains and oilseeds for seeds, popcorn, rice, small grains, sorghum, soybeans, sunflowers, etc.)) were used. Farms that did not indicate value of gross income, value of labor hired or hours worked, or value of capital (i.e. land, equipment, buildings, etc.) were not selected for the sample. We also included categorical variables of family and non-family in our technical efficiency estimates.

Table 3.1. Farm counts by sample and organization type

Organization Class	2002-2004		2005-2007		2008-2010	
	Farms	%	Farms	%	Farms	%
COC	10114	81.90%	5620	35.86%	11359	65.30%
Mixed	1326	10.70%	4429	28.26%	3582	20.60%
SOC	902	7.30%	5621	35.87%	2455	14.10%
Total	12342	100%	15670	100%	17396	100%

Table 4.2 shows the organizational attributes used in the scoring of COC, Mixed, and SOC. SOC farms have a greater percentage of farms that have 3 or more households sharing in income, larger percentage of acres operated as cash rent or share contract, more use crop production contracts and crop marketing contracts and have stock in a producer cooperative. COC farms tend to have fewer households sharing in the income, are mostly proprietorships, do not rent as many acres, do not use production or marketing contracts, and mostly do not have stock in a cooperative.

Table 3.2. Percentage of organization attributes by farm type and sample

Organization Attributes	2002-2004 Sample			2005-2007 Sample			2008-2010 Sample		
	COC	Mixed	SOC	COC	Mixed	SOC	COC	Mixed	SOC
Proprietorship	88.8	15.3	8.5	89.2	84.8	64.2	92.7	74.5	15.5
Partnership and Trust	7.6	39.7	41.2	8.6	11.3	19.7	5.4	16.5	44.0
Corporations	3.6	44.9	50.2	2.2	3.9	16.1	1.9	9.0	40.5
Equity in Cooperative	35	56.6	66.1	13.7	30.7	54.9	23.0	76.1	60.6
Use Marketing Contract	18.3	35.5	52.4	14.9	19.8	75	25.9	83.3	84
Use Production Contract	1.7	6.2	9.0	---	---	---	3.2	14.1	12.1
3 or More Households Sharing in Farm Income	1.3	24.8	66.5	27.0	75.6	84.3	1.5	8.5	48.0
% of acres operated under a share contract (Mean)	26	27	32	15	21	24	16	20	24
% of acres operated under a cash contract (Mean)	31	37	47	24	35	45	33	45	50

In both the Cobb-Douglas and translog models we are attempting to specify the theoretical production function, estimate the random component that is a part of the production function, estimate an increased degree of SOC or lower alpha level, and then determine if SOC is associated with more technical inefficiency than COC or vice versa. Because size of the farm can influence technical efficiency through scale efficiencies, and not from organization attributes, we try to illustrate changes in technical efficiency due to SOC and not related to size of the farm. In addition, because the expected inefficiency of SOC is due to asymmetric information and improper incentives, we attempt to estimate the changes in or improvements in technology or contract design that may improve asymmetric information or more align incentives.

RESULTS

The results of the parameter estimates show that the estimated Cobb-Douglas production function coefficients maintained relative stability across all three samples (See Table 3.3). The translog production function had a great deal more variability in the coefficients estimates, but was similar in estimating the ratio of inefficiency (γ). Our results were similar to other SFA analysis of technical efficiency in farm production, in that a good portion of the variance was attributed to inefficiency. This is evident in our relatively large estimate of γ or 0.766.

Table 3.3. SFA parameter estimates by sample and model

Model Parameters	**2002-2004**		**2005-2007**		**2008-2010**	
	Cobb-Douglas Model	Translog Model	Cobb-Douglas Model	Translog Model	Cobb-Douglas Model	Translog Model
B_0	-2.22	-10.13	-.3.22	45.17	-2.74	-4.95
B_1	.874	2.2	.784	-8.144	.829	1.23
B_2	.227	-.132	.435	-.211	.334	.131
B_3	***	.0005	***	.476	***	.046
B_4	***	.121	***	-.0004	***	.130
B_5	***	-.139	***	.044	***	-.168
δ^2	.831	1.884	.837	1.77	.756	1.85
γ	.766	.9052	.701	.853	.744	.904
μ	0	-.2.61	0	-2.45	0	-2.59

The resulting technical efficiency estimates show small family COC farms ($500,000 dollars or less in gross farm income) possessed the maximum technical efficiency, using either a Cobb- Douglas production function or a translog production function. Estimated maximum technical efficiency was near 99% for small COC farms using either model. This occurred across all sample years (See Table 3.4 and 3.5). However, despite COC farms possessing the maximum technical efficiency, Mixed and SOC farms possessed a higher mean technical efficiency than COC. This was also consistent across all sample years (See Table 3.4 and 3.5). SOC farms possessed 61-66% technical efficiency using the Cobb-Douglas model and 68-72% using the translog model, while COC possessed 58-59% mean technical efficiency using the Cobb-Douglass and 65-67% technical efficiency using the translog model. Furthermore, SOC and Mixed mean technical efficiency increased from 2002-2010, while COC mean technical efficiency decreased during the same period. Technical efficiency appears to increase for all farms as gross farm income increases. But as gross farm income increase, SOC mean technical efficiency increases at a slower rate than COC (See Figures 3.2 and 3.3) during the 2005-2007 and 2008-2010 samples.[18] This is evident when examining the distribution of COC, Mixed, and SOC farms relative to gross farm income (See Figure 3.4) and the predicted production frontier and input levels (See Figure 3.5). In both figures 3.4 and 3.5, technical efficiency of COC, Mixed, and SOC had a strong positive relationship with the log of gross farm income and log of labor and capital deployed (i.e. technical efficiency increased with size). However, in both cases, SOC farms tend to be near the production frontier at lower input and output levels, while COC farms tend to be away from the production frontier at lower input and output levels. But as SOC farms increase scale, the distribution of SOC farms drifts further from the estimated production

[18] 2002-2004 Sample showed that mean technical efficiency increased with output size (measured by Log of gross farm income) for all farm types (COC, Mixed, and SOC). SOC and Mixed farms were consistently lower than COC in technical efficiency using the Translog production function in all sales classes (i.e. 0-500K, 500K-1M, 1-2M, >2M).

frontier (See Panel 3, Figure 3.5). As COC farms increased scale, the COC farm distribution approached the estimated production frontier (See Panel 1, Figure 3.5).

Table 3.4. Mean technical efficiency by organization, family, and sample using Cobb Douglas model and assuming zero mean inefficiency distribution.

Cobb Douglas Production Function μ =0	2002-2004		2005-2007		2008-2010	
	Mean Technical Efficiency (Std. Dev.)	Maximum Technical Efficiency	Mean Technical Efficiency (Std. Dev.)	Maximum Technical Efficiency	Mean Technical Efficiency (Std. Dev.)	Maximum Technical Efficiency
COC	.5867 (.1578)	.9889	.5827 (.1536)	.9966	.5843 (.15)	.9875
Mixed	.6150 (.1395)	.8982	.5859 (.1438)	.9758	.6451 (.1243)	.9067
SOC	.6061 (.1397)	.8983	.6325 (.1228)	.9901	.6619 (.1285)	.9861
Family	.5909 (.15)	.9889	.6009	.9966	.6074 (.1659)	.9875
Non-Family	.6409 (.15)	.9310	.6107	.9122	.6190 (.1470)	.9458
Total	.5911 (.15)	.9889	.6014 (.1423)	.9966	.6078 (.1478)	.9875

Table 3.5. Mean technical efficiency by organization, family, and sample using translog model and assuming non-zero mean inefficiency distribution.

