NATURE OF THE FARM: REVISITED

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ABSTRACT:

This study empirically examines the effects of farm organization (separation of ownership and control) on farmer effort and farm success using a structural equation model and data from the 2005-2010 Agriculture Management Resource Survey. Contrary to expectations of existing theory, the results show that larger separated ownership and control farms have a higher probability of farm success, and their operators supply more labor effort than combined ownership and control farms. The results seem consistent even with greater exogenous uncertainty, or more asymmetric information. The implications are that current theoretical literature on farm organization and evolution was not validated using this method and data set and may need to be modified.

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[1]. 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.

[1] 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).

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 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[2] (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).

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

[2] 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.

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 proxy accurately 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)

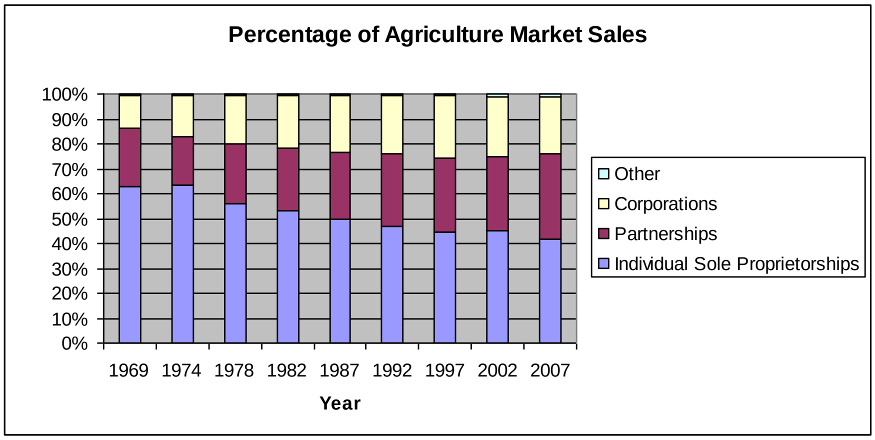

Figure 2.1. Percentage of Agriculture Market Sales by Farm Organization type

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 of utility between 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 (Cooperatives and vertically integrated corporations). 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).

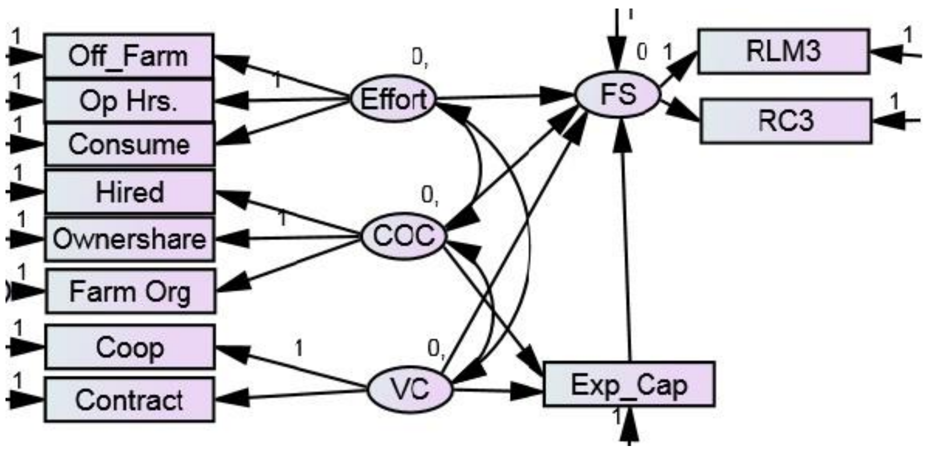

Figure 2.2 SEM model

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)[3]. The measurement variable of “Op. Hrs” is expected to be positively correlated with effort, 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, or a hired manager, that does not own the business and works 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

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

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)[4]. 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 significance tests to determine significant differences. Given the large data set, unless

[4] 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.

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[5].

We also excluded operators from the sample that indicated they were retired. Though the theory does not outline effort as a function of age, effort would be expected to decrease as age

[5] 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.

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 may have additional factors besides amount 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 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[6]. 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,

[6] 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 2.3).

"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 amount[7]. 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

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[7] 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.

“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) 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 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 make the argument here that 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 off-farm work or their increased income for consumption. 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 the effort of 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.

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