EXTERNAL EQUITY FINANCING OF AGRIFOOD FIRMS

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MARIO P. MONDELLI

Dr. PETER G. KLEIN, Dissertation Supervisor

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The undersigned, appointed by the dean of the Graduate School,

have examined the dissertation entitled

EXTERNAL EQUITY FINANCING IN AGRIFOOD FIRMS

Presented by

MARIO P. MONDELLI

A candidate for the degree of

Doctor of Philosophy,

And hereby certify that, in their opinion, it is worthy of acceptance.

_____

Dr. Peter G. Klein, Chair

_____

Dr. Fabio R. Chaddad

_____

Dr. Michael L. Cook

_____

Dr. David J. Obrien

_____

Dr. Randall E. Westgren

_____

Dr. Decio Zylbersztajn

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In academia, we do our best to understand causal relationships that are particularly difficult in social sciences. The understanding of academic achievement is not the exception, and we hardly understand the factors that explain it. I am aware that effort, dedication, motivation and abilities are relevant factors but I have my doubts that these are the most important one. However, I am certain that I would not be writing this page of the dissertation without the excellent support and advice I got during my PhD.

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Mario P. Mondelli

Dr. Peter G. Klein, Dissertation Supervisor

ABSTRACT

This dissertation investigates the determinants that influence a firm's decision to use external private equity in agriculture. Scholars have recognized the benefits of external equity finance for agricultural firms (i.e., capital derived from a source other than retained earnings and existing owners) and the use of external equity in agriculture has increased since 1990. This is important because this source of capital allows farms to exploit business opportunity, particularly for companies that pose risks that discourage debt capital, and because private equity has fostered entrepreneurial activity. However, the literature addressing this phenomenon is limited. The asset specificity approach (Williamson 1988) offers insightful contributions to understand the choice of financial mechanisms. This approach brings additional insights and complements agency—the dominant perspective in finance. The analysis focuses on the differential redeployability of the assets involved in the production of different agricultural product. I construct an international dataset of agricultural companies that receive external private equity finance to test hypotheses about the determinants of using external equity finance. Results show that the attributes of the assets involved in agriculture are important factors to explain financing choices in agriculture. This research contributes to the understanding of the role of asset specificity to explain financing decisions and to the identification of what types of asset specificity play an important role in agriculture.

CHAPTER I INTRODUCTION

This dissertation analyzes several issues on external equity financing in agriculture. Private equity capital has developed into an important source of funding for private middle market companies, firms in financial stress, and as growth capital. Scholars have recognized the benefits of external equity financing for agriculture. Access to external equity—that is, capital derived from a source other than retained earnings and existing owners—allows firms to expand and take full advantage of business opportunities without incurring excessive financial risk from high level of debt, as well as firms/projects with prolonged periods of cash shortages (Collins and Bourn 1986; Fiske, Batte and Lee 1986; Raup 1986; Lowenberg-Deboer, Featherstone and Leatham 1989; Barry and Robison 2001; Wang, Leatham and Chaisantikulawat 2002).

The use of external equity as a funding source by companies in the agrifood sector has increased since late 1990s. For example, based on the information captured by the Venture Economics database, the number of agrifood companies that received their first investment from external equity investors in North America and the European Union increased from less than 40 in the 1980s to 210 in the 2000s.[1] Similar features apply for companies operating in agricultural production industries. However, the literature on the use of external private equity in the farming sector is very limited.

[1] Source: Data extracted from Thomson Financial´s SDC Platinum VentureXpert. Included countries of the European Union 15.

The importance of this phenomenon is twofold. First, because private equity plays a critical role at financing companies that pose numerous risks and uncertainties that discourage other investors (Lerner, Hardymon and Leamon 2009). Financing firms by private equity investors has become increasingly more important, both strategically and financially (Caselli 2010). Second, the option of public equity is restricted for most companies in agricultural production, which enhance the importance of the option of external private equity for companies in this sector.[2]

The transaction cost approach to a firm's financing decisions (Williamson 1988) offers insightful contributions to understanding the use of alternative financial mechanism across farming industries. This approach brings additional insights and complements agency theory that has been the dominant perspective in the finance literature. However, empirical analysis of the asset specificity approach to financial decisions has been very limited, partially due to data constraints and difficulties to find good measures of asset specificity in databases of secondary data.

The differential attributes of the assets involved in agricultural production are an important source of variation across farm activities. Whereas some farm activities heavily rely on highly redeployable assets, farmland being the most distinctive one; other farm activities rely on single-purpose equipment and facilities that are, in certain cases, non-redeployable. The agricultural setting provides a rich and, to some degree, unexplored area for application and refinement of transaction cost approach (Masten 2000; Williamson 2004).

[2] In addition, private equity has fostered entrepreneurial activity because it can lead to better coordination of assets across firms and markets, as assets are redeployed to higher-value uses (Klein 1999; Chapman and Klein 2010).

This variation across farm activities justifies efforts to abandon the traditional approach of capital as an undifferentiated (composite) kind, and to explore the differential redeployability of the assets involved in the production process, as well as its implications in terms of contracting and financial choices. The literature on agricultural finance has been successful at addressing the effect that the non-depreciable attribute of land has on the financial characteristics of agriculture (Barry and Robison 2001). However, little is known about the effect that other attributes of the assets involved in agricultural production have on the use of alternative financing mechanisms.

This dissertation's focus is on the determinants that influence a firm's decision to use external private equity in agricultural production. The analysis of this problem is organized in two studies. In the first, I investigate the differences among farm activities based on the attributes of the assets involved in the production process. I identify groups of farm activities that share similarities in the properties of the assets and discuss the implications that the characteristics of the assets in different farm activities (i.e., industries) have for financing decisions.

This study sets the ground for the analysis of the determinants that influence the firm's decision to use external equity. The analysis on how differences in the assets in different industries in the farming sector affect the firm's financing decisions informs the theoretical discussion and the identification of hypotheses for the second study.

The second study discusses a theoretical framework using insights from the transaction cost approach to financing decisions. Hypotheses on the determinants that affect the decision to use external private equity by agricultural firms are tested using a

dataset of international companies in the agricultural sector that have received external private equity finance.

This dissertation is divided in four additional chapters. Chapter II provides a review of the literature on the use of external equity capital in agriculture and lending decisions. Chapter III provides an assessment of the degree of asset specificity involved in the production of the major agricultural products. In this chapter, I develop an empirical taxonomy of farm activities based on the degree of asset specificity using cluster analysis; and finally, I discuss implications for financial choices that allow to connect the groups of farming activities with the use of debt versus equity capital. In Chapter IV, I provide an empirical analysis of the determinants of using external equity finance by firms in agriculture. Chapter V summarizes the dissertation and concludes.

CHAPTER II LITERATURE REVIEW

1 EXTERNAL EQUITY FINANCING IN AGRICULTURE

This research uses the following definitions for the terms private equity and venture capital. Venture capital refers to investment in earlier-stage firms (e.g., seed or start-up firms). Private Equity is a broader term that also encompasses later-stage projects, buyouts, and turnaround investments. Hence, the term private equity encompasses all private investment stages, including venture capital.

The private equity market has been growing since the 1980s and consolidating as a funding source for a diverse range of enterprises. For example, the pool of U.S. private equity funds has growth from $5 billion in 1980 to $10 billion in 1991 to $180 billion in 2000 (Kaplan and Schoar 2005). Venture capital, in particular, has developed as an important intermediary in financial markets, providing capital to firms that might otherwise have difficulty to attract financing.

The venture capital literature has evolved in direction to a better understanding of the manners in which venture capital funds are raised and structured, how the capital is invested, and how investments are concluded (Gompers and Lerner 2001b). Scholars suggest that firms that receive venture capital finance tend to achieve higher performance and are more innovative (Kortum and Lerner 2000; Gompers and Lerner 2001b; Gompers and Lerner 2001a).

The rapid growth of private equity market is attributed, among other factors, to organizational innovations. Specialized financial intermediaries have emerged to overcome problems along the investment process. Limited partnership has been widely adopted as a mean of organizing private equity investments where institutional investors are the limited partners, and professional investment managers are the general partners (Prowse 1998).

In the following sub-sections, I summarize the previous findings on the motives for equity finance in the agricultural production sector, the use of private equity in the production sector, and the types of arrangements that can support equity finance.

1.1 Motives for External Equity Financing in Agriculture

During the 1980s, the use of equity capital caught the attention of scholars motivated by the farm financial crisis. Debt capital became restricted and uncertain, which made external equity a more attractive option. A special issue of the American Journal of Agricultural Economics (1986, vol. 68, num. 5) on the 'use of equity capital in financing future agricultural production' summarizes the motives and problems for nonfarm equity in U.S. agricultural production during the 1980s.

For the farmer, the incentives for outside equity consist in a replacement of debt by equity that requires a share of income as payment and, therefore, would reduce financial risk because financing cost would vary with income. Hence, highly indebted farmers might be willing to consider selling off some of their equity (Collins and Bourn 1986).

Investors might find attractive to take on risks in contemporary farming for different reasons. First, in anticipation of long-run capital gains that a current farm operator cannot value highly (e.g., land value), and because investors can endure periods of low or negative income at lower costs than a farmer can. Second, investors can introduce managerial reforms that will result in more effective and more profitable use of farm capital. Finally, the tax system could permit the use of farm losses to offset nonfarm taxable income, thus reducing the after-tax impact of low or negative returns on farm assets (Raup 1986).

Studies show that farmland provides significant portfolio diversification benefits in Australia, U.S., and Canada (Eves 2005; Painter 2009). Painter (2009) finds that the performance of investments in Canadian farmland has low correlation with those obtained in bonds and most of the stock markets—a finding that has implications for both farmers and non-farmers. For farmers, it implies that they should consider owning stocks and bonds to complement their farmland holdings, leasing instead of buying more farmland when they expand. For non-farmers, it implies that they should consider farmland as an attractive alternative for portfolio diversification.

According to previous studies, the most important barriers for the flow of nonfarm equity into farm businesses include legal restrictions on farm asset ownership,[3] high transaction costs, and peculiar organizational structure of farm businesses (Fiske, et al. 1986; Lowenberg-Deboer, et al. 1989). Transaction costs in those studies are defined as the costs involved in underwriting the sale of stock or limited partnerships as well as

[3] By 1990, land ownership by corporations was restricted in ten states in the United States. Investments by nonresident aliens is limited or prohibited in thirty states.

the search costs borne by the farmer and outside investors in striking a deal. These transaction costs are relatively higher for small size farm business units.

According to Barry et al. (2000, p. 606) "reliance on outside equity will undoubtedly increase in the future, at least for some types of operations that wish to (1) avoid the use of extensive financial leverage, (2) spread risk over more diverse set of investors, and (3) more effectively manage income tax obligations."

The literature is silent at addressing industry specific factors such as the type of assets involved in the production process as relevant factors to explain why some farm activities might be more likely to use external equity capital. Barry and Robinson (1986; 2001) address the idiosyncratic attributes of farmland and its implication for agricultural finance. Specifically, they argue that the debt-carrying capacity of non-depreciable assets such as farmland is lower than that of depreciable assets, under traditional loan repayment conditions. However, they do not explore differences among agricultural industries.

1.2 Literature on external equity capital in agriculture

Lowenberg-DeBoer *et al.* (1989) review the literature on external equity capital in the agricultural sector. They argue that the research framework for analyzing equity use in farming businesses is not well developed.

Most empirical work in agricultural economics assumes that equity is fixed or that it increases through retained earnings. Models on capital structure choice have been developed (Collins 1985; Collins and Bourn 1986) but none of them discriminates between inside and outside equity. Recent research estimates the effect of capital

structure (debt ratio) on farm performance, but the source of equity capital is not discriminated (c.f., Zhengfei and Oude Lansink 2006).

The capital structure debate in the finance literature does not directly address the external equity problem in farming businesses. The studies in that literature focus on corporate firms with publicly traded stocks in the manufacture and service sectors. Most agricultural firms are sole proprietorships or partnerships, and those farms organized as corporations are usually closely held by family groups.[4]

In summary, the literature on external private equity in the farming sector is not abundant and discontinued over time. Comparatively little research is available to inform the analysis of the opportunities and limitations of external equity investments in the agricultural sector. Empirical research is restricted due to the lack of data.

1.3 Institutional Arrangements to Support Private Equity in Agriculture

Several institutional arrangements for nonfarm equity investment have been identified in the literature, and they generally fall into three categories: direct, personal ownership of farm assets; partnerships (unlimited and limited); and direct ownership of farm assets by a corporation.

The first one is the most common method that involves, in general, land as the asset owned (Lowenberg-Deboer, et al. 1989). Barry et al. (2000, p. 595) refer to this mechanism as the "informal" way of entering outside equity capital to agriculture.

[4] For example, in the U.S. 86% of the farms are family or individually owned, 8% are partnerships, 4% are family corporations, and less than 2% are non-family corporations (2007 data from the U.S. Census of Agriculture).

Leased land is an important source of external equity financing and has been increasingly used, particularly by large farm size enterprises. In the United States and Canada, 50% of the farmland is leased by farm operators and the demand for leased land is growing (Painter 2006; Painter 2009). For an urban investor, direct ownership might not be attractive because finding and buying appropriate farm property may involve high search and information costs. In addition, farm assets come in rather large, discrete units and, hence, are not appropriate for small investors. However, big investors and investors pooling capital together can easily overcome these difficulties.