Translog Production Function μ ≠0	**2002-2004**		**2005-2007**		2008-2010	
	Mean Technical Efficiency (Std. Dev.)	Maximum Technical Efficiency	Mean Technical Efficiency (Std. Dev.)	Maximum Technical Efficiency	Mean Technical Efficiency (Std. Dev.)	Maximum Technical Efficiency
COC	.6684 (.154)	.9977	.6671 (.1464)	.9989	.6540 (.1599)	.9992
Mixed	.6971 (.1287)	.9250	.6727 (.1063)	.9775	.7142 (.1243)	.9073
SOC	.6836 (.1326)	.8983	.7133 (.1228)	.9357	.7202 (.1506)	.9270
Family	.5909 (.15)	.9977	.6009	.9989	.6733 (.1499)	.9992
Non-Family	.6409 (.15)	. 9393	.6107	.9211	.6759 (.1672)	.9048
Total	.6726 (.1509)	.9977	.6853 (.1316)	.9989	.6758 (.1506)	.9875

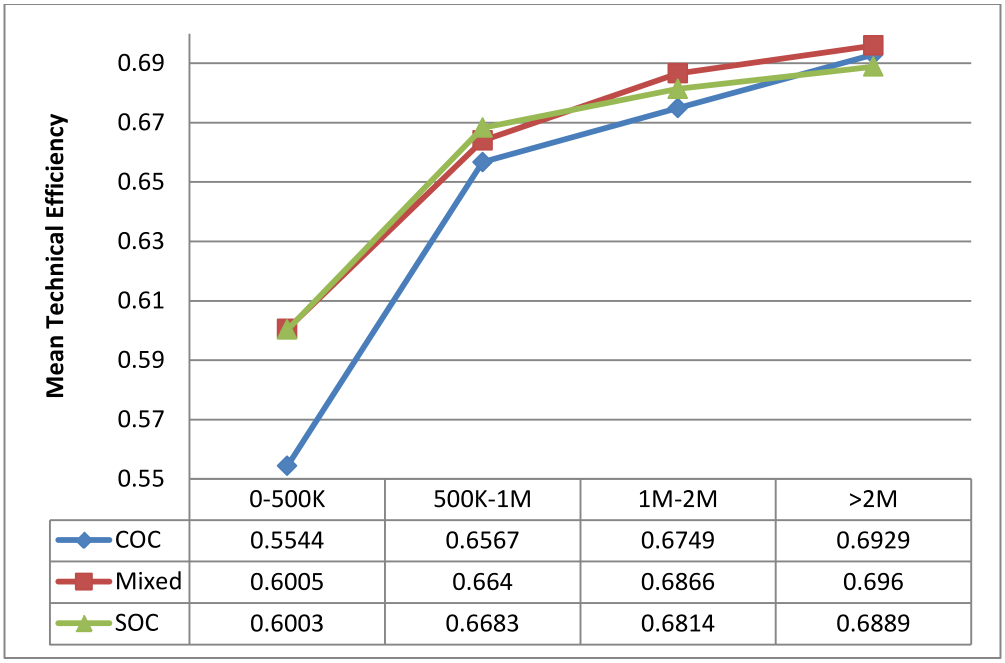


Figure 3.2. Mean technical efficiency of COC, Mixed, and SOC, relative to gross farm income class in the 2008-2010 sample, using Cobb-Douglas model.

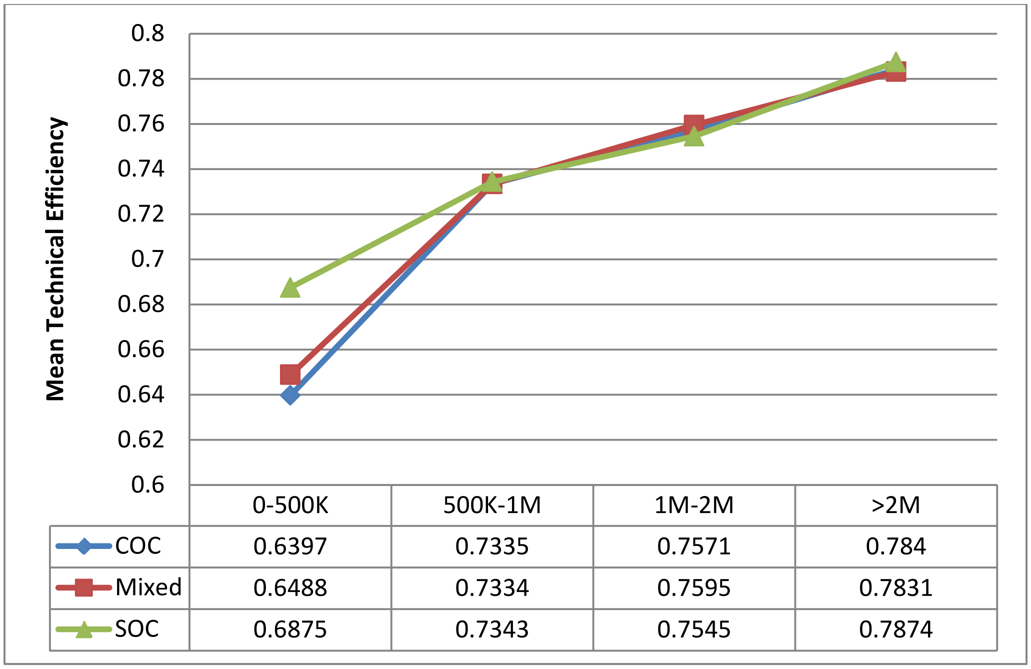


Figure 3.3 Mean technical efficiency of COC, Mixed, and SOC relative to gross farm income class in the 2005-2007 sample using translog model.

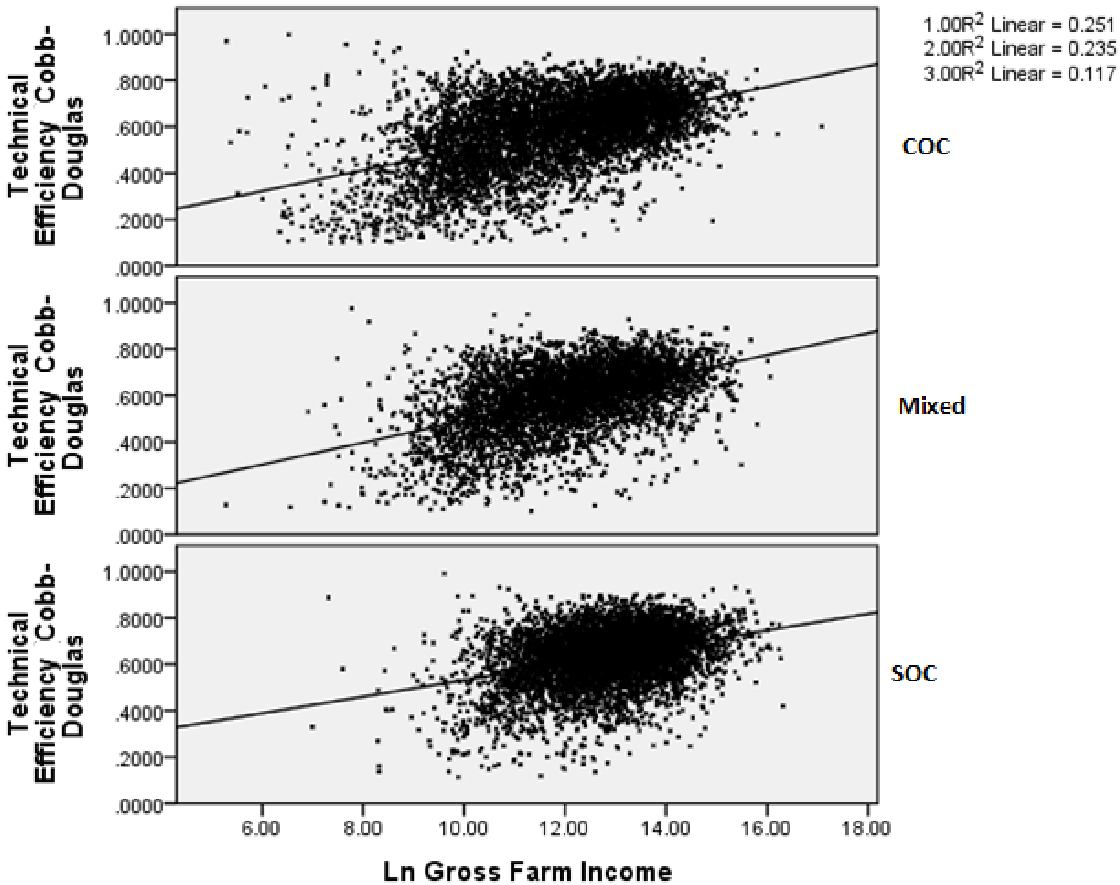


Figure 3.4. Scatterplot of technical efficiency and log of gross farm income of 2005-2007 sample using Cobb-Douglas production function and organization type in Panels (COC, Mixed, SOC)

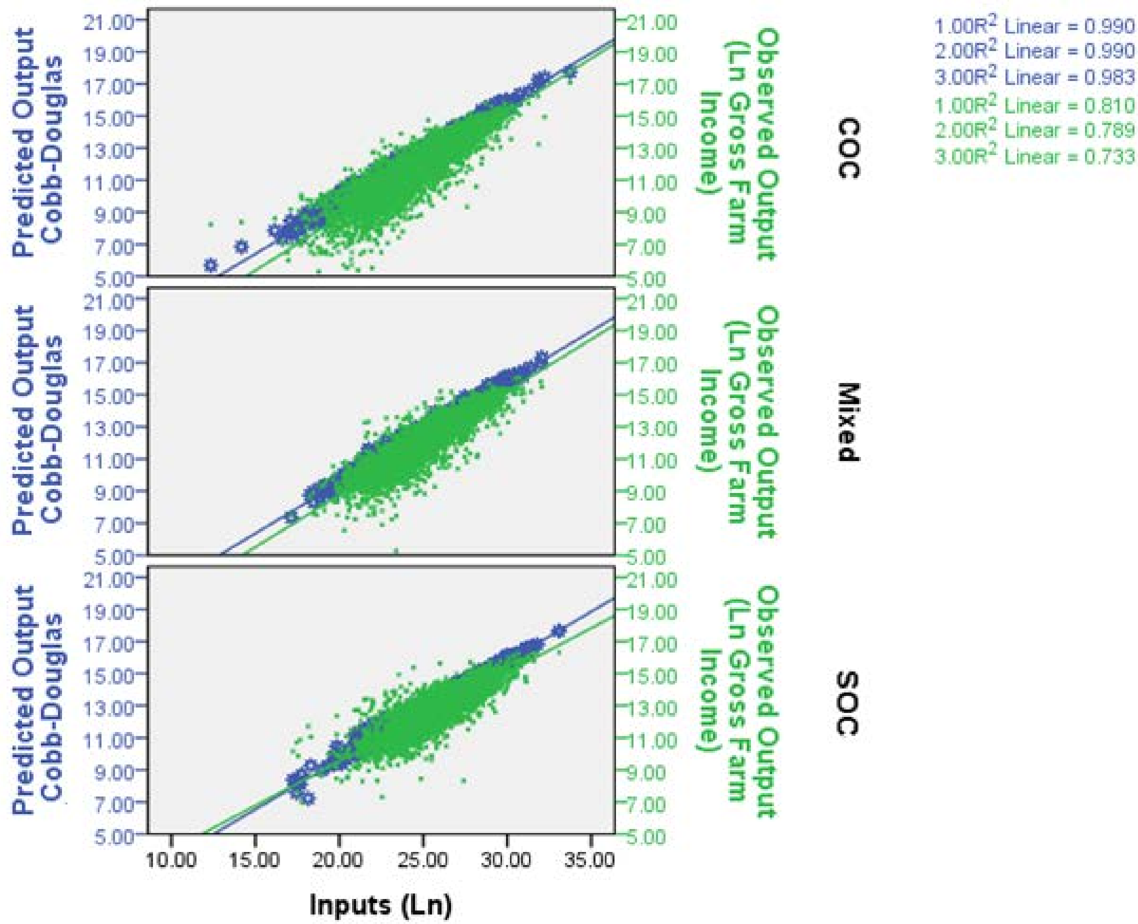


Figure 3.5. 2005-2007 Scatterplot of Predicted Output (blue points and blue linear trend line) compared to observed outputs (green points and green linear trend line) using Log inputs and estimated Cobb-Douglas Production function. Panels show distribution of different organization types and trends relative to frontier (COC, Mixed, SOC).

Further investigation of the farms and percentage of farms that were above the average mean technical efficiency shows that SOC farms tend to perform better as a group than Mixed or COC. Tables 3.6 and 3.7 shows that from 60-71% of SOC farms have above average technical efficiency, while 54-50% of COC farms are above average technical efficiency when using a Cobb-Douglas production function to determine the production frontier. Results were consistent with the translog production function to estimate the production frontier, where 59-56% of COC farms were above average mean technical efficiency, while 62-72% of SOC farms were above average.

Table 3.6. Farms above the average mean technical farms, by type and percentage, using Cobb-Douglas.

Organization Class	2002-2004			2005-2007			2008-2010		
	Farms in Sample	Farms above Avg.	% above avg.	Farms in Sample	Farms Above Avg.	% above avg.	Farms in Sample	Farms above Average	% above avg.
COC	10114	5439	53.7%	5620	2927	52.1%	11359	5649	49.7%
Mixed	1326	827	62.3%	4429	2304	52.0%	3582	2388	66.6%
SOC	902	540	59.8%	5621	3685	65.5%	2455	1746	71.1%
Total	12342	6806	55.1%	15670	8916	56.8%	17396	9783	56.2%

Table 3.7. Farms above the average mean technical farms, by type and percentage, using translog model.

Organization Class	2002-2004			2005-2007			2008-2010		
	Farms in Sample	Farms above Avg.	% above avg.	Farms in Sample	Farms Above Avg.	% above avg.	Farms in Sample	Farms above Average	% above avg.
COC	10114	6012	59.4%	5620	3183	56.6%	11359	6332	55.7%
Mixed	1326	895	67.5%	4429	2507	56.6%	3582	2576	71.9%
SOC	902	555	61.5%	5621	3904	69.4%	2455	1776	72.3%
Total	12342	7462	60.4%	15670	9594	61.2%	17396	10684	61.4%

DISCUSSION

The results of our SFA analysis indicates some faults with our initial hypotheses. Given the faults, we did not attempt hypotheses testing or alterations to the models to do more specific variable testing[19]. As a result, our study developed into more of an exploratory empirical analysis, than a confirmatory empirical analysis. We suggest that our existing conceptual frameworks may need to improve before more strict confirmatory analysis is warranted.