The three major partnership arrangements for nonfarm investors are unlimited partnership, (direct) personal ownership of a limited partnership, and indirect limited partnerships held by a corporation of another partnership.

For external equity to be a viable source of capital, it requires not only an appropriate set of expectations on the part of the farmer and the investors but also a financial mechanism. Collins and Bourn (1986) discuss the economic conditions necessary to support a market for external farm equity. This setting involves pooled limited partnerships interested in commercial farms, and held by a second-tier financial unit. A limited partnership could be formed with farmers as general partners, where the common entity provides capital in exchange for a share of the farm's earnings from both operations and capital gains.

In New Zealand, for example, since the late 1990s the number of equity partnerships in the agricultural sector has significantly increased. Shareholders usually number less than ten and shares are not necessarily equal. Wilson (2006) documents that in dairy farming alone there are 250 equity partnerships. Since 2001, these equity

partnerships have increased the equity of the business and production by impressive averages of 18% and 8% compound per year respectively.

In Argentina, since 1990 major organizational changes have taken place in the agrifood production sector. This period is characterized by a significant expansion in area and productivity of agricultural production and by high profit opportunities in that sector. In particular, after the Argentine macro-economic crisis in 2001, investors and financial organizations outside the agrifood business circuit began to finance the agricultural sector (Chaddad, et al. 2009).

Chaddad et al. (2009) describe two types of arrangements that support the relationship between external investors and farmers. One is an agricultural trust fund (known as *fideicomiso*) which has both producers and outside investors as partners and is regulated by a specific Law passed in 1995. A typical agricultural trust fund has three main parties: (i) an investor, (ii) actors that receive capital (including a coordinator of the organization), and (iii) a controller (third party, usually banks) that guarantees that the coordinator fulfills his or her obligations. Business profits are distributed based on criteria established when the *fideicomiso* is established. This type of financial arrangement is generally set up to develop one to three agricultural cycles because the investors that are generally involved in this arrangement prefer short-term investment periods.

The second financial arrangement found in Argentina is an investor-oriented corporate structure model. This arrangement involves capital funds from several partners and is associated with large-scale grain enterprises (above 10,000 hectares) mostly on leased land. Investors receive, in general, a fixed percentage-based return on investments.

These financial contracts are short-term covering, in general, one agricultural cycle and renewed on a yearly basis when parties agree. This mechanism has made it easier for outside investors to enter the farming sector during periods of high prices and profitability.

Fiske *et al.* (1986) raise the question about whether nonfarm equity will more likely replace existing farm businesses than to share ownership with them. However, the literature seems to lack empirical studies examining this issue.

In the United States, partnerships between farmers and nonfarmers are most common for farm operations that involve a substantial nonland component, equipment, or specialized management. In fact, limited partnerships have been used to facilitate investment in cattle feeding, citrus groves, nut orchards, and other specialized ventures in the 1960s and early 1970s (Scofield 1972; Barry, et al. 2000).

Raup (1973: 286) argues that in the United States "There are types of farming for which capital requirements and economies of size are often beyond the reach of single-proprietor or family-type farms. Heading this list are integrated broiler and egg enterprises, mechanized orchards, citrus, and nut groves, large-scale beef cattle feed lots, pineapple and sugar cane, and vegetable crops for canning or processing." Raup discusses that corporate farming activity might expand on these type of farming. Raup also alerts that tax policy has attracted non-farm capital into some farming sectors to an extent that makes it difficult to argue the prevalence of corporate farming on the basis of efficiency or economies of size. The greatest stimuli arise at that time from capital-gains tax provision and from the opportunity for non-farm investors to use farm losses to offset non-farm income.

Barry et al (2000, p. 597) elaborate on why incorporation for attracting outside equity capital has not been widespread in agriculture. They point out high administrative costs and lengthy review of the corporation prospectus by state and federal regulatory agencies. In addition, public stock offering would be too costly for agricultural corporations seeking less than $500,000, which is a disincentive for any but large firms. Nonetheless, the corporation offers certain advantages over proprietorship and general partnerships. Successful corporations are found in vertical integrated enterprises where the agricultural production unit is combined with other enterprises in vertical sequence (e.g., input supplier, processor). Next section elaborates on the organizational forms and the specific characteristics of farming.

1.4 Institutional Environment

The institutional environment in which the parties operate affects the financial contracts. Access to equity capital might be facilitated for firms in some countries but not in others. The same way, the credit systems and regulation vary across countries and so does the financial options that companies have.

Although this study does not focus on the role of the instructional environment and approaches institutions as given, it is important to mention the important role for financial choices of factors such as civil versus common law systems, legal protection, political stability, efficiency of judicial system, corruption, risk of contract repudiation, and shareholder rights. For agriculture in particular, factors such as the land property regime and the restrictions on ownership of land are important factors.

It might be argued that agricultural companies tend to operate in locally; however, this is changing and is no longer the norm for certain type of farmers who are operating globally (Karantinini and Zylbersztajn 2007). On the investors side, there is a growing tendency of international private equity funds to invest in other developed countries (Manigart, De Prijcker and Bose 2010). Institutional factor play an important role for this type of phenomenon.

2 IDIOSYNCRATIC ATTRIBUTES OF FARMING ENTERPRISES

The most prominent characteristic of farming activity is that family-based firms continue to be the dominant organizational form despite the changes that have taken place in agriculture in the last two centuries. In several farming sectors, the "pure" family farm dominates, where family members run the business and provide labor for the production process. However, several organizational changes have also taken place that motivates a closer look to this picture.

The main feature that distinguishes farm production from industrial production is the seasonality and other constraints derived from the effects of Mother Nature on production. Agricultural production is constrained by biological processes with seasonal stages and crop cycles and is subject to climate random effects. The idiosyncratic characteristics of farming production have been previously recognized, however, its effect on farm organization and financial arrangements have received less attention.

Allen and Lueck (1998) merge the modern theory of the firm with the seasonal forces of the biological production process into a model of farm organization. They incorporate the effects of nature through (i) random shocks to farm output, and (ii) through seasonal forces, such as the length of production stages and the frequency of crop cycles. The effect of these variables on the organizational choice (sole proprietorship, partnership, and corporation) is stated as follows. First, random production shocks generate moral hazard problems. Because of random shocks, effort explains a lower proportion of output, which increases monitoring costs of management and hired labor. Second, seasonal constraints (cycles, stages, etc.) limit the benefits of specialization.

A farm can explore gains from specialization by expanding size but costs associated with moral hazard would increase. In this framework, the simplest family farm[5] avoids moral hazard costs because the farmer is the complete residual claimant, but at the same time scarifies gains from specialized labor if compared with the factory style or corporate agricultural production. Moreover, as shown in the following table, family farms face financial constraint when compared to other organizational forms.

Table 1. Incentives under different organizations

	Effort moral hazard	Effort specialization	Capital constraints	Labor monitoring
Family farm	No	No	Yes	No
Partnership	Some	Yes	Some	No
Corporate farm	Yes	Yes	No	Yes

Source: Allen and Lueck (2004, p. 180)

[5] A "pure" family farm is the simplest case, where a single farmer owns the output and controls all farm assets, including all labor assets. The single farmer is in reality a husband-wife team and their juvenile children (Allen and Lueck 1998).

3 AGRICULTURAL LOAN DECISIONS

The literature on agricultural lending is relevant for this study to set the ground on what agricultural projects are more or less likely to obtain credit capital. This literature is not conclusive as to which factors are most important in the agricultural loan decision-making process (Featherstone, et al. 2007). Agricultural lenders use five main factors when evaluating an agricultural loan application—capacity, capital, collateral, character, and conditions.

"Capacity" refers to the repayment capacity of the borrower based on cash flows from operations or other sources of income. "Capital" refers to the ability of the operation to survive unanticipated risks and it is evaluated based on firm's financial position with special emphasis on risk ratios, including measures of liquidity and solvency. "Collateral" represents the level of assets securing a loan and serves a final source of loan repayment if the borrower defaults. "Character" refers to borrower's personal characteristics such as honesty, integrity, and reliability. It is a subjective estimate of the likelihood a borrower will try to honor their obligations. Finally, "Conditions" refer to the intended purpose of the loan, and reflect general economic trends that affect a borrower's ability to repay (Duchessi, Shawky and Seagle 1988; Gustafson 1989; Featherstone, et al. 2007).

Credit officers evaluate each of these factors independently based on the borrower's financial statements, references, other documentation, and from previous experience with the borrower. These factors are then aggregated by various weighting

schemes to assess the borrower's financial position and the loan decision (Gustafson 1989).

Collateral is an important factor in the loan decision-making process, since lending risk is inversely related to the amount and quality of collateral provided. Gustafson et al. (1991) find that lenders base the maximum amount of credit they would approve on a percentage of appraised collateral securing the loan. Rates varied from 50% to 80%, with lower rates applied to machinery.

In addition, there are important differences between farming industries in areas such as credit scoring and the use of other measures of credit worthiness for agricultural loans. For example, Turvey (1991), while not focusing on the effects of farm type on credit scoring, compares alternative credit scoring models includes dummies to control for farm type (e.g., cash crops, dairy, beef, hogs, broiler). These dummies are statistically significant, suggesting that there are factors specific to the farm commodity sectors that explain differences in credit decisions.

An important point to make here is that factors considered by loan officers for collateral assessment take into account differences among farm sectors and, in particular, differences in the type of assets involved in the production process.

Although there is a general framework given by the five credit factors described above, there is important variation among credit organizations with regard to their actual credit assessment models. The difference among credit organizations emerges from the weight or importance that each accords to these factors in making the loan decision. That is, guidelines used by credit officers to evaluate a farm project, although existing, are not implemented uniformly across credit organizations. For example, some credit

organizations grant credit more on the basis of collateral values. In that case, they must ensure an accurate assessment of the assets used as collateral (real estate, machinery, facilities, etc.). Alternatively, other credit organizations grant credit on the basis of repayment capacity and must ensure an accurate assessment of the borrower's future farm plans and expectation of profitability and cash flow (Gustafson, Beyer and Saxowsky 1991; Gustafson, Pederson and Gloy 2005).

Next Chapter focuses on the analysis of the attributes of the assets involved at the farm activity levels and discusses the implication that the characteristics of the assets have for financial decisions.

CHAPTER III AN EMPIRICAL TAXONOMY OF FARM BUSINESSES: FARM ASSETS AND THE FINANCING OF AGRICULTURAL PRODUCTION

1 INTRODUCTION

Changes in the organization of agricultural production such as the increase of contract farming and vertical coordinated forms of production are important structural shifts in the late twentieth-century U.S. agriculture (James, Klein and Sykuta 2011). In this context, transaction cost economics shows promise in contributing to the understanding of current structural changes in the agricultural production sector.[6]

Williamson discusses applications of transaction cost economics in the agricultural sector and concludes that scholars "[…] have barely scratched the surface of interesting and important contract/governance issues in the agricultural arena." (2004, p. 37) Moreover, Masten, in his article on "Transaction-cost economics and the organization of agricultural transactions" (2000, p. 190) argues that "agriculture provides a rich and largely unexplored area for application and refinement of transaction-cost theory."

Modern agriculture presents novel and important challenges that are not only a fertile arena for applications of transaction cost economics but also an opportunity for refinement of the theory. However, empirical applications in the agricultural production

[6] I follow North American Industry Classification System (NAICS) terminology where sector refers to a higher level of classification and 'industry' refers to a more detailed level of classification such as beef cattle feedlots, corn farming, and dairy cattle and milk production, etc.

sector have suffered from measurement problems of relationship-specific assets—the most important and most distinctive attribute with respect to which transactions differ.[7] Studies of organizational forms have tended to restrict analysis to a single industry or firm, and hence, have not explored variations across agricultural sectors (i.e., dairy, cash crops, vegetables, etc.). This limitation is of particular importance because, were they available, measures of the variations in organizational forms and in the attributes of transactions of agricultural commodities—such as relationship-specific assets—would present abundant opportunities for formal statistical tests (Masten 2000) and refinement of the theory.

One salient feature of agricultural production is that it heavily relies on non-depreciable assets that, in some cases, are also highly redeployable, farmland being the most distinctive example. However, agricultural production relies also on other types of assets such as single purpose equipment and facilities that are, under certain conditions, non-redeployable. Such differential redeployability is not only a distinctive feature of agriculture as a whole but also a source of variation across farm activities. Understanding agricultural production this way justifies efforts to abandon the traditional approach of treating capital as an undifferentiated (composite) kind. Rather, we should explore the differential redeployability of the assets involved in the production process as well as its implications in terms of contracting and financing.

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[7] The terms asset specificity and relationship-specific investments are used here as synonymous and refer to "durable investments that are undertaken in support of particular transactions, the opportunity cost of which investments is much lower in best alternative uses or by alternative users should the original transaction be prematurely terminated." (Williamson 1985, p. 55) As highlighted by Klein (2005) this definition of relationship-specific investment is very similar to the one used by Klein, Crawford, and Alchian (1978). They define asset specificity ("specialized asset") as any asset that generates appropriable quasi-rents; i.e., any asset whose value to its current renter exceeds its value to another renter.