In hypotheses 1-4 we expected one type of farm organization SOC to be better and crowd out COC or SOC to be bounded by agency costs. However, there is more of a mixed story to performance of technical efficiency by organization type. While SOC was

[19] A more efficient form of testing organization attributes effect using SFA analysis would be to include the organization attributes in the SFA model as technical efficiency effects. Given the quadratic relationship of SOC farms to technical efficiency, when controlling for size, and the exponential/linear relationship of COC organization on technical efficiency, we chose to present our results by not including the organization variables in the model where we would require multiple variables to describe the organization attribute effects on technical efficiency. Using multiple variables and the different forms of relationships may make it more difficult to communicate the data results. Thus, we chose to tradeoff estimation efficiency for clarity of presentation.

on average better than COC in mean technical efficiency, SOC farms did not ever exhibit the maximum technical efficiency score, nor were SOC farms mean technical efficiencies consistently better over increasing sizes of the farms. COC, was neither dominant either, in that COC farms always had the maximum efficiency, but mean technical efficiency was inferior except when farm size became large. Often the literature and conceptual frameworks imply that a certain organization type will be strictly dominant, thus emergence of a unique form. However, the results of this analysis show that strict dominance did not occur. Perhaps this is because the true relationship of SOC and farm performance is more complex than existing literature and conceptual frameworks presume.

We found evidence to support hypothesis 3, relating to the improvement of technical efficiency in SOC farms over time. Some of this improvement may be attributed to controlling agency costs in SOC farms due to novel organization types. However, it is not clear in our analysis, or in the data, whether the observed improvement in technical efficiency from the 2002-2004 sample to the 2008-2010 sample was actually due to changes in organization types, since we do not have longitudinal data nor a variable that tracks organizational changes. However, we know that structural changes in farm organization have been occurring. In addition, we observed that COC farms did not improve in technical efficiency during the same period as SOC farms did (See Tables 3.4 and 3.5).

We did not find evidence that family farms were superior to non-family farms as the literature often presumes. To the contrary, non-family farms appear to be significantly better in mean technical efficiency scores over all samples and both models. This probably has to do with the sample of non-family farms being larger on average than family farms, where we see advantages to technical efficiency as farm size increases. The results suggest that small family COC grain faming is not the most technically efficient farm organization type given the capital restrictions to family farming.

Another aspect of our analysis is that we found that small SOC farms are superior to that of smaller (less than $500K in gross sales) COC farms. This may suggest there are some advantages of SOC to technical efficiency that are unrelated to size. But as size increases, SOC farms seem to decrease in their advantages to COC farms. This may be due to SOC farms being bounded by agency costs.

CONCLUSION

The overall conclusion of the analysis is that all types of grain and oilseed farms will continue to exist if we assume farms having above average technical efficiency will likely survive. The makeup of grain and oilseed farms that had above average technical efficiency ratings consisted of all farm sizes and farm organization types (i.e. COC, mixed, and SOC). The makeup of the population of farms, however, will more likely have more SOC or Mixed organizational attributes and be larger, given the estimated trends of technical efficiency, scale, and organization composition[20]. This is the case even when we found that small family COC farms possess maximum technical efficiency as the literature presumes. This analysis suggests that understanding the general evolution of farm organization may be improved by maintaining the long held assumption that

[20] Hoppe and Korb (2006) show that as farm size increase the rate of exit decreases.

agency costs increase as farm organization becomes more SOC, but a better understanding to the benefits to SOC attributes is required. SOC benefits may aid in improving technical efficiency in scale, but there can also be benefits unrelated to scale such as risk sharing, management specialization, investment according to market value rule, and asset specific investment. Moreover, novel contract and organization design may be allowing SOC farms to reduce agency costs and improve technical efficiency. This analysis gives indication that SOC benefits technological efficiency at a greater rate than agency costs are incurred. Implications are: 1) reducing agency costs in SOC farms may provide even greater technical efficiency, 2) restricting SOC farm organization may hinder farm technical efficiency as a whole, 3) increasing the size of COC farms may improve technical efficiency, 4) technology advances that improve asymmetric information in principle-agent relationships and novel contract design may reduce agency costs in SOC farms over time.

Limitations

A limitation of this study is that we only tested technical efficiency of SOC, Mixed, and COC farms using one method (i.e. SFA). Kalaitzandonakes, Wu, and Ma (1992) have found that estimates were not robust for technical efficiency on Missouri Grain farms, when method of estimation was changed from parametric deterministic, parametric stochastic, and non-parametric. In addition, we are not able to assess the non-pecuniary costs to monitoring technical efficiency among SOC farms relative to COC farms. For example, the SOC farms we measure in our study may have very active or nearby owners, partners, etc. that oversee the farm management decisions and actions in order to improve technical efficiency. To the extent this excess monitoring charges are not incorporated in the costs to production, we may be overstating the efficiency of SOC farms. Limitations also exist with SFA analysis in that they are predictions (estimations) on technical efficiency based upon assumptions of variance distributions and production function specification. We also use an imprecise measurement of SOC. Future research and data on property right distributions may be better able to more precisely measure the theoretical SOC with a greater degree of accuracy.

Chapter IV

CONCLUSION

This study explores the effects of separated ownership and control on farm efficiency and farm success. The major findings of this study is that separation of ownership and control didn't have the expected effect to operator effort, or farm success, from operator effort that existing theory had predicted. When we attempted multiple methods and controlled for size we did find more evidence of a limiting factor to separated ownership and control farm organization in decreasing technical efficiency relative to more combined ownership and control or mixed farms of equal size. We also found that combined ownership and control consistently possessed maximum technical efficiency. Contrary to existing theory and conclusions, we do find evidence for continued evolution to more separated ownership and control farming. This can occur regardless of non-family relationships or with greater exogenous uncertainty.

Considering our findings, we suggest future research into an enhanced conceptual framework that examines farm organization evolution. The conceptual framework we would propose would not be limited to being static, nor implicitly assume simplicity, in examining optimal farm organization. To the contrary, the framework would require elements that are more dynamic and allow for a more holistic examination of farm organization evolution. We contend that optimal farm organization choice is more complex and future adaptations to improve performance may require greater interdependency of farms. Future research question we propose: what property rights will be necessary for the nexus of the farm to capture benefits from greater farm interdependency and minimize agency costs or costs to free riding from vaguely defined property rights? This type of research question may be better addressed by developing agent-based models simulating farm transactions, and developing propositions by making changes in the strategies and rights of the agents to change the transaction equilibriums and payoffs.

An additional recommendation for future empirical research would be improved large data sets on farm organization financials and pursuing case study research. The ARMS data set, while valuable, does not address some of the more interesting empirical research areas in changes in farm organization and performance. For example, there is no data on what type of firm a farm delivers to under a production contract, marketing contract, or using a spot market, and whether the farm manger has ownership in that firm. It may also be valuable to know the number of purchasers of farm products available to a farm manager in a defined geographical region, and the type of business the purchaser is (exporter, milling, etc.). This type of data may be a better measure of the asset specific nature of farm production transactions with processors, consumers, or distributors. Not only would the type of purchasing firm be of interest to organizational economists, but also a more precise understanding of relationships they have with the purchaser organizationally (i.e. Cooperative, LLC, etc.) and financially (e.g. equity and patronage redemption rights, dividends). ARMS data, though aimed at understanding evolution in farm organization and performance, still defines the farm, and performance of the farm, using a mid to early 20^{th} century perspective on farms. Changes in the 20^{th} and 21^{st} century to farm organization may require the perspective of farm data set collectors to expand, along with the web of farm organization relationships, to related agribusinesses. Only then can large data analysis address some of the more intriguing efficiency implications of different governance types and the evolution of farm organization. In addition, ARMS often tries to fit farm organizations responses into a few types of farm organizations where the farm manager chooses one organization type or another to describe their operation. This format may cause difficulty for farm managers' to answer because parts of their operation may involve different organization relationships or greater intricacy in describing the relationship. There may be improved clarity in knowing all the relationships, and types of relationships, that exist for a farm operation, and not constrained by a limited ability of the farm manager to reveal the true nature of their farm organization and the type of transactions they possess by choosing an ambiguous legal class, or formal contract, type. Naturally, the tradeoff of using ARMS data is that information is lost because the survey is designed to capture homogenous information, over a wide geographic regions, and types of farms, efficiently. Valuable future empirical work would be a more detailed analysis of farm organization through case study research limited in scope. Case studies can better describe farm organizations, changes to those farm organization, and corresponding financial performance. Unfortunately, case study research may limit the robustness, and methods, that one gains with technical analysis of large data sets. A combination of case study empirical work and large data set technical analysis may improve our understanding to the changes in farm organization and performance.

Additional future research would expand farm organization differences, and performance, to a comparative institutional analysis of farms in different nations. This work would better address all the efficiency implications to changes in U.S. farm organization over the 20th century. Differences in farm organization across nations would be a fruitful area to understand the institutional effects to economic performance from a more micro, sector specific analysis. Important differences, and adaptions to the differences, in farm organization occur because of path dependency and institutional environment reasons, despite that many farm transactions are homogenous. The findings would not only be of interest to farm stakeholders and policy makers, but would have broader appeal to scholars interested in New Institutional Economics.

The summary of our findings is that the existing theoretical relationships on farm agent behavior and organization, and implications for farm organization evolution, was not confirmed by the ARMS data using the empirical methods we chose. To the contrary, the data suggested there are more complexities, or nuances, than the theoretical propositions assume. Unraveling the institutional reasons for farm agent behavior, farm organization choice, and farm organization evolution will require further theoretical and empirical research. Improvements in data, and models, are required to better address the extension of farm transactions, and the complexity in choice functions. It is evident that property right allocations do matter in the efficiency of farms. A better understanding on how to harness property right allocations to improve farm efficiency can enable increased social welfare.

BIBLIOGRAPHY

Aghion, Philippe, and Patrick Bolton. "An incomplete contracts approach to financial contracting." *The review of economic Studies* 59.3 (1992): 473-494.

Ahearn, Mary, Jet Yee, and Wallace Huffman. "The effect of contracting and consolidation on farm productivity." Economics of Contracting in Agriculture Workshop, Annapolis, MD (July). 2002.

Aigner, Dennis, C. A. L. Lovell, and Peter Schmidt. "Formulation and estimation of stochastic frontier production function models." Journal of econometrics 6.1 (1977): 21-37.

Allen, Douglas, and Dean Lueck. "Contract choice in modern agriculture: cash rent versus cropshare." Journal of Law and Economics (1992): 397-426.

Allen, Douglas W., and Dean Lueck. "Back Forty on a Handshake: Specific Assets, Reputation, and the Structure of Farmland Contracts, The." JL Econ. & Org. 8 (1992): 366.

Allen, Douglas W., and Dean Lueck. "Transaction costs and the design of cropshare contracts." The Rand Journal of Economics (1993): 78-100.

Allen, Douglas W., and Dean Lueck. "Risk preferences and the economics of contracts." The American Economic Review (1995): 447-451.

Allen, Douglas W., and Dean Lueck. "The Nature of the Farm*." The Journal of Law and Economics 41.2 (1998): 343-386.

Aly, Hassan Y., et al. "The technical efficiency of Illinois grain farms: An application of a ray-homothetic production function." Southern Journal of Agricultural Economics 19.1 (1987): 69-78.

Anderson, Philip. "Perspective: Complexity theory and organization science."*organization Science* 10.3 (1999): 216-232.

Anderson, Ronald C., and David M. Reeb. "Founding-family ownership and firm performance: evidence from the S&P 500." The Journal of Finance 58.3 (2003): 1301-1327.

Axelrod, Robert, and Michael D. Cohen. Harnessing complexity: Organizational implications of a scientific frontier. Free Press, 2001.

Bagi, Faqir Singh. "Stochastic frontier production function and farm-level technical efficiency of full-time and part-time farms in west Tennessee." North Central Journal of Agricultural Economics (1984): 48-55.

Bahls, Steven C. "Preservation of Family Farms-The Way Ahead." *Drake L. Rev.* 45 (1997): 311.

Bardhan, Pranab K., and T. N. Srinivasan. "Cropsharing tenancy in agriculture: a theoretical and empirical analysis." The American Economic Review (1971): 48-64.

Barkema, Alan, Mark Drabenstott, and Kelly Welch. "The quiet revolution in the US food market." Economic Review 76.3 (1991): 25-41.

Barry, Peter J., T. Steven, and Kaouthar Lajili. "Vertical coordination, financial structure, and the changing theory of the firm." American Journal of Agricultural Economics 74.5 (1992): 1219-1225

Barzel, Yoram. *Economic analysis of property rights*. Cambridge University Press, 1997.

Battese, George E. "Frontier production functions and technical efficiency: a survey of empirical applications in agricultural economics." Agricultural economics 7.3 (1992): 185-208.

Battese, George Edward, and Tim J. Coelli. "Frontier production functions, technical efficiency and panel data: with application to paddy farmers in India." Journal of productivity analysis 3.1-2 (1992): 153-169.

Battese, George E., and Greg S. Corra. "Estimation of a production frontier model: with application to the pastoral zone of Eastern Australia." Australian Journal of Agricultural and Resource Economics 21.3 (1977): 169-179.

Berle, Adolf A., and Gardiner Gardiner Coit Means. The modern corporation and private property. Transaction Publishers, 1932.

Bernheim, B. Douglas, and Michael D. Whinston. "Incomplete contracts and strategic ambiguity." American Economic Review (1998): 902-932.

Blank, Stephen C. "The End of the American Farm?." The Futurist 33.4 (1999): 22-27.

Blank, Steven C. *The economics of American agriculture: Evolution and global development*. ME Sharpe, 2008.

Boehlje, Michael D., and Ludwig M. Eisgruber. "Strategies for the Creation and Transfer of the Farm Estate." *American Journal of Agricultural Economics* 54.3 (1972): 461-472.

Boehlje, Michael. "Structural changes in the agricultural industries: how do we measure, analyze and understand them?." American Journal of Agricultural Economics 81.5 (1999): 1028-1041.

Born, Patricia, et al. Organizational form and insurance company performance: stocks versus mutuals. No. w5246. National Bureau of Economic Research, 1995.