The first purpose of the study presented in this chapter is to identify groups of farming activities that share similar attributes of the assets involved in the production process. Finding groups of farming activities with common features in the assets involved in the production process will reveal industry patterns within the agricultural sector. Moreover, it may reveal industry differences that are not contemplated in the industry classification systems such as Standard Industrial Classification (SIC). The second purpose is to understand the implication that the characteristics of the asset involved in farm activities in different industries have for financing decisions. These objectives are pursued as follows. First, I provide an assessment of the degree of asset specificity involved in the production of the major agricultural products. Second, I develop an empirical taxonomy of farm activities based on the degree of asset specificity using cluster analysis. Third, I discuss implications for financial choices linking the groups of farming activities with the use of debt versus equity capital.

An important challenge for empirical studies is to find/create good measures of asset specificity. Proxies such as advertising intensity and R&D intensity are poor measures of the liquidation value of the assets involved in a project. Similarly, many studies use the ratio of tangible/intangible assets as a measure of liquidation value, which is also a very incomplete measure (Williamson 1988). Tangible assets can also involve high levels of asset specificity such as single-purpose facilities designed to supply products to a specific buyer. In addition, asset specificity is difficult to measure consistently across firms and industries, partially explaining why there are far more single-industry studies of vertical boundaries than cross-industry studies (Klein 2005).

What is ranked as relatively specialized asset in one firm or industry may be rated differently in another firm or industry.

In summary, the main challenge for studies that seek to analyze the role of differential redeployability on organizational forms is to find good measures of relationship-specific investments. Measurement problems have been a major limitation of previous studies, which has also restricted the use of multiple industry comparisons. The main challenge to measuring asset specificity in the particular context of agricultural production is that the production of each agricultural product involves several assets, each with differing degrees of asset specificity. In addition, differences in the production technologies available for even a single agricultural product needs to be considered, in particular, when different technologies involve assets with different degrees of asset specificity (e.g., confined versus pasture-based dairy or beef production, caged versus cage-free broiler production).

The strategy adopted in this study is to estimate the degree of asset specificity of the assets involved in the production of each agricultural product. For this endeavor, credit officers that focus on the agricultural production sector are used as the primary source of information. I rely on their judgment for the assessment of collateral to measure the degree of relationship-specific assets in most agricultural production activities. Credit officers are a relevant source of information because when evaluating a farm project to approve loans to farmers, they perform an assessment of the farm assets that serve as collateral. The assessment performed by credit officers involves not only the appraisal of farm assets but also the assessment of other factors that affect the salvage value. The connection with the transaction cost framework is that, as highlighted by Williamson

(1988, p. 588), dealing with the differential redeployability of assets is the core challenge. In that respect, credit officers are a relevant source of information to measure asset specificity.

Data collection is based on a mail survey where credit officers rate questions related to each type of relationship-specific investments involved in the production of each agricultural product (i.e., physical, temporal, site, and human-asset specificity). The list of agricultural products is based on SIC and NAICS industry classification. I included additional farm activities in agricultural products that are produced under different production systems (e.g., pasture based versus confinement in dairy and beef).

The contribution of this study is twofold. First, it provides an empirical taxonomy of farm production activities based on the degree of asset specificity. Second, it contributes to the understanding of the differences across farm activities in relation to farm financing characteristics. This study will benefit future studies that attempt to understand variations across agricultural industries, and studies that apply transaction cost theory to several contractual problems such as inter-firm contractual relationships and firm financing decisions.

This study proceeds as follows. Section 2 presents the transaction cost framework in an agricultural production setting and provides background on agricultural loan decisions and collateral assessment. Section 3 discusses the methods and data. Section 4 discusses the results, and Section 5 presents concluding remarks.

2 THEORETICAL FRAMEWORK

2.1 Transaction Cost Economics and Agriculture

Transaction cost theory approaches the boundaries of the firm as being the result not only of the limits of productive technology, but also on organizational considerations. More precisely, transaction cost theory studies the choices of firms among alternative governance mechanisms—that is, alternative "means by which to infuse order, thereby to mitigate conflict and realize mutual gain." (Williamson 1985)

The central exercise of this contractual approach is to explain how partners choose, from the set of feasible contractual arrangements, the one that best mitigates the relevant contractual hazards at least costs (Klein 2005). This task is articulated by Williamson in the discriminating alignment hypothesis which postulates that "[…] transactions [be they for intermediate product, labor, finance, final products, etc.], which differ in their attributes, are aligned with governance structures, which differ in their cost and competencies, in a discriminating (mainly, transaction-cost-economizing) way." (Williamson 1991, p. 277)

Of the several attributes with respect to which transactions differ, asset specificity is the most important and most distinctive one (Williamson 1985; Williamson 1988; Williamson 1991). The condition of asset specificity refers to "durable investments that are undertaken in support of particular transactions, the opportunity cost of which investments is much lower in best alternative uses or by alternative users should the original transaction be prematurely terminated." (Williamson 1985, p. 55)

The rationale of this approach is that when transactions are supported by generic assets, it is easy to redeploy assets to alternative uses or users, and each party can go its own way with little cost to the other. On the contrary, when significant investments in durable, specialized assets are put at risk, and there is small numbers bargaining, bilateral dependency sets in (Williamson 1985; Williamson 1991). In these situations, assets cannot be redeployed from the existing use except at a significant loss of productive value. This generates incentives for a bilateral coordination of investment decisions. In particular, transactors are likely to be reluctant to make such investments without some form of protection.

The transaction cost approach to a firm's financing decisions considers debt and equity as alternative governance structures rather than as financial instruments, where debt is the market form and equity is the administrative form. In this setting, the degree of asset specificity is also the primary factor to explain the use of debt versus equity finance (Williamson 1988).

The problem faced by firms is choosing the financial mechanism that minimizes the costs of external funding. Debt is a low cost governance arrangement for projects involving highly redeployable assets because if the project fails, debt-holders can liquidate assets to recover their investments; if the project is successful, interest and principal will be paid on schedule. The same does not hold, however, if the assets involved in a project are highly specific (i.e., non-redeployable), resulting in their having lower value for other purposes should the project be liquidated. Because the losses are greater when a project involving non-redeployable assets fails, the terms of debt financing will be adjusted adversely as the degree of redeployability of assets declines.

Equity capital, although not costless, involves control over the capital-seeking firm, a feature that mitigates opportunistic behavior by the owner-manager. This in turn, reduces the cost of capital for projects that involve limited redeployability (Williamson 1988).

Based on this approach, firms engaged in farm activities that rely more on assets with low redeployability are expected to have higher equity requirements than firms engaged in farming activities that rely more on multiple purpose facilities and equipment, land. While the literature on agricultural finance has been successful at addressing the effect that the non-depreciable attribute of land has on the financial characteristics of agriculture (Barry and Robison 2001), little is known about the effect that other attributes of the assets involved in agricultural production have on the use of alternative financing mechanisms. Therefore, empirical testing of the aforementioned predictions might prove insightful for understanding the use of different financial mechanisms across farming industries.

Williamson (1991) describes six types of asset specificity. The first three—physical, human, and site specificity—have received more attention in the empirical literature. Physical-asset specificity pertains to the equipment, machinery and facilities that are required to provide a product or service. Human-asset specificity arises when specific knowledge, experience or human capital is required to support the transaction. Site specificity refers to situations where successive stations or assets must be located close to one another.

The fourth type of asset specificity is brand-name capital. The fifth is dedicated assets, which are substantial investments in general-purpose assets made for a particular customer. Although not specific to that customer, because of the magnitude of these

investments their release to the market would depress the market value of the assets. The sixth is temporal-asset specificity, which refers to assets that must be used in a particular sequence and where timely responsiveness is important. Temporal specificity may arise when the value of a product is inherently time dependent (e.g., newspapers), because of the serial nature of production (e.g., construction projects), or when the products are perishable (e.g., dairy, fish, and other food products) (Masten 2000, p. 180).

Agricultural transactions occur in a broad range of contractual arrangements. Based on the empirical literature it is possible to discuss which attributes of the transaction play a bigger role at determining the contractual arrangement that will be chosen in agricultural production.

Masten (2000) argues that perishability is the most conspicuous attribute of agricultural products when compared to non-agricultural products and, hence, temporal-asset specificity is expected to play a distinctive role. Producers of perishable fruits, vegetables, dairy products, seafood and the like are particularly vulnerable to opportunistic behavior by processors. A default by the processor during harvest time would mean a significant loss of value for producers of such products. Likewise, losses would arise were there to be crop deterioration or from costly sales in the case of thin spot markets. Processors of highly perishable products are also at risk; because they cannot store perishable products, a default by a producer would either interrupt the processing activity or require quick and costly replacement from a thin spot market (Knoeber 1983). Timing factors also create temporal specificities in other agricultural industries such as broiler and dairy. Because of the risk of contamination with pathogens, broiler has a narrow range of time which it must be sent to processors (Martinez 1999).

Similarly, because of the perishability attribute of raw milk, transactions in the dairy industry are expected to be coordinated by long term contracts, and producer cooperatives.

Another attribute that is expected to have more relevance in the agricultural production sector compared to non-agricultural sectors is site specificity. That is the case of agricultural products with high weight-to-value ratio and in particular, when that high ratio is reduced significantly in the processing facility. In those cases one would expect processing facilities to be located in proximity to input sources (Masten 2000). The importance of site specificity is, to some extent, also influenced by the perishability of products.

Vertical contracts cover a wide range of U.S. agricultural transactions (MacDonald and Korb 2008). For example, hogs and tobacco production are two farm activities where vertical contracts coordinated more than 70% of the production in the U.S. in 2005. Hog production does not face the severe schedule restriction described above for broiler because hogs can be transported further without losing significant value.[8] However, hog production relies heavily on single-use facilities, and in many cases, a heavily concentrated processing industry. Thus, although site and temporal specificity are less important in hog production, physical-asset specificity can play an important role. That is, vertical contracts are not limited to transactions of perishable products or situation where site specificity plays an important role in explaining organizational choices.

[8] Stress, weight loss, or death during transport are some of the reason these farm activities would lose value.

Physical and human-asset specificity play a relevant explanatory role in certain agricultural projects and, in particular, to understand variation across agricultural transactions. Furthermore, as discussed above, Transaction Cost theory informs the understanding of the alignment of several types of transactions beyond the applications of intermediate or final products such as labor and finance. Although the empirical literature using Transaction Cost Economics to study "make or buy" problems is growing, applications to understand firms' financial decisions are more scarce.

2.2 Measures of Asset Specificity

Empirical studies struggle to find good measures of asset specificity. Available measures in databases of secondary data such as the tangible/intangible assets ratios, R&D and advertising expenditures often are poor measures and may not capture whether the investment has value outside the transaction for which it was initially made. In addition, it is important to consider and assess small-numbers bargaining situations to obtain a good measure of relationship-specific investments.

In addition, asset specificity is difficult to measure consistently across firms and industries. This partially explains why there are far more single-industry studies of vertical boundaries than cross-industry studies (Klein 2005). What is ranked as relatively specialized asset in one firm or industry may be rated differently in another firm or industry.

Needless to say that as highlighted by Masten and Saussier (2002) case studies are an important complement to econometric analysis. What case studies lack in generality they often make up in depth. Moreover, while a case study cannot disprove the general

validation of a theory, a well-documented fact can refute the applicability of a theory to a particular case.

The discussion here is how to overcome the measurement challenges. A more appropriate approach considering the limitations of using secondary data to measure asset specificity that has been used by some authors is to collect data through surveys of industry participants (cf, Anderson and Schmittlein 1984; Masten, Meehan and Snyder 1991; Poppo and Zenger 1998). To obtain good measures of asset specificity it is important to understand the industry and get access to informants that do so.

For this research, practitioners in agricultural finance and credit officers that focus on the agricultural production sector are a very relevant source of information for the classification of farm assets based on their level of asset specificity. For example, the collateral that a farmer can use based on his or her farm assets when applying for loans is a straightforward measure of asset specificity. This point is discussed in greater detail in the following section.

2.3 Collateral Assessment

Agricultural lenders use five main factors when evaluating an agricultural loan application—capacity, capital, collateral, character, and conditions.[9] Collateral is an important factor in the loan decision-making process because lending risk is inversely related to the amount and quality of collateral provided. As highlighted in the literature review, lenders base the maximum amount of credit they would approve on a percentage of appraised collateral securing the loan. Rates varied from 50% to 80%, with lower rates applied to machinery (Gustafson, et al. 1991).

The collateral assessment involves not only the appraisal of the farm assets but also an assessment of other factors to determine the percentage of the appraised collateral that they would approve in the loan (i.e., loan-to-value ratio). For this task, lenders use a combination of quantitative and qualitative information on a borrower's behavior. That is, even when credit evaluation models are used, considerable lender judgment is still required (see, for example, Gustafson, et al. 2005; Featherstone, et al. 2007).

Although the literature is vague in explaining how lenders evaluate different types of assets and on which ones they put greater emphasis, it can be inferred that the nature of the assets and the type of business are important to determine the percentage of appraised collateral that they are willing to lend.