Braverman, Avishay, and Joseph E. Stiglitz. "Sharecropping and the interlinking of agrarian markets." The American Economic Review (1982): 695-715.

Brem, Markus. "Organisational Change in Agricultural Transition." Acta Oeconomica 52.1 (2002): 25.

Brickley, J.A.,C. Smith, J . Zimmerman (1996), Organizational Architecture: A Managerial Economics Approach, Homewood, Ill.Economic Studies 66.1 (1999): 57-82.

Briggs, Harold E. "Early Bonanza Farming in the Red River Valley of the North."*Agricultural History* 6.1 (1932): 26-37.

Browne, Michael W., and Robert Cudeck. "Alternative ways of assessing model fit." Sage Focus Editions 154 (1993): 136-136.

Chaddad, Fabio R., and Michael L. Cook. "The economics of organization structure changes: A US perspective on demutualization." Annals of Public and Cooperative Economics 75.4 (2004): 575-594.

Chaddad, Fabio R., and Michael L. Cook. "Understanding New Cooperative Models: An Ownership–Control Rights Typology." Applied Economic Perspectives and Policy 26.3 (2004): 348-360.

Cheung, Steven NS. "Private property rights and sharecropping." The Journal of Political Economy (1968): 1107-1122.

Cheung, Steven NS. "Transaction costs, risk aversion, and the choice of contractual arrangements." JL & Econ. 12 (1969): 23.

Che, Yeon-Koo, and Donald B. Hausch. "Cooperative investments and the value of contracting." American Economic Review 89 (1999): 125-147.

Chrisman, James J., Jess H. Chua, and Reginald A. Litz. "Comparing the Agency Costs of Family and Non-Family Firms: Conceptual Issues and Exploratory Evidence." Entrepreneurship Theory and Practice 28.4 (2004): 335-354.

Chrisman, James J., Jess H. Chua, and Pramodita Sharma. "Trends and directions in the development of a strategic management theory of the family firm." Entrepreneurship Theory and Practice 29.5 (2005): 555-576.

Chua, Jess H., James J. Chrisman, and Erich B. Bergiel. "An agency theoretic analysis of the professionalized family firm." Entrepreneurship Theory and Practice 33.2 (2009): 355-372.

Coase, Ronald Harry. "Problem of Social Cost, The." Jl & econ. 3 (1960): 1.

Coase, Ronald H. "The nature of the firm." Economica 4.16 (2007): 386-405.

Cochrane, Willard W. Development of American Agriculture: A Historical Analysis. University of Minnesota Press, 1993.

Coelli, Tim J. A guide to FRONTIER version 4.1: A computer program for stochastic frontier production and cost function estimation. Vol. 96. No. 07. CEPA working paper, 1996.

Coelli, Timothy J., et al. An introduction to efficiency and productivity analysis. Springer, 2005.

Coltrain, David. Value Added: opportunities and strategies. Diss. Kansas State University, 2000.

Constantin, Paulo Dutra, Diogenes Leiva Martin, and E. B. B. R. Rivera. "Cobb-Douglas,'Translog Stochastic Production Function and Data Envelopment Analysis in Total Factor Productivity in Brazilian Agribusiness'." The Flagship Research Journal of International Conference of the Production and Operations Management Society. Vol. 2. No. 2. 2009.

Cook, Michael L. "The future of US agricultural cooperatives: A neo-institutional approach." *American Journal of Agricultural Economics* 77.5 (1995): 1153-1159.

Cook, Michael L., and Constantine Iliopoulos. "Beginning to inform the theory of the cooperative firm: Emergence of the new generation cooperative. "LIIKETALOUDELLINEN AIKAKAUSKIRJA (1999): 525-535.

Cook, M. L., and Leland Tong. "Definitional and classification issues in analyzing cooperative organizational forms." Co-operatives: Their Importance in the Future Food and Agriculture System, FAMC-1-97 (1997): 113-118.

Country Life Commission. "Report on the Commission on Country Life." (1911).

Daily, Catherine M., and Marc J. Dollinger. "An empirical examination of ownership structure in family and professionally managed firms." Family business review 5.2 (1992): 117-136.

Dasgupta, Siddhartha, Thomas O. Knight, and H. Alan Love. "Evolution of agricultural land leasing models: A survey of the literature." *Review of Agricultural Economics* 21.1 (1999): 148-176.

Davidova, Sophia, et al. "Variations in Farm Performance in Transitional Economies: Evidence from the Czech Republic1." Journal of Agricultural Economics 54.2 (2003): 227-245.

Dorogovtsev, Sergey N., and Jose FF Mendes. "Evolution of networks."*Advances in physics* 51.4 (2002): 1079-1187.

Dyer, W. Gibb. "Examining the "family effect" on firm performance." Family Business Review 19.4 (2006): 253-273.

Eisenhardt, Kathleen M. "Agency theory: An assessment and review." Academy of management review (1989): 57-74.

Elliott, Matthew. "How the Farm Firm has Evolved: A Conceptual Framework" Unpublished Dissertation (2013)

Elliott, Matthew. "Nature of the Farm: Revisited" Unpublished Dissertation (2013)

Eswaran, Mukesh, and Ashok Kotwal. "A theory of contractual structure in agriculture." *The American Economic Review* 75.3 (1985): 352-367.

Fama, Eugene F., and Michael C. Jensen. "Separation of ownership and control." *JL & Econ.* 26 (1983): 301.

Fama, Eugene F., and Michael C. Jensen. "Agency problems and residual claims." *JL & Econ.* 26 (1983): 327.

Fama, Eugene F., and Michael C. Jensen. "Organizational forms and investment decisions." *Journal of financial Economics* 14.1 (1985): 101-119.

Furtan, William Hartley, Kostas Karantininis, and Mogens Lund. "Reversing the road to super farms." 102nd Seminar, May 17-18, 2007, Moscow, Russia. No. 10025. European Association of Agricultural Economists, 2007.

Garcia, Philip, Steven T. Sonka, and Man Sik Yoo. "Farm size, tenure, and economic efficiency in a sample of Illinois grain farms." American Journal of Agricultural Economics 64.1 (1982): 119-123.

Glauber, Joseph W., Keith J. Collins, and Peter J. Barry. "Crop insurance, disaster assistance, and the role of the federal government in providing catastrophic risk protection." Agricultural Finance Review 62.2 (2002): 81-101.

Gomez-Mejia, Luis R., Manuel Nunez-Nickel, and Isabel Gutierrez. "THE ROLE OF FAMILY TIES IN AGENCY CONTRACTS." Academy of Management Journal 44.1 (2001): 81-95.

Gorton, Matthew, and Sophia Davidova. "Farm productivity and efficiency in the CEE applicant countries: a synthesis of results." Agricultural economics 30.1 (2004): 1-16.

Grossman, Sanford J., and Oliver D. Hart. "The costs and benefits of ownership: A theory of vertical and lateral integration." *The Journal of Political Economy*(1986): 691-719.

Habbershon, Timothy G., and Mary L. Williams. "A resource-based framework for assessing the strategic advantages of family firms." Family Business Review12.1 (1999): 1-25.

Habbershon, Timothy G., Mary Williams, and Ian C. MacMillan. "A unified systems perspective of family firm performance." Journal of business venturing 18.4 (2003): 451-465.

Hallagan, William. "Self-selection by contractual choice and the theory of sharecropping." The Bell Journal of Economics (1978): 344-354.