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[9] "Capacity" refers to the repayment capacity of the borrower based on cash flows from operations or other sources of income. "Capital" refers to the ability of the operation to survive unanticipated risks and it is evaluated based on firm's financial position with special emphasis on risk ratios, including measures of liquidity and solvency. "Collateral" represents the level of assets securing a loan and serves a final source of loan repayment if the borrower defaults. "Character" refers to borrower's personal characteristics such as honesty, integrity, and reliability. It is a subjective estimate of the likelihood a borrower will try to honor their obligations. Finally, "Conditions" refer to the intended purpose of the loan, and also reflect general economic trends that affect a borrower's ability to repay (Duchessi, et al. 1988; Gustafson 1989; Featherstone, et al. 2007).

For purposes of understanding the present study, it is important to highlight that the factors considered by loan officers for collateral assessment take into account differences among farm sectors and, in particular, differences in the type of assets involved in the production process. There is a salient relationship between the factors involved in the collateral assessment and the concept of asset specificity, which makes loan officers a relevant source of information to estimate the degree of relationship-specific assets involved in the production of each agricultural product.

3 DATA AND METHOD

3.1 Sources of information

The identification of groups of farming activities that share similar attributes of the assets involved in the production process requires the assessment of the degree of asset specificity of the assets involved in the production of each agricultural product. That is, for each major agricultural product I estimate the degree of asset specificity of all the assets involved in the production of that product.

Credit officers who focus on the agricultural production sector are the 'key informants' for the assessment of the degree of relationship-specific assets involved in the production of each agricultural product. I use credit officers' knowledge and judgment in two ways. First, I sent them a survey questionnaire asking them to rate each farm activity regarding each type of asset specificity (i.e., physical, temporal, site, and

human). Second, I interviewed credit officers in order to understand the lending process and criteria used to rate investment projects.

The information collected in the interviews is used in Section 4.2 to analyze implication of the classification and groups of farming activities for the organization of agriculture and, in particular, for the financing of agriculture. I focused, in particular, on the criteria used to classify farm assets in agricultural investment projects and how differences in the attributes of farm assets affect lending decisions. To capture different aspects of the lending process, I interviewed credit officers from a variety of credit organizations such as Farm Credit System associations, commercial banks, and also financial organizations that provide short term loans to farmers. Appendix A.2 reports the list of interviewed informants.

The argument to support the use of credit officers as key informants for this study is twofold. The first is because the factors considered in the assessment of the collateral by credit officers are, to a great extent, related to the concept of asset specificity. Credit officers estimate the amount that the bank may recover in the event of failure, and this task involves not only the appraisal of the farm assets but also the assessment of other factors that affect the salvage value of the assets. In particular, credit officers evaluate whether the assets are redeployable or are specialized for single use. They also consider other factors such as a comparison of the size of the operation relative to competitors. These factors explain not only the value of collateral assets but also help determine the likelihood that the operation could be absorbed by its competitors in case of failure.

Second, loan officers have significant experience in evaluating farm assets in different commodity sectors. As discussed in Section 2.3, the guidelines for collateral

assessment used by agricultural credit organizations take into account differences among farm sectors such as differences in the type of assets involved in the production process. That is, loan officers are a qualified source to perform comparisons across farm sectors.

One of the challenges of measuring asset specificity is that the production of each agricultural product involves several assets with different degrees of asset specificity. For example, the production of some agricultural products involves mainly land and multi-purpose machinery that can be used for the production of several agricultural products (e.g., the asset involved in soybean and corn productions). In such cases, the degree of physical-asset specificity would be low if compared with other agricultural products whose production involves small acreage of land, mainly single use facilities and equipment, and few potential buyers (e.g., hog production). However, most farm activities present a more complex situation, using a combination of assets with different degrees of asset specificity

The strategy adopted in this paper is to assess the overall degree of each form of asset specificity for each farm activity, as opposed to assessing each farm asset individually and then aggregating the individual assessments to determine the degree of asset specificity for each farm activity. For that purpose, credit officers offer the advantage that they not only analyze the individual assets involved in a farm project, but also they perform an assessment of the investment project as whole.

3.2 Key variables and survey questions

The strategy adopted for the collection of data is based on previous surveys by Masten, Meehan, and Snyder (1991), Poppo and Zenger (1998), and Anderson and Schmittlein

(1984). Masten et al. measure asset specificities of a set of components used in naval shipbuilding, based on the judgment of a team of company officials including the managers of the production planning and purchase specification departments. Respondents rated, for example, the degree to which skills, knowledge or experience of workers are specific to a particular application; and the degree to which facilities and equipment used in the production process are specific to a particular component. Poppo and Zenger study make-or-buy decisions in information services and rely on top computer executives as key informants to measure the degree of relationship-specific assets for nine information services through a mailed survey. Similarly, Anderson and Schmittlein test a model of integration of the sales force and rely on the judgment of sales managers to measure asset specificity of several electronic components.

The survey designed for this study required each loan officer to rate the level of asset specificity of the assets involved in the production of each agricultural product. Based on the literature review, I identified key dimensions in the assessment of collateral that are related to the concept of asset specificity. Each respondent was asked to name up to ten farm activities with which they were familiar. The respondents rated each farm activity across seven questions that cover four types of assets specificity—physical, temporal, site, and human. Questionnaire items were measured using a 7-point scale in which '1' represented 'low degree' and '7' represented 'high degree.' Table 1 reports the survey questions used as indicator variables for asset specificity.

Table 1. Survey questions used as indicator variables for asset specificity.

Variable	Survey question	Scale
Salvage value	To what degree would assets in this farm activity lose value in the event of bankruptcy (consider all assets as a bundle)?[/1]	1 to 7
Switch costs	How costly would it be for the producer to switch where they sell their product (consider all costs, including time and resources to find new buyers)?[/2]	1 to 7
Activity specific	To what degree are facilities and equipment used in the production process specific to this product (specialized/single use facility and equipment)?	1 to 7
Bargaining problems	How important are bargaining problems caused by small numbers of potential buyers (concentration in buyer´s market)?	1 to 7
Temporal specificity	How important is timely delivery of this product to processors/distributors (consider the time period within which the product must be sent to buyers)?	1 to 7
Site specificity	How important is it to be close to buyer's facilities for this product (consider the distance between farmers and buyers)?	1 to 7
Human-asset specificity	To what degree are skills, knowledge, or experience of the farmer/ manager, specific to this production activity and to particular buyers?[/1]	1 to 7

[/1] Adapted from Masten et al. (1991)

[/2] Adapted from Poppo and Zenger (1988)

To compare responses and identify potential differences among respondents, the following demographic questions were also included in the questionnaire. In what year were you born? What is the highest degree you have attended? How many years of experience do you have in the agricultural lending industry? To get a sense of the credit officers' farm background, the following questions were asked: Are you involved in farm production? Or, were you raised in a farm?

3.3 List of agricultural activities

An additional challenge is related to the coexistence of different productive technologies within an agricultural activity. For example, some dairy farms use confinement systems whereas others use pasture-based technology. A similar division can be found in beef production with feedlot versus grass-finished systems. In addition, a poultry farm can use either a caged or caged-free production system. These different technologies involve significantly different assets and, hence, it can be expected that the overall degree of asset specificity for the farm activity will vary depending on the production technology chosen. For that reason, for some farm activities I include variants depending on whether multiple production technologies of production exist.

The survey contains a list of 40 agricultural production activities. This list was obtained by using SIC (4-digits) and NAICS (6-digits) industry classification and additional variants for agricultural outputs produced with different productive technologies. Specifically, cases including variants as follows:

i. Beef cattle-feedlots and beef cattle pasture-based;
ii. Dairy –confinement and dairy – pasture-Based;
iii. Broiler-caged, and broiler-cage-free.

Table 2 report the list of farm activities and their industry classification codes.

Table 2. List of farming activities: SIC and NAICS codes.

	Group	Farm Activity	NAICS 2002	SIC (4-digits)	SIC (8-digitis)
1	Cash Grains	Corn Farming	111140	0111	
2		Rice Farming	111160	0112	
3		Soybean Farming	111150	0115	
4		Wheat Farming	111110	0116	
5		Barley Farming	111199	0119a	01190401
6	Field Crops	Cotton Farming	111920	0131	
7		Peanut Farming	111992	0139c	01390201
8		Potato Farming	111211	0134	
9		Sugarcane Farming	111930	0133a	01339902
10		Tobacco Farming	111992	0132	
11		Hay Farming	111940	0139b	01390104
12	Fruits and Tree Nuts	Berry Farming	111333, 111334	0171	
13		Deciduous Tree Fruits	111332	0172	
14		Grape Vineyards	111335	0173	
15		Orange Groves	111310, 111320	0174	
16		Tree Nut Farming	111331, 111339	0175	
17	Under cover	Mushroom Production	111411	0182a	01820103
18		Food Crops Grown Under Cover (vegetables, hydroponic, other)	111419	0182b	01820101, 01820104/5/6, 01829901/2/3
19		Nursery and Tree Production	111421	0181a	01810100
20		Floriculture Production	111422	0181b	01810200
21	Livestock	Beef Cattle Feedlots	112112	0211	
22		Beef Cattle, Pasture-Based	112111	0212	
23		Hog and Pig Farming	112210	0213	
24		Sheep/Goat Farming	112410, 112420	0214	
25	Dairy	Dairy Cattle and Milk Production, Confinement	112120	0241a	
26		Dairy Cattle and Milk Production, Pasture-Based	112120b	0241b	
27	Poultry and Eggs	Broiler Caged	112320	0251a	
28		Broiler Cage-Free	112320b	0251b	
29		Chicken Egg Production	112310	0252	
30		Poultry Hatcheries	112330	0253	
31		Turkeys and Turkey Eggs	112340	0254	
32	Animal Specialties	Apiculture	112930	0271	
33		Finfish Farming and Fish	112920	0272	

		Hatcheries		
34		Fur-Bearing Animal and Rabbit Production	112511	0273, 0921
35		Horse and Other Equine Production	112512	0273
36		Shellfish Farming	112910	0279
37	Commercial Fishing	Finfish Fishing	114111	0912
38		Shellfish Fishing	114112	0913
39	Forestry	Forest Nurseries and Gathering of Forest Products	113110	0811
40		Timber Tract Operations	113210	0831

SIC: Standard Industrial Classification; NAICS: North American Industry Classification System

3.4 Data and Sample

Sample

The survey was mailed to a sample of commercial banks and credit organizations of the Farm Credit System in April 2011.[10] The reason I selected a sample of credit officers in both types of credit organization is to account for potential differences in the responses on the asset specificity variables by farm activities. However, it is important to highlight that the survey questions do not explore specific characteristics on the assessment of collateral of each credit organization. This is important for two reasons; first, because the survey strategy does not intend and is not design to perform a comparative analysis of the difference between FCS and commercial banks. The purpose is to assess four types of asset specificity variables using credit officers as key informants. Second, because the type of information requested from each credit officer does not require them to reveal lending policies of their organization

[10] This method is aligned with previous studies on agricultural lending assessment such as Featherston Wilson, Kastens, and J. Jones (2007), that surveyed credit officers.

The Farm Credit System has 93 credit organizations that are direct-lending associations affiliated with one of the five Farm Credit banks.[11] According to the Federal Deposit Insurance Corporation, there are 1566 commercial banks in the United States with agricultural loans comprising at least 25% of total value of loans.[12] Commercial banks and the Farm Credit System accounted for over three quarters of the U.S. farm sector's loan volume (45 and 36 percent, respectively) in 2007 (Harris, et al. 2009).

The sample contains 300 credit officers and was selected as follows. I selected two bank branches for each of the 93 Farm Credit System (FCS) Associations from the National Directory of the Farm Credit System 2008-2009, an annual publication of FCCServices, Inc. This method was chosen on account of the important penetration that FCS associations have in the United States (i.e., they cover all states). Deliberately selecting from the larger population allowed me to give priority to the areas where lending services are most important. Once I selected the branch, I obtained credit officers' contact information from the National Directory of FCS or from the branch's website. I contacted the branch manager when credit officer contact information was not directly available. As reported in Table 3, the survey was sent to 184 credit officers of the Farm Credit System, covering 38 different states.

For the selection of a sample of credit officers from agricultural commercial banks, I relied on the geographical distribution of the previously selected sample of FCS

[11] AgFirst Farm Credit Bank; AgriBank, FCB; Farm Credit Bank of Texas; CoBank, ACB; and U.S. AgBank, FCB. The last two recently merged.

[12] The number of agricultural banks varies with the definition that is adopted. For example, according to the Federal Reserve, an agricultural credit banks has an agricultural loan ratio greater than the average for all commercial banks (on 6/30/2002 was 14.97%). For the purpose of this study, the cutting point of 25% used by the Federal Deposit Insurance Corporation is more appropriate because loan officers need to be familiar with lending projects in the agricultural sector.

banks to select a sample of commercial banks. This was done by matching the geographical location of the FCS sample at the county level with the directory of commercial banks. Contact information for commercial banks was obtained from the directory of agricultural banks of the Federal Deposit Insurance Corporation (FDIC).[13] However, because some counties do not have an agricultural commercial bank listed in this directory, not every bank in the FCS sample was matched with a commercial bank. I sent the survey to 116 credit officers of commercial banks, covering 30 different states.

It is important to mention that banks within the Farm Credit System focus mainly on the agricultural sector, whereas this is not necessarily the case for the commercial banks. Although the latter are classified as agricultural banks, the portfolio of loans in the agricultural production sector can be as low as 25%. This reality justifies the procedure of selecting the sample of credit officers from the geographical distribution of the banks within the Farm Credit System first and then using the geographical location of this sample to select the sample of commercial banks, not the other way around.

An alternative technique in surveying key informants is to define the population and response rates based on a sample of those who pre-commit to respond. This way, response rates are high, but population selection bias might be introduced. To avoid this bias, I chose to mail surveys to a randomly selected sample as describe above.

Survey responses

Table 3 reports the sample of credit officers to whom the survey questionnaire was mailed and the response results. The survey was mailed to 300 credit officers in 38

[13] Available at http://www2.fdic.gov/idasp/main.asp

different states in the U.S.. Out of 288 deliverable surveys (12 envelopes returned because of wrong address), I received 50 responses from credit officers, resulting in a response rate of 17.4%.[14] It is important to highlight that, as described in next subsection, the unit of analysis for the cluster analysis performed in this study is the farm activity and not each credit officer response. Each credit officer rated, on average, 7 from a list of 40 farm activities which gives a total number of 319 observations. A copy of the survey is reported in Appendix A.1.

Table 3. Credit officers survey: response results

	Credit Officers (N)	Coverage of US States (N)
Farm Credit System	184	38
Commercial Banks	116	30
Total Sample (mailed out)	300	38
Undeliverable (return to sender)	12	
Total deliverable sample	288	38
Surveys responded	50	more than 22 [/a]
Response rate	17.4%	

[/a] Based on the 30 respondents that provided contact information. These respondents cover 22 States.

The survey was mailed out and collected between April 14 and June 14, 2011. The 300 surveys were mailed on April 14, and a first reminder was sent by e-mail on May 3 to 191 credit officers in the sample (those for whom I was able to obtain e-mail

[14] This response rate is quite consistent with other studies. For example, Poppo and Zenger (1998) obtained 181 responses out of 3000 mail surveys. They argue that their response rate is consistent with studies which use precommitment techniques (cf, Anderson and Narus 1990; Mohr and Spekman 1994). As mentioned, with precommit technique, response rates are high, but bias is introduced potentially through population selection.

contacts using the directories and extensive searching in their organizations' web sites). A second reminder was sent on May 16 to 184 contacts in the sample.

Of the 50 returned questionnaires, 48 were usable and contained a total of 319 case observations. A case refers to one individual respondent's assessment of a farm activity (see Table 4). These observations cover 40 farm activities and, as expected, the number of responses per farm activity varies. Whereas some farm activities (e.g., corn, beef cattle-pasture-base, hog) were selected and rated by most credit officers, other farm activities with less economic importance or more dense geographic concentration received fewer responses (e.g., sugarcane, sugar beet, fur-bearing animal and rabbit). Although the variation in the number of responses per farm activity is a natural consequence of the distribution of farm activities, it limits the statistical analysis for some farm activities. To mitigate this situation, I asked a regional manager at FCS for contacts of credit officers that had lending experience in the following farm activities that by May 14 I had gotten few responses: finfish fishing; floriculture production; orange groves. Through this procedure, I received eight contacts from FCS and sent them the survey questionnaire. The total sample of FCS reported in the Table 3 includes these contacts.

Table 4. Summary of survey responses: returned questionnaires, total number of cases, responses per farm activity, and number of farm activities rated per respondent.

Usable returned questionnaires (N)	Cases /a (N)	Farm activities (N)	Responses per farm activity (average) /b	Num. of farm activities rated per respondent (average)
48	319	40	8	7

/a A case refers to one individual respondent's assessment of a farm activity
/b Min=1, Max=30

In relation to the quality of the responses, it is important to recall that the information collected in this survey does not refer to characteristics of the respondents and does not request information on respondents' credit organizations. As explained above, respondents were asked to rate seven questions on the ten agricultural products that they were most familiar with, the survey was short (4 pages including the cover letter), and it could be completed in less than 25 minutes. In addition, respondents had the opportunity to respond anonymously, in which case I would be unable to identify them or their organization. Given these features of the survey design, there are no apparent incentives for respondents to provide inaccurate information. This statement was confirmed by three interviewed credit officers who considered that, based on the requested information, there was no reason why a credit officer would not respond (other than not choosing or being able to devote their time).

Table 5 reports the respondents' demographic characteristics by type of credit organization—Farm Credit System and agricultural commercial bank. I perform a mean test on these variables to examine whether the demographic characteristics of the credit officers present important differences between type of credit organization. The main result from this table is that there are no statistical differences on the demographic variables among respondents from FCS and commercial banks. An average respondent is a credit officer of 48 years old, with more than 23 years of experience in the agricultural lending industry, and has some farm background. His or her education level corresponds to one person that has attended slightly more than college undergraduate degree.

The bottom part of Table 5 reports descriptive statistics and mean tests of the responses by credit organization for two farming activities (corn and beef pasture-based)

and three questions (salvage value, temporal specificity, and site specificity). The purpose here is to check if the responses on the asset specificity variables by credit organization differ significantly. For illustration, I selected two farm activities with high number of responses from credit officers in both types of credit organizations. The main result from the bottom part of Table 5 is that, for most variables, there are no statistically significant differences in the assessment of the asset specificity variables among respondents from FCS and commercial banks.

Table 5. Credit officer's demographic characteristics and responses on selected asset specificity questions by type of credit organization

Organization	Respon-dents (N)	Age (mean)	Education (mean)[/a]	Years of experience (mean)	Have farm background[/b] (%)
Farm Credit System	27	47.2	2.4	22.6	81%
Commercial Bank	6	51.0	2.2	28.2	100%
mean test (FCS v. ComBanks)[/c]	--	N.S.	N.S.	N.S.	**
Did not report organization's membership	15	48.6	2.1	22.7	93%
Total	48	48.1	2.3	23.4	87%

	Respon-dents (N)	corn farming[/d]			beef (pasture-based)[/d]		
		salvage value	temporal specificity	Site spe-cificity	salvage value	temporal specificity	Site spe-cificity
Farm Credit System	13	2.9	3.6	3.9	3.0	3.6	3.5
Commercial Bank	6	3.5	1.7	2.8	3.8	4.0	4.0
mean test (FCSv.ComBanks)[/c]	--	N.S.	***	N.S.	N.S.	N.S.	N.S.
Total	19	3.1	3.0	3.6	3.2	3.7	3.6

* Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level. N.S.= Difference not statistically significant

[/a] The highest education degree that the respondent has attended. 1=High school; 2=College; 3=Master/MBA; 4=Doctorate

[/b] Question: Are you involved in farm production? Or, were you raised in a farm?

[/c] Two-sample t-test with unequal variances.

[/d] For illustration I selected two farming activities with high number of responses from credit officers in both types of credit organizations (corn and beef pasture-based) and three questions. Table 1 reports the survey questions.

Variables

Table 7 reports summary statistics of survey responses by farm activity and includes correlation coefficients. Questions 1 through 4 are related to physical-asset specificity. The variables given by Question 1 (salvage value) and Question 3 (switching costs) are a straightforward measures of physical-asset specificity and were validated in Masten et al. (1991) and Poppo and Zenger (1998), respectively. Question 2 (activity

specific) and Question 4 (small numbers bargaining problems) provide (together) a measure of physical-asset specificity. That is, a high level of asset specificity occurs when a farm activity involves facilities and equipment that are specific to a certain product and existence of small number of potential buyers.

The correlations among the four indicators for physical-asset specificity are between 0.40 and 0.62 (first panel in Table 7). Although these coefficients denote a statistically significant correlation among these variables, the values indicate moderate correlation (Hinkle, Wiersma and Jurs 1988). The positive correlation, as a measure of the degree of linear relationship between two variables, indicates that, for example, if the assets of farm activity lose value in the event of bankruptcy ('salvage value') the costs of switching where the products are sold is expected to be high ('switch costs'). The lack of strong correlation among the four indicators of physical-asset specificity illustrates the measurement problem that empirical research has often faced. Moreover, finding a weaker than expected correlations supports the strategy of multiple measures as opposed to using a single variable in this study.

To mitigate potential measurement problems I use the information contained in these four questions to derive a multidimensional measure to be used in the empirical analysis. Further support for combining the measures was obtained by conducting factor analysis for the four physical-asset specificity measures.[15] One factor was revealed with Cronbach's alpha (reliability) of 0.79, which indicates between adequate and very good degree of internal consistency (Kline 2011, p. 70). Therefore, a measure of physical-asset

[15] Extraction method: principal component analysis.

specificity was computed from the mean of the following four variables: Question 1 to Question 4.[16] The remaining analysis employs this combined index exclusively. The computation of the physical-asset specificity construct was based on the weighted sum scores method where factor loading of each item is multiplied to the scaled score for each item before summing. Table 6 reports these factor scores. One advantage of this method over sum of scores with equal weights is that items with the highest loadings on the factor would have the largest effect on the factor score (DiStefano, Zhu and Mîndrilă 2009). To allow comparisons with the other types of asset specificity variables, the 1 to7 metric was kept.

Table 6. Factor analysis: component score coefficient matrix.[/a]

		Component
	Indicator	1
Q1	Salvage value	.303
Q3	Switch costs	.339
Q2	Activity specific	.330
Q4	Bargaining problems	.302

[/a] Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaïser Normalization.

The other three types of asset specificity (site, temporal, and human) are computed based on one survey question each. Ideally, I would use information from more than one question to compute these variables to minimize measurement errors as I did for

[16] The four questions associated with physical asset specificity are approached as indicators of the same construct, which is relationship-specific investment in physical assets. Given that this survey's goal is to asset the level of physical asset specificity in 40 industries, I cannot rely in a single question designed for a particular context. This supports the use of the questions used by Poppo and Zenger (1998) and by Masten et al. (1991), as opposed to select the most appropriate question for industries in agriculture. As explained above there are important differences among industries in this sector.

asset specificity. However, adding more questions to the questionnaire would reduce the response rate.

The second panel in Table 7 reports summary statistics and correlations of the four types of asset specificity variables used in the cluster analysis. The correlation between site- and temporal-asset specificity is moderate positive (0.58), which indicates that those farming activities where timing factors create temporal specificities (high temporal-asset specificity), are also likely to be associated with incentives for sellers and buyers to locate their facilities close to each other and, hence, creating site-specificities (high site specificity).

Table 7. Summary statistics of survey responses by farm activity: mean values, standard deviation, and correlation coefficients.

	Ques-tion	Variable	N	Mean	s.d.	1	2	3	4	5	6	7
1	Q1	Salvage value	319	4.02	1.85							
2	Q3	Switch costs	319	3.49	1.89	.40**						
3	Q2	Activity specific	319	4.64	1.86	.53**	.62**					
4	Q4	Bargaining problems	316	4.14	1.86	.42**	.49**	.45**				
5		Physical-asset specificity (Construct)	316	4.08	1.47	.73**	.81**	.85**	.73**			
6	Q5	Temporal specificity	319	4.41	1.98	.31**	.56**	.55**	.48**	.61**		
7	Q6	Site specificity	319	4.18	1.58	.15**	.40**	.34**	.37**	.40**	.58**	
8	Q7	Human-asset specificity	312	4.98	1.57	.36**	.41**	.47**	.34**	.50**	.42**	.44**

N=319. Spearman's rho correlation.

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

3.5 Taxonomy and cluster analysis techniques

There are two basic approaches to classification—typology and taxonomy. A typology is generally multidimensional and conceptual, meaning that it is a classification where the cells of the typology represent concepts rather than empirical cases. Taxonomies differ from typologies in that they classify items on the basis of observable and measureable characteristics. Moreover, taxonomies are, in general, hierarchical (as in family, genus, species) (Bailey 1994, p. 6). However, this is far from a universal distinction in social sciences research. For convenience, the term "taxonomy" is used in this study as defined above.

The important step for a successful classification is the ability to identify the key variables on which the classification is to be based. For this task, there is no specific formula for identifying key characteristics; rather, three approaches coexist—inductive, deductive, and cognitive (Ketchen and Shook 1996). In this study, I base the identification of the key variables on the Transaction Cost approach and use empirical data and quantitative analysis to construct the taxonomy.

Cluster analysis has been a popular method in research areas such as strategic management, where the emphasis is to identify groups of similar individuals or organizations. This technique takes a sample of elements (e.g., individuals, organizations, industries) and groups them such that the statistical variance among elements grouped together is minimized while between-group variance is maximized. More importantly, cluster analysis permits the inclusion of multiple variables as sources of configuration definition.

Some concerns or unresolved issues have been identified in cluster analysis. Ketchen and Shook (1996) summarize the main concerns regarding use of the technique in strategic management research. A major issue is that cluster analysis can impose groupings where none exists. A second issue is that the selection of appropriate clustering algorithms is critical to the effective use of cluster analysis. Different groups emerge from different choices of the rules, i.e., procedures followed to sort observations. A third unresolved issue in cluster analysis regards the choice of a stopping rule, which is a criterion to determine the number of clusters.

On the selection of clustering algorithm, not only is there no consensus among cluster experts but each method is questionable because each one has limitations (Ketchen and Shook 1996). There are two basic types of algorithms to develop cluster solutions—hierarchical and nonhierarchical. The hierarchical method involves successive clustering and re-clustering of individuals elements by adding them (agglomerative) or deleting them from (divisive). In nonhierarchical methods (also known as K-means), a data set is divided into a prespecified number of groups. Therefore, as opposed to hierarchical methods, the number of clusters must be known *a priori*. Nonhierarchical methods have the following advantages over hierarchical ones. First, the cluster solution is less influenced by outliers because this method allows observations to switch cluster membership. Second, the final cluster solution optimizes within-cluster homogeneity and between-cluster heterogeneity because this method allows multiple rounds through the data.