Hansmann, Henry. "The organization of insurance companies: mutual versus stock." Journal of Law, Economics, & Organization 1.1 (1985): 125-153.

Hansmann, Henry. "Ownership of the Firm." *Journal of Law, Economics, & Organization* (1988): 267-304.

Hambidge, Gove. Farmers in a Changing World--a Summary... US Government Printing Office, 1941 .

Harbur, Matthew M. "Anti-Corporate, Agricultural Cooperative Laws and the Family Farm." Drake J. Agric. L. 4 (1999): 385.

Harl, Neil E. "The age of contract agriculture: consequences of concentration in input supply." Journal of Agribusiness 18.1 (2000): 115-128.

Harl, Neil E. Farm estate and business planning. Century Communications, 1984.

Harl, Neil E. "Considerations in Incorporating Farm Businesses." U. Fla. L. Rev.18 (1965): 221.

Hart, Oliver D. "Incomplete Contracts and the Theory of the Firm." Journal of Law, Economics, & Organization (1988): 119-139.

Hite, Julie M., and William S. Hesterly. "The evolution of firm networks: From emergence to early growth of the firm." *Strategic Management Journal* 22.3 (2001): 275-286.

Hoppe, Robert A., et al. *Structural and Financial Characteristics of US Farms: 2001 Family Farm Report*. US Department of Agriculture, Economic Research Service, 2001.

Hoppe, Robert, James M. MacDonald, and Penni Korb. "Small farms in the United States: Persistence under pressure." USDA-ERS Economic Information Bulletin 63 (2010).

Jackson, Matthew O., and Alison Watts. "The evolution of social and economic networks." *Journal of Economic Theory* 106.2 (2002): 265-295

James, Harvey S. "Owner as manager, extended horizons and the family firm."*International Journal of the Economics of Business* 6.1 (1999): 41-55.

James, Harvey S., and Michael E. Sykuta. "Property Right and Organizational Characteristics of Producer-owned Firms and Organizational Trust." Annals of public and cooperative economics 76.4 (2005): 545-580.

Jensen, Michael C., and William H. Meckling. "Theory of the firm: Managerial behavior, agency costs and ownership structure." *Journal of financial economics* 3.4 (1976): 305-360.

Johnson, James, and Kenneth Baum. "Whole farm survey data for economic indicators and performance measures." Agricultural economics research-United States Dept. of Agriculture, Economic Research Service 38 (1986).

Kalaitzandonakes, Nicholas G., Shunxiang Wu, and Jian-chan Ma. "The Relationship between Techinical Efficiency and Firm Size Revisited." Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie 40.3 (1992): 427-442.

Kauffman, Stuart. At Home in the Universe: The Search for the Laws of Self-Organization and Complexity: The Search for the Laws of Self-Organization and Complexity. Oxford University Press, USA, 1996.

Kauffman, Stuart A., and Edward D. Weinberger. "The< i> NK</i> model of rugged fitness landscapes and its application to maturation of the immune response." Journal of theoretical biology 141.2 (1989): 211-245.

Kauffman, Stuart, and Simon Levin. "Towards a general theory of adaptive walks on rugged landscapes." *Journal of theoretical Biology* 128.1 (1987): 11-45.

Klein, Peter G. The Elgar companion to transaction cost economics. Edward Elgar Publishing, 2010.

Krause, K. R. "Farm Mutual Insurance Company Mergers." (1964).

La Porta, Rafael, et al. "Investor protection and corporate governance." Journal of financial economics 58.1 (2000): 3-27.

Lajili, Kaouthar, et al. "Farmers' preferences for crop contracts." Journal of Agricultural and Resource Economics (1997): 264-280.

Langemeier, Michael. "Persistence in Financial Performance." Journal of International Farm Management 5.2 (2010): 1-15

Lawless, Greg. "History of cooperatives in Wisconsin." Bulletin 2 (2002).

Levinthal, Daniel A. "Adaptation on rugged landscapes." Management science43.7 (1997): 934-950.

Levinthal, Daniel A. "Organizational adaptation and environmental selection-interrelated processes of change." Organization Science 2.1 (1991): 140-145.

Loehlin, John C. Latent variable models: An introduction to factor, path, and structural equation analysis. Psychology Press, 2012.

Marshall, Alfred. "Principles of economics, an intorductory volume." (1920).

MacDonald, James M., Mary C. Ahearn, and David Banker. "Organizational economics in agriculture policy analysis." *American Journal of Agricultural Economics* 86.3 (2004): 744-749.

MacDonald, James M., et al. "Contracts, markets, and prices: Organizing the production and use of agricultural commodities." USDA-ERS Agricultural Economic Report 837 (2004).

MacDonald, James M., Robert Hoppe, and David Banker. "The evolution of structural change in the US farm sector." IAPRAP\ IATRC Summer Symposium, Adjusting to Domestic and International Agricultural Reform in Industrial Countries, June 6-7, 2004, MacDonald, James M., and Penelope J. Korb. Agricultural contracting update, 2005. No. 58639. United States Department of Agriculture, Economic Research Service, 2008.

Martinez, Steve W. A comparison of vertical coordination in the US poultry, egg, and pork industries. US Department of Agriculture, Economic Research Service, 2002.

McConaughy, Daniel L., et al. "Founding family controlled firms : Efficiency and value." Review of Financial Economics 7.1 (1998): 1-19.

McKelvey, Bill. "Avoiding complexity catastrophe in coevolutionary pockets: Strategies for rugged landscapes." Organization Science 10.3 (1999): 294-321.

Milgrom, Paul, and John Roberts. "Bargaining costs, influence costs, and the organization of economic activity ." Perspectives on positive political economy(1990): 57-89.

Mishra, Ashok K., Hisham S. El-Osta, and Cheryl J. Steele. "Factors affecting the profitability of limited resource and other small farms." Agricultural finance review 59 (1999): 77-91.

Mishra, Ashok K., Fisseha Tegegne, and Carmen L. Sandretto. "The Impact of Participation in Cooperatives on the Success of Small Farms." Journal of agribusiness 22.1 (2004): 31-48.

Mishra, Ashok K., Hisham S. El-Osta, and Cheryl J. Steele. "Factors affecting the profitability of limited resource and other small farms." Agricultural finance review 59 (1999): 77-91.

Mishra, Ashok K., Hisham S. El-Osta, and Saleem Shaik. "Succession Decisions in US Family Farm Businesses." (2010).

Mugera, Amin W., and Michael R. Langemeier. "Does Farm Size and Specialization Matter for Productive Efficiency? Results from Kansas." Journal of Agricultural and Applied Economics 43.4 (2011): 515.

Neumann, Kathleen, et al. "The yield gap of global grain production: A spatial analysis." Agricultural Systems 103.5 (2010): 316-326 .

North, Douglass C. Institutions, institutional change and economic performance. Cambridge university press, 1990.

O'Donoghue, Erik J., et al. The Changing Organization of US Farming. US Department of Agriculture, Economic Research Service, 2011.

Otsuka, Keijiro, Hiroyuki Chuma, and Yujiro Hayami. "Land and labor contracts in agrarian economies: Theories and facts." Journal of Economic Literature 30.4 (1992): 1965-2018.

Otsuka, Keijiro, and Yujiro Hayami. "Theories of share tenancy: A critical survey." Economic Development and Cultural Change (1988): 31-68.

Olson, Frayne E. An empirical approach to exploring the role of selective incentives in mitigating the free rider problem. Diss. University of Missouri, 2007.