While there are several concerns to be addressed when using cluster analysis, there are also multiple procedures in cluster analysis that help to mitigate some of these

concerns and provide greater validity and robustness in the analysis. For example, rather than selecting a single best algorithm or method, cluster researchers promote the use of multiple procedures for a single research problem (Denzin 1978, in Ketchen and Shook 1996).

Ketchen and Shook (1996, p. 446) review the literature on cluster analysis and state that the solution advocated by experts (Punj and Stewart 1983; Hair, et al. 1992) is the to use a two-stage procedure where "a hierarchical algorithm is used to define the number of clusters and cluster centroids; these results then serve as the starting points for subsequent nonhierarchical clustering." To obtain the improvement of the nonhierarchical requires *a priori* knowledge of the number of clusters. In that respect, the best results may be obtained by using hierarchical and nonhierarchical methods in tandem.

In keeping with the recommended approach, I use the two-stage cluster procedure in this study. The task is to analyze the survey data for each farm activity and to place farm activities into groups on the basis of their degree of similarity/dissimilarity in the several attributes of the assets involved in the production process. In order to examine differences in the attributes of the assets involved among farm activities, individual credit officers' responses were aggregated by farm activity. That is, I compute the mean response for each farm activity on each of the four asset specificity variables. As a result, the cluster analysis procedure is performed on the mean values of each farm activity.[17]

[17] A similar treatment of the data set is found in Ng, Westgren, and Sonka (2009). They use cluster analysis to place 11 firms into strategic groups on the basis of their degree of similarity, or dissimilarity, in 16 competitive attribute ratings. They survey members of the swine genetic value chain and each respondent was asked to name up to eight swine genetic firms with which they were familiar with and to rate, for each firm, 16 competitive attributes. Cluster analysis procedure was performed on the mean response for each firm's attribute.

Two important decisions need to be made. The first regards which agglomerative algorithm to be used in the hierarchical method. Of the several hierarchical algorithms for computing distance between two clusters (each with its own strengths and limitations), I use two algorithms that are widely applied—complete linkage (also labeled as furthest neighbor) and average linkage (between-groups linkage or UPGMA) based on Euclidean distance. In complete linkage, the distance between groups is defined as the distance between the most remote pair of individuals. It requires that potential members of a cluster bear similarity to all members of the cluster. In average linkage, the distance between groups is given by the average of all inter-individual distances, using pairs of individuals, each individual being from a different group. This method uses information about all pairs of distances, not just the one of the most remote pairs, as the complete linkage method does (Landau and Everitt 2004).

For robustness, I compared the cluster solutions from these two hierarchical methods. Then I compare the clusters solutions from the hierarchical and the nonhierarchical (K-means) methods. For this comparison, I relied on Goodman-Kruskal lambda test as a measure of the degree of association or similarity between both cluster solutions. This statistic (lambda) has a range between 0 and 1, where 0 indicates perfect non-relationship and 1 indicates perfect relationship.

The second decision is to choose the criteria to identify the number of clusters in the solution. A common technique employed to define the number of clusters is visual inspection of dendrogram. Specifically, researchers examine the incremental changes in the distance between two merging clusters, where a sudden increase in the size of the difference in adjacent steps indicates that dissimilar clusters have been merged. Hence,

the appropriate number of clusters is given by the step prior to that clustering step (Landau and Everitt 2004).

4 RESULTS AND DISCUSSION

4.1 A taxonomy of farm businesses

Cluster results

I used cluster analysis to examine the survey data for each farm activity and to place farm activities into groups on the basis of their degree of similarity/dissimilarity in the four attributes of the assets involved in the production process. I run this analysis for 31 farm activities that were rated by at least three credit officers.

The two hierarchical procedures—complete linkage and average linkage (between-groups) provide almost identical cluster solutions. I identified six groups of farm activities based on the examination of the incremental changes in the Euclidean distance between two merging clusters (agglomeration schedule). Table 11 in the Appendix reports the agglomerative hierarchical clustering process for two methods—complete linkage and average linkage. As explained in Section 3.5, I examined the incremental changes in the distance between two merging groups, where a large increase implies that dissimilar clusters have been merged (Hair, et al. 2010). A large increase occurs in step 26, which indicates step 25 as an appropriate cluster solution.

Table 8 reports the Goodman and Kruskal (G-K) lambda test results which indicates that the cluster solutions of these two procedures have perfect relationship (Lambda statistic=1.0).

Based on the cluster cutoff determined though the hierarchical procedure, I used the nonhierarchical K-means procedure prespecifying six cluster solutions. The comparison between complete linkage and K-means procedures is also reported in Table 8 and indicates a strong relationship (Lambda statistic=0.84). This result indicates that the cluster solutions are robust and are not sensitive to changes in the cluster method.

Table 8. Comparison between complete linkage and K-means procedures: G-K Lambda test statistics (symmetric)

Comparison	Lambda	Significance
Complete linkage and K-means (6 cluster cutoff)	0.842	0.000
Complete and Average linkage (6 cluster cutoff)	1.000	0.000

Based on the discussion on cluster analysis in the Methods section, I followed a two stage procedure to obtain the best cluster solution. One of the premises discussed is that K-means offers improvement but requires one to know *a priori* the number of clusters. For that reason, I use the cluster solution obtained with the K-means procedure for the empirical analysis.

Table 9 reports the membership of each farm activity to the six clusters identified and the mean scores of the cluster members on the four asset specificity variables. Mean test of cluster groups are also reported in this table to show in which asset specificity variable the different cluster groups have statistical differences.

Table 9. A taxonomy of farm activities: Cluster results and mean values for the asset variables by cluster group. K-means cluster procedure.

		asset specificity (mean)[/a]			
Cluster	Farm activity	physical	temporal	site	human
#1	Broiler (Cage-Free)	6.6	6.3	6.7	6.7
mean test: significance (Cluster #1 vs #2)		0.02**	0.95	0.23	0.17
#2	Berry Farming Food Crops Grown Under Cover Shellfish Fishing	4.5	6.4	5.9	5.5
mean test: significance (Cluster #2 vs #3)		0.01***	0.03**	0.00***	0.55
#3	Broiler (Caged) Chicken Egg Production Dairy (Confinement) Dairy (Pasture Base) Deciduous Tree Fruits Finfish Fishing Floriculture Production Hog and Pig Farming Nursery and Tree Production Potato Farming Tobacco Farming	5.2	5.7	4.4	5.7
mean test: significance (Cluster #3 vs #4)		0.00***	0.00***	0.52	0.20
#4	Beef Cattle Feedlots Orange Groves Peanut Farming Rice Farming Sheep/Goat Farming Tree Nut Farming	3.9	4.5	4.6	5.4
mean test: significance (Cluster #4 vs #5)		0.56	0.00***	0.20	0.89
#5	Cotton Farming Horse and Equine related	4.2	3.6	3.4	5.2
mean test: significance (Cluster #5 vs #6)		0.12	0.02**	0.54	0.01**
#6	Barley Farming Beef Cattle, Pasture Base Corn Farming Hay Farming Soybean Farming Timber Tract Operations Turkeys and Turkey Eggs Wheat Farming	3.2	3.2	3.8	4.1
	Mean (all 31 farm activities)	**4.4**	**4.8**	**4.4**	**5.2**
	Standard Deviation	1.0	1.3	0.9	0.8

Mean test: Two-sample t-test with unequal variances. p-values reported.

* Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level.

[/a] Represents the average values for each group of farm activities. The asset specificity variables were measured on a 7-point scale in which '1' represented 'low degree' and '7' represented 'high degree.'

Discussion

The six identified clusters represent a distinct composition of the assets involved in the production process. Table 10 summarizes the characteristics of the six types of farming activities based on the four types of asset specificity. In this table, I also report the percentage of production under contracts (marketing and/or production) and the percentage of the total value of production explained by nonfamily farms. Since nonfamily farms are related to the use external equity capital, these statistics allow to see check the relation between the groups of farm activities and the organization of agriculture.[18]

When using cluster analysis, boundaries among groups are, in general, difficult to establish from the cluster output because each cluster might have "outliers". Figure 1 reports a plot comparing cluster groups, with farm activities' mean values on site-temporal asset specificity (combined) and physical-asset specificity. This plot shows that it is possible to distinguish distinct groups and that the presence of outliers is not a problem for the interpretation of this cluster output. This desirable property of the identified cluster groups can be attributed to the two-stage cluster procedure that, as discussed in the methods section, allows to exploit the advantage of the nonhierarchical method in the treatment of outliers. That is, by allowing observation to switch cluster membership, nonhierarchical methods are less impacted by outliers (Hair, et al. 2010).

[18] Note here that nonfamily farm according to the ERS-USDA refer to any farm for which the majority of the farm business is not owned by individuals related by blood, marriage, or adoption.

Figure 1 shows a continuum of farming activities based on the characteristics of the assets involved in the production process. In this graph, I combine site- and temporal-asset specific by computing the mean value and plot this variable with physical-asset specificity. The two extreme points are cage-free broiler with high values both dimensions of asset specificity, and in the lower extreme all the farming activities of Cluster #6 that rely on highly redeployable assets (low asset specificity) and low degree of perishability and low site specificities (e.g., soybean, corn, wheat).

Figure 2 and Figure 3 report similar plots than Figure 1 with different combinations of the four types of asset specificity. Figure 2 reports a plot of physical-asset specificity and human-asset specificity. Figure 3 reports a plot of site-temporal asset specificity and human-asset specificity. The three graphs allow to analyze differences among farm activities based on the four types of asset specificities. More importantly, these graphs show the consistency of the cluster groups identified in this study as a powerful way to group farming activities that are similar in certain attributes of the assets involved in the production process.

Table 10. Taxonomy of farm activities: comparison of cluster groups bases on asset specificity variables, percentage of production under contracts, and value of production by nonfamily farms.

Group	Distinguishing characteristics	Farm activity	Asset specificity[/a]				production under contract [/b]	value of prod. by nonfamily farms [/c]	Production under contract (%) [/b]	value of prod. by nonfamily farms (%) [/c]
			Physical	Temporal	Site	Human				
#1	High asset specificity (all)	Broiler (Cage-Free)	High	High	High	High	NA	NA		
#2	High temporal and site asset specificity	Berry Farming	Medium+	High	High	Medium+	Medium+	High	64%	27%
		Food Crops Grown Under Cover							54%	
		Shellfish Fishing								
#3	Medium-high asset specificity (all types)	Broiler (Caged)	Medium+	Medium+	Medium+	Medium+	Medium+	Medium+	94%	9%
		Chicken Egg Production							94%	9%
		Dairy (Confinement)							59%	15%
		Dairy (Pasture Base)								
		Deciduous Tree Fruits							64%	27%
		Finfish Fishing								
		Floriculture Production								27%
		Hog and Pig Farming							76%	14%
		Nursery and Tree Production								27%
		Potato Farming								13%
		Tobacco Farming							78%	
#4	Medium-low asset specificity	Beef Cattle Feedlots	Medium-	Medium-	Medium+	Medium+	Medium-	Medium+	18%	27%
		Orange Groves							64%	27%
		Peanut Farming							65%	
		Rice Farming							27%	
		Sheep/Goat Farming								21%
		Tree Nut Farming								
#5	In-between	Cotton Farming	Medium-	Low	Low	Medium-	Medium-	NA	45%	
		Horse and Equine related								
#6	Low asset specificity (all types)	Barley Farming	Low	Low	Medium-	Low	Low	Low		
		Beef Cattle, Pasture Base								
		Corn Farming							30%	5%
		Hay Farming								
		Soybean Farming							18%	4%
		Timber Tract Operations								
		Turkeys & Turkey Eggs								
		Wheat Farming							8%	4%

Table notes:

Description based on the mean value of each cluster. High=one standard deviation above from the mean or higher; Low=one standard deviation below from the mean or lower; Medium=between 'Low' and 'High' (one standard deviation away from the mean in either direction); where Medium^{+} and Medium^{-} indicate 'above' and 'below' the mean, respectively.

[a] Based on primary data collected in this research.

[b] Based on ARMS Data 2005 reported in MacDonald and Korb (2008). This is an approximation based on the available information because the contracting data is not available for some farm activities.

[c] Over total farms in each farm activity. Based on ARMS data 2009. This is an approximation based on the available information in the tailored reports because these reports do not cover all farm commodities. http://www.ers.usda.gov/Data/ARMS/app/default.aspx?survey_abb=FINANCE

Figure 1. Plot comparing cluster groups: farm activities' mean values on site-temporal asset specificity vs. physical-asset specificity.

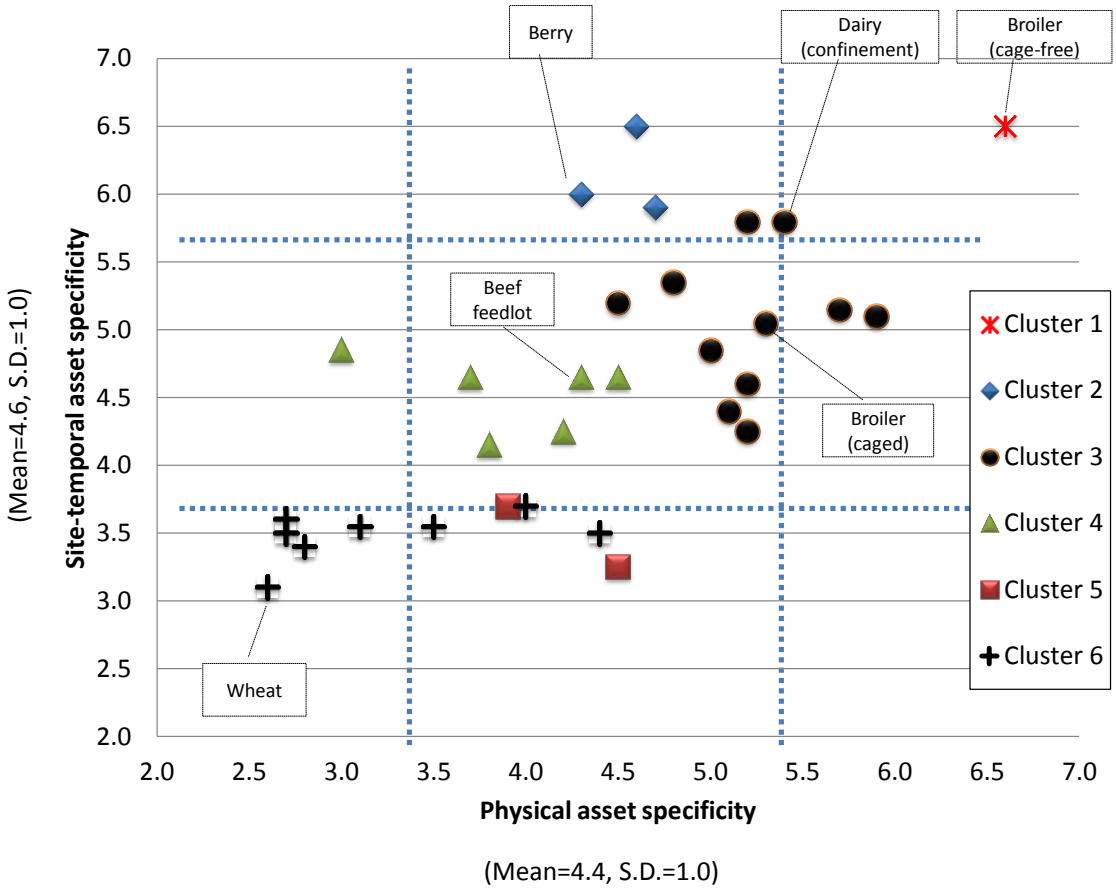


Figure 2. Plot comparing cluster groups: farm activities' mean values on human-asset specificity vs. physical-asset specificity.

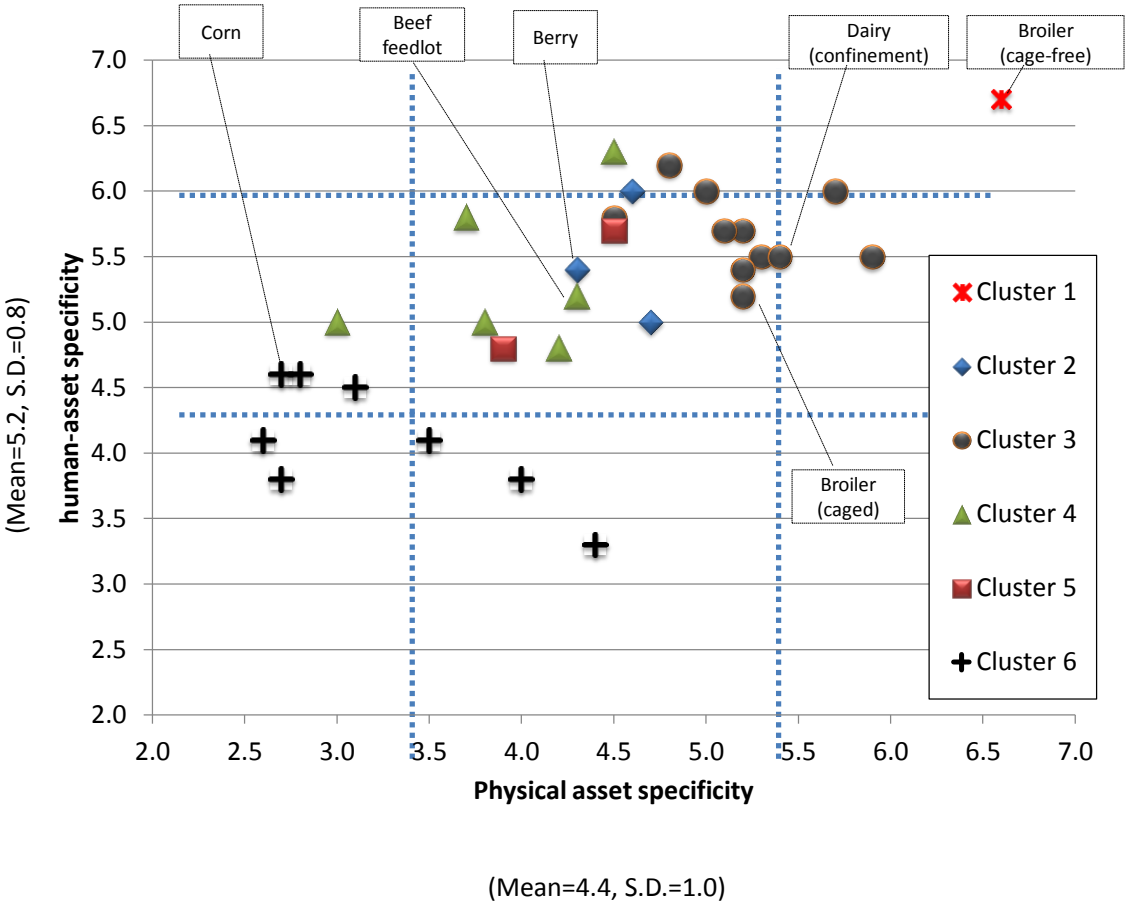
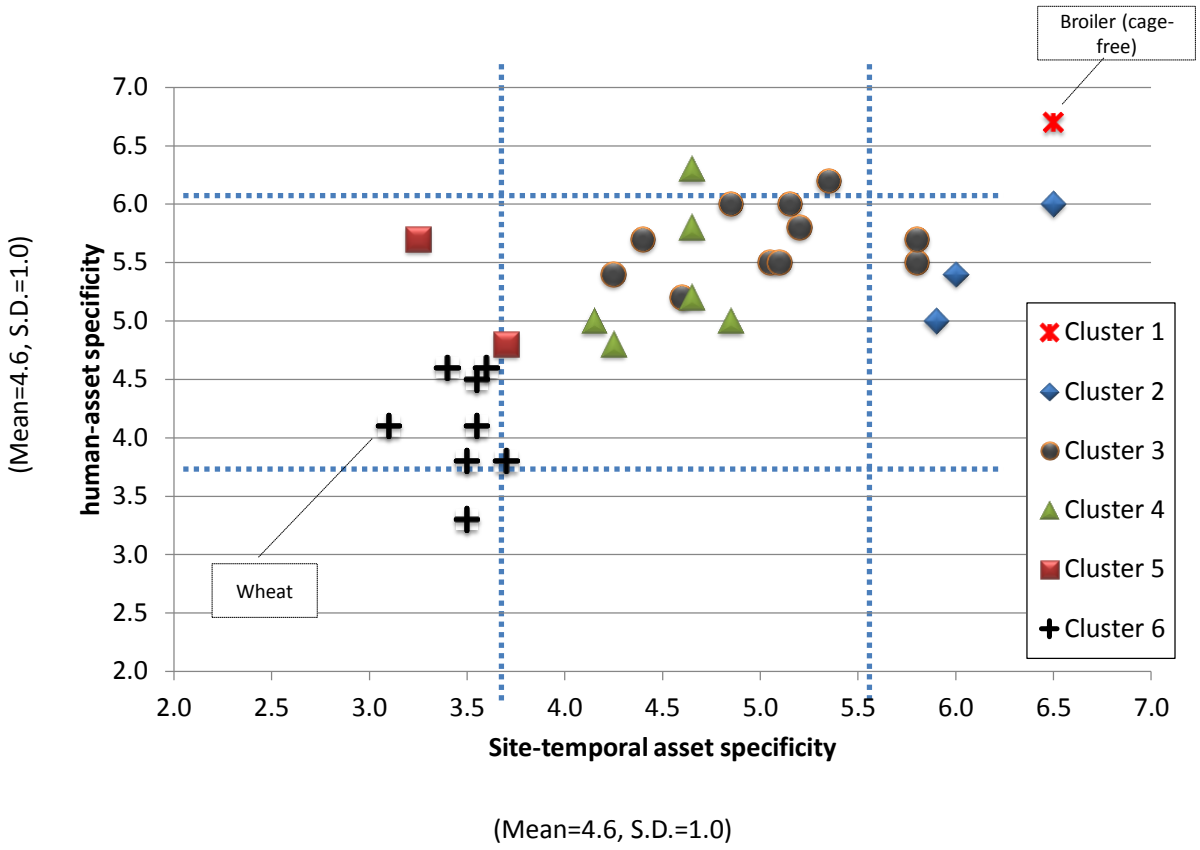


Figure 3. Plot comparing cluster groups: farm activities' mean values on human-asset specificity vs. site-temporal asset specificity.



#1 – High asset specificity (all types)

Farm business in Cluster #1 can be best described as relying on highly nonredeployable assets and involving high temporal, site and human-asset specificities. The presence of a high degree of asset specificity in all four types makes this group a distinct and extreme one.

In the plot presented in Figure 1, cage-free broiler industry is located in upper right corner, which indicates that this industry presents distinctive characteristics when compared to other farm activities based on the two selected types of asset specificity.

Contractual hazard and specialized coordination forms are required to coordinate the production in this industry. Not surprisingly, the broiler industry has received much attention and has been extensively studied within the transaction cost literature (e.g., Ménard 1996; Martinez 1999; Martinez 2002).

#2 – High temporal and site asset specificity

Farm businesses in this group are heavily exposed to perishability problems and site specificities. As discussed above, it is expected that these two types of asset specificity occur simultaneously in farming activities because perishable products might lead to incentives for sellers and buyers to locate their facilities close to each other. These characteristics bring together farm activities that *a priori* might be seen as very different from each other (such as shellfish fishing, berry, and food crops grown under cover). Farm activities in this group share important similarities in the type of organizational problems resulting from their high temporal and site specificities condition.

Farm activities in this group face similar organizational challenges that derive from the connection between perishability and hold-up problems. Postcontractual opportunism emerges from the situation of, for example, producers of perishable commodities in a region with a dominant processor. This exposure to hold ups explains the protective role of agricultural cooperatives in governing transactions of perishable products (Knoeber 1983; Cook 1995). That is the case of bargaining cooperatives in fruit and vegetables. This feature is extended to some of the farm activities in next cluster such as dairy where processing cooperatives dominate in the dairy industry accounting for more than 75% the total milk procurement in U.S., New Zealand, Australia, and most EU-15 countries.

3 – Medium-high asset specificity (all types)

Farm businesses grouped in Cluster #3 can best be described as exposed to several assets specificity problems. As shown in Table 10, based on loan officers assessment farm businesses in this cluster have a "medium^{+}" degree of physical, temporal, and human-asset specificity. That is, the mean value of each type of asset specificity measure for the farm activities in this group ranges between the mean value and one standard deviation above from the mean. A distinctive and important characteristic of this group is that these farm activities do not rely on farmland as the dominant asset. Further analysis on this observation is presented in next section.

Contracts play an important role in the coordination of the production in these farm activities. For example, contracts coordinate above 70% of the production of hog, broiler, and tobacco.

4 – Medium-low asset specificity

Farm activities grouped in Cluster #4 have "medium-low" levels of physical- and temporal-asset specificity. That is, the mean value of each asset specificity measure for the farm activities in this group ranges between the mean value and one standard deviation below from the mean.

The comparison between Cluster #4 and Cluster #3 is clearly represented in Figure 1. Whereas farm activities in both groups are in the middle range of site-temporal specificities, the difference is that farm activities in Cluster #3 have higher degree of physical-asset specificity.

One interpretation of this result is that although farm activities in both groups involve facilities and equipment that are, to some degree, specific to the product

involved, farm activities in Cluster #4 tend to use more land, which is, in general, highly redeployable.

6 – Low asset specificity

Cluster #6 farm activities can be best described as relying on highly redeployable assets and involving low temporal, site and human-asset specificities. This group represents the opposite features of Cluster #1. That is, the combination of low degree of asset specificity in all four types makes this group a distinctive and extreme one that denotes the lower tail in a continuum of farm activities sorted by the degree of asset specificity.

Farm activities in this group form a more homogeneous group where the production process relies heavily on land and multiple purpose assets. All the cash crops are in this group together with pasture-based beef cattle production.

5 – In-between

Farm activities in Cluster #5 have similar characteristics to Cluster #6 but involve less redeployable facilities and equipment and some degree of site specificity. In that respect, this group is best described as an in-between group (between Cluster #6 and Cluster #4). Only two farm activities belonging to this group—cotton farming, and horse and equine related.

Summary

Overall, this taxonomy shows that farm activities constitute a clear continuum on the degree of asset specificity. More importantly, given the theoretical construct and predictions of Transaction Cost Economics, this taxonomy allows us to group farm activities with similar organizational problems based on the characteristics of the assets

involved in the production process. Further comparative analysis within and between these groups can originate useful insights.

This taxonomy contributes to the understanding of the differences among farm activities and calls for further analysis to explore commonalities and comparison between the farm activities in this group and on how agricultural production is organized.

Cross-industry studies have largely relied on industry classification systems such as SIC and NAICS to group industries within major economic sectors. The classification developed here is an alternative way to group industries within the agricultural sector.

The advantage of this classification is that it is based on characteristics of the assets involved in the production process that have been identified as key factors in organizational economic theories such as transaction cost economics and an important stream of empirical research in several industries. That is, this classification is more theoretically sound and group farming activities that share great similarities in terms of the type of investments, contractual risks, and organizational challenges. This aspect facilitates the comparative analysis of industries in this sector.

In addition, farm activities (i.e., industries) that a priori would be approached as distant using for example SIC classification at 4 or 3 digits, might share important similarities in terms of type of investment and contracting or financing challenges. A clear example is given by the farm activities in cluster #2 that includes food crops grown under cover and shellfish fishing. Similarly, farming activities in cluster #3 would be approached as distant industries whereas according to the assessment of credit officers used in this study, have important similarities as far as the attributes of the assets is

concerned. That is the case, for example, of broiler, dairy, floriculture, and potato farming.

Next section discusses the interpretation and potential implications of this taxonomy for the organization of agriculture and, in particular, for the financing of agriculture.

4.2 Farm Financing

As discussed in the Methods section, the main variables used to identify clusters of farming activities were based on Transaction Cost Economics. In that respect, it is possible to analyze the implications that this classification has on the financial characteristics of agriculture. This section relies on insights regarding collateral assessment and lending processes from semi-structured interviews with credit officers from different credit organizations in the U.S.. To capture different aspects of the lending mechanisms, I interviewed credit officers from different credit organizations such as Farm Credit System associations, commercial banks, and also credit organizations that provide short term loans to farmers.

The analysis of farm financing presented here should be interpreted as insights and hypotheses for future empirical tests rather than a conclusive analysis of the farm financing characteristics.

Credit evaluation of farm investment projects

Collateral is a key determinant of the level of debt capital the bank will approve (Gustafson, et al. 1991; Gustafson, et al. 2005). Credit officers take into account factors that affect the value of the assets in the case of failure. In particular, they consider characteristics such as whether the facilities and machinery are single-use versus multiple-purpose, and the number of potential buyers for the assets offered as collateral. These assertions were corroborated in the interviews to credit officers in commercial banks and Farm Credit System.

Multiple-purpose assets such as land are more secured assets because its value does not change in case of default and, hence, it represents low risk collateral from the lender's point of view. Risks associated with collateral increase for depreciable assets such as machinery and equipment. Risks are particularly high for single-purpose assets.

Most interviewed credit officers provided examples like this: when comparing two similar investment projects in different farm activities, for example, confinement dairy versus corn, the loss in case of failure would be higher for confinement dairy. The explanation here is that whereas the assets involved in confinement dairy will lose value in case of failure, the assets involved in the production of corn will most likely keep their value.

In this scenario, the potential buyers for the single-purpose facilities and equipment used in confinement dairy would be restricted to other confinement dairy farmers. Moreover, if the failure is attributed to industry factors (as opposed to management problems), the number of potential buyers will be significantly reduced, being limited to fewer remaining or potential dairy farmers or speculators who can invest

in dairy assets and wait for the recovery of the industry. In any case, it is expected that the assets will lose value.

The problem with single-purpose specialized assets is not only that the number of potential buyers is restricted to other producers in the same industry, but also that the design of specialized assets such as a broiler or hog facility might differ from one farmer to another and, hence, the value of the assets for a different farmer might be lower. A farmer interested in buying those assets might have to make adaptations, which will be an argument to "beat down" the price of those assets. The types of issues described here are unusual for multiple-purpose assets such as farmland.

In addition, credit officers have to reassess collateral in times of distress in a particular industry. In that case, the value of multiple-purpose assets tends to be more stable than single-purpose facilities, which underscores the importance of the attribute of the assets for lending purposes.

A second factor that credit officers look at when evaluating the collateral is the 'risk associated with the commercialization' of the farm product. In certain farm industries, 'counterparty risk' is an important element to be analyzed by the credit officer. That is the case of highly concentrated industries and where marketing contracts and production contracts tend to coordinate the transactions between farmers and processors such as hog and broiler production. That is, in industries where contracting and the relationship with the buyer is important, lenders evaluate not only the farm project and the analysis of the producer operation, but also the viability of the processor and the contract between the farmer and the processor. Some credit officers refer to this factor as

the sixth credit factor taken into account in the credit evaluation process—in addition to collateral, capacity, credit, character, and conditions.

This means that credit officers pursue additional analysis on investment projects in industries that are highly concentrated or farm projects that have long term contractual relationship with the processor. Poultry represents a clear example of this situation, where a producer that is willing to enter the industry can rent or buy a poultry operation but in order to run a business he or she needs a contract with the integrator. The value of the assets might be affected by this condition where lower salvage value is associated with farm activities in which the business project is bounded by the relationship with the integrator.

Dairy activities face a similar situation because the bank might require information about the processor and, in particularly, whether the producer markets the milk through a cooperative or an investor own firm. In the case of an investor own firm, the credit officer might evaluate the relationship with and the viability of the processor. Cotton can be also mentioned as an example if considering the current condition of that industry in U.S. As production returns in some regions where there are no cotton gins, the commercialization and the relationship with the processor becomes a relevant factor for cotton projects.

The counter example is given by cash crops where the relationship with the buyer is not that important for the viability of the farm project.

A third aspect considered by credit officers when assessing the collateral is ‘size of the operation relative to competitors’. Loan officers compare the size of the operation with what is normal for a certain region or according to industry standards. This factor is

related to the likelihood that the operation could be absorbed by its competitors in case of failure.

If an operation has either bigger or smaller size relative to the competitors, the assets will have lower value in case of failure. An example of this situation is given by new dairy operations that involve higher scale of production relative to the existing dairy farms in a given region. If that type of project fails, those operations would not be absorbed by other dairy farmers. This is the case of pasture-based dairy farms run by investors and farmers from New Zealand in southwest Missouri. These operations are larger than the existent pasture-based dairy farms in Missouri and the concern for credit banks is that if this type of enterprise fail, it will be very difficult for other farmers to acquire these operations. Another example would be a new ethanol facility with a scale below the industry standard. From the lenders' point of view, those investments projects involve higher risks because in case of failure, competitors might not be interested or might negotiate down the price due to inefficiencies associated with economies of scale.

Because of these factors, the advance rate for a single-purpose asset tends to be lower than for multiple-purpose ones. Whereas loans approval for 65-70% of appraised value of the collateral in the case of land, this percentage is reduced when less redeployable assets are involved. Hence, farming activities that rely on low redeployable assets will face higher credit constraints to finance their projects.

In addition, it is common for credit organizations to exercise hold positions by commodities or industries. That is, there are limits on the amount of credit to be allocated for certain commodities. Hold positions are determined based on industry analysis/assessment where the risks associated with the collateral is taken into

consideration. Hold positions tend to be low for industries that rely heavily on single-purpose facilities such as hog production and broiler production and high for cash crops. In the processing industries, a clear example of low hold position is the ethanol industry.

The important point to be made here is the high association between the key determinant within the transaction cost approach—relationship specific assets—and the factors taken into account by credit officers when evaluating the collateral in the lending process. As farm activities rely more on assets with low redeployability, the number of potential buyers in case of failure is reduced, which increases the costs of debt capital.

The alternative mechanism for external funding is equity. Although not costless, external equity mitigates part of the problems described above because investors have, in general, control over owner-manager decisions, which provides better assurance properties. In addition, in case of failure outside owners (external equity investor) who participate in other businesses in the same industry or in related industries might be able to repossess and redeploy the assets more efficiently than the bank. Unlike the banks, outside owners can usually wait to sell the assets.

Banks must abide by policies that make debt a more rigid financing mechanism. In that respect, equity investors are more forgiving than banks, which makes this mechanism a better fit for farm projects that, for example, have to afford longer period of bad returns.

Although there is interaction and complementarity among credit factors that banks take into account for lending decisions (e.g., management and collateral),[19] collateral itself serves to distinguish groups of farming activities that involve higher risks from the bank's point of view.

This corroborates for the agricultural production sector the prediction of the transaction cost approach to financing decisions discussed in Section 2.1. When comparing two farm projects that are similar in everything but the characteristics of the assets involved in the production process, the one involving less redeployable assets will face higher credit constraints. Having made this connection for the particular setting of agricultural loan decisions in the U.S., the groups of farming activities identified in this study have important implications to understand the financing characteristics of farming.

The groups of farm activities reported in Table 10 represent a continuum in the probability of a farm project being financed by debt. Farm activities in Cluster #4 (corn, soybean, wheat, barley, hay, beef cattle pasture-based) involve highly redeployable assets, being land the most important one.

Farmland has desirable properties from the lender's point of view, which reduces the risks of lending to these farm activities. Besides the redeployable attribute of farmland that allows to use of this asset for the production of several agricultural products, the non-depreciable attribute of farmland has additional financing implications. Next section presents further analysis on the non-depreciable attribute of farmland that is important to understand what financial mechanism is better for purchasing farmland.

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[19] For example, Berger and Udell (1995) find that borrowers with longer banking relationships pay lower interest rates and have more flexibility in the collateral needed to secure the loan..

Financing properties of farmland

Barry and Robison (1986; 2001) argue that the debt-carrying capacity of non-depreciable assets, farmland in particular, is lower than that of depreciable assets, under traditional loan repayment arrangement. Considering that farm real estate accounted for 87% of the value of total farm assets in 2009 (USDA), it is logical to expect lower aggregate debt-to-asset ratios for the agricultural production sector. For example, the farm sector debt-to-asset ratio was, in 2007, 10% for the U.S. (USDA), 14.6% for the UK and 26.1% for the European Union (FADN).[20] These debt-to-asset ratios for the farm sector are low relative to other economic sectors. For example, this ratio for the corporations in the U.S. food processing and restaurant sectors was, in 2004, 21% and 29%, respectively (Compustat). Similarly, Petersen and Rajan (1994) report average debt-to-asset ratios for over 3,400 small non-farm U.S. companies of 27% for corporations and 24% for sole proprietorships and partnerships in those sectors.

The explanation for this phenomenon is that owning farmland can be a profitable investment, but it will have persistently inadequate cash flows (Oltmans 1995). That is, land is an appreciable asset and the returns from investments in land come in the form of capital gains as well as current income. This makes the purchase of farmland unable to pay for itself on a cash flow basis using debt capital. The financial implication related to these pricing and returning characteristics of farmland in which much of its economic return occurs as capital gains or losses (Barry and Robison 2001) is the following. If debt financing is used to purchase land, down payment amounts reduce liquid reserves.

[20] Farm Accountancy Data Network - FADN

For these reasons, land is more ideally suited to equity financing because it usually carries lower demand on current cash flow than debt financing (Oltmans 1995, p. 62). Purchasing land for leasing purposes has been a mechanism used by external investors (non-farmers) that allows them to diversify their investment portfolio. These features inform why renting land is a way to expand and control additional land. About 66% of medium and large-scale farms in the U.S. own part of the land they operate and rent the rest (Hoppe, et al. 2007). Moreover, approximately 50% of farmland in U.S. and Canada is leased by farm operators and the demand for leased land is growing (Painter 2006).

Two important remarks here. First, the prediction within the transaction cost lens that debt would be suitable for farm businesses that rely heavily on redeployable assets such as farmland does not contradict the analysis of farmland discussed here. Lenders would be willing to support the purchase of land given that those investments are secured by collateral. However, it might be very difficult for an entrant farmer to purchase land with debt, but it might be feasible in later stages for gradual expansion relying on equity for existing landholdings to support the purchase of additional land. The suitability of debt versus equity to purchase land is different for the case of those farmers that obtain the land through heritage. Those farmers might be able to increase the acres of the farm through time using debt capital based on their land as collateral.

Second, the distinctive attributes of farmland and the financing implications discussed here strengthen the effort of distinguishing farm activities based on the attributes of the assets involved in the production process that motivates this study. The literature on agricultural finance usually refers to the farm sector one in which farmland

is the dominant asset. Although this is true at the aggregate level, it ignores important heterogeneity within farm industries and, hence, it can be misleading for some farm activities. The taxonomy of farm activities developed in this study clearly distinguishes farm activities that rely heavily on farmland from farm activities that rely more on other types of investments. Next subsection elaborates on this point.

Cluster groups and farm financing

As discussed above, cluster #6 includes all cash crops, hay, and pasture-based beef cattle production. The salient feature of this group is that the production process relies heavily on farmland and multiple purpose assets. These operations involve low degree of asset specificity, farmland being the most important asset. Farm financing analysis in those industries