Olson, Mancur. "Tbe logic of collective action." (1965).

Olson, Mancur. "Space, agriculture, and organization." American Journal of Agricultural Economics 67.5 (1985): 928-937.

Ostrom, Elinor. "Coping with tragedies of the commons." *Annual review of political science* 2.1 (1999): 493-535.

Ostrom, Elinor. Governing the commons: The evolution of institutions for collective action. Cambridge University Press, 1990.

Ostrom, Elinor. Understanding institutional diversity. Princeton University Press, 2009.

Otsuka, Keijiro, Hiroyuki Chuma, and Yujiro Hayami. "Land and labor contracts in agrarian economies: Theories and facts." *Journal of Economic Literature* 30.4 (1992): 1965-2018.

Otsuka, Keijiro, and Yujiro Hayami. "Theories of share tenancy: A critical survey." *Economic Development and Cultural Change* (1988): 31-68.

Philadelphia, PA. No. 15759. International Agricultural Policy Reform and Adjustment Project (IAPRAP), 2004.

Pittman, Harrison M. "The Constitutionality of Corporate Farming Law in the Eighth Circuit." An Agricultural Law Research Article, The Agricultural Law Center (2004): 10.

Pitts, Margaret J., et al. "Dialectical tensions underpinning family farm succession planning." *Journal of Applied Communication Research* 37.1 (2009): 59-79.

Rasmussen, Wayne David. "Farmers, cooperatives, and USDA: a history of Agricultural Cooperative Service." *Agricultural information bulletin* (1991).

Rao, CH Hanumantha. "Uncertainty, entrepreneurship, and sharecropping in India." The Journal of Political Economy (1971): 578-595.

Raup, Philip M. "Corporate farming in the United States." *The Journal of Economic History* (1973): 274-290.

Reid Jr, Joseph D. "Sharecropping as an understandable market response: The post-bellum south." The Journal of Economic History (1973): 106-130.

Reid, Joseph D. "Sharecropping and agricultural uncertainty." Economic Development and Cultural Change 24.3 (1976): 549-576.

Reid Jr, Joseph D. "The Theory of Share Tenancy Revisited--Again." The Journal of Political Economy (1977): 403-407.

Rivkin, Jan W. "Imitation of complex strategies." Management Science 46.6 (2000): 824-844.

Rivkin, Jan W., and Nicolaj Siggelkow. "Organizational sticking points on NK landscapes." Complexity 7.5 (2002): 31-43.

Schneiberg, Marc, Marissa King, and Thomas Smith. "Social movements and organizational form: Cooperative alternatives to corporations in the American insurance, dairy, and grain industries." American Sociological Review 73.4 (2008): 635-667.

Schmitt, Günther. "Plenary paper 2: Why is the agriculture of advanced Western economies still organized by family farms? Will this continue to be so in the future?

Schulze, William S., et al. "Agency relationships in family firms: Theory and evidence." Organization science 12.2 (2001): 99-116.

Schutz, Anthony. "Corporate-Farming Measures in a Post-Jones World." Drake Journal of Agricultural Law 14.1 (2009): 97.

Segal, Ilya. "Complexity and renegotiation: A foundation for incomplete contracts." The Review of Economic Studies 66.1 (1999): 57-82.

Sexton, Richard J., and Julie Iskow. "Factors Critical to the Success or Failure of Emerging Agricultural Cooperatives." (1988).

Shaban, Radwan Ali. "Testing between competing models of sharecropping."The Journal of Political Economy 95.5 (1987): 893-920.

Sherrick, Bruce J., et al. "Factors influencing farmers' crop insurance decisions." American Journal of Agricultural Economics 86.1 (2004): 103-114.

Short, Helen. "Ownership, control, financial structure and the performance of firms." Journal of economic surveys 8.3 (1994): 203-249.

Simon, Herbert A. "The architecture of complexity." *Proceedings of the american philosophical society* (1962): 467-482.

Smith, Bruce D., and Michael J. Stutzer. "Adverse selection, aggregate uncertainty, and the role for mutual insurance contracts." Journal of Business (1990): 493-510.

Smith, Bruce D., and Michael Stutzer. "A theory of mutual formation and moral hazard with evidence from the history of the insurance industry." Review of Financial Studies 8.2 (1995): 545-577.

Sonka, Steven T., Robert H. Hornbaker, and Michael A. Hudson. "Managerial performance and income variability for a sample of Illinois cash grain producers." North Central Journal of Agricultural Economics 11.1 (1989): 37-47.

Staatz, John M. "A game-theoretic analysis of decision making in farmer cooperatives." Cooperative theory: New approaches 18 (1987).

Staatz, John M. "Recent developments in the theory of agricultural cooperation." Journal of Agricultural Cooperation 2.20 (1987): 74-95.

Stayton, Brian F. "Legislative Experiment in Rural Culture: The Anti-Corporate Farming Statutes, A." UMKC L. Rev. 59 (1990): 679.

Stiglitz, Joseph E. "Incentives and risk sharing in sharecropping." The Review of Economic Studies (1974): 219-255.

Strickland, Roger P. "The negative income of small farms." Agricultural economics research United States Dept. of Agriculture, Economic Research Service 35 (1983).

Sykuta, Michael E., and Michael L. Cook. "A new institutional economics approach to contracts and cooperatives." *American Journal of Agricultural Economics* 83.5 (2001): 1273-1279.

Tirole, Jean. "Incomplete contracts: Where do we stand?." *Econometrica* 67.4 (2003): 741-781.

Vogel, Jennifer M. "Iowa Code Chapter 9H. 2: The State of Iowa's Battle Against Corporate Farming." *J. Corp. L.* 30 (2004): 199.

Weinberger, Edward D. "Local properties of Kauffma n’s Nk model: A tunably rugged energy landscape." Physical Review A 44.10 (1991): 6399.

Websters Ninth New Collegiate. "Merriam-Webster Inc." Springfield, MA (1998): 157.

Wernerfelt, Birger. "A resource-based view of the firm." Strategic management journal 5.2 (2006): 171-

Williamson, Oliver E. "Transaction-cost economics: the governance of contractual relations." Journal of law and economics 22.2 (1979): 233-261.

Williamson, Oliver E. "Comparative economic organization: The analysis of discrete structural alternatives." Administrative science quarterly (1991): 269-296.

Winters, Donald L. "Tenant farming in Iowa, 1860-1900: a study of the terms of rental leases." Agricultural History 48.1 (1974): 130-150.

Winters, Donald L. "Tenancy as an Economic Institution: The Growth and Distribution of Agricultural Tenancy in Iowa, 1850–1900." The Journal of Economic History 37.02 (1977): 382-408.

Wittmaack, Nathan. "Should Corporate Farming be Limited in the United States?: An Economic Perspective."

Zahniser, Steven S., et al. "Structural Change in an Era of Increased Openness: A Background Paper on the Structure of US Agriculture." *Structural Change as a Source of Trade Disputes under NAFTA* (2002): 8.

VITA

Matthew Stewart Elliott, son of Robert and Jayne Elliott of Alliance, Nebraska. Matthew is a part owner/manager of their family farm operation in western Nebraska. Matthew graduated with a Bachelor of Science in Agribusiness, in 2001, from California Polytechnic State University in San Luis Obispo, California. He received his Master of Science in Agricultural Economics in August 2009, from the University of Missouri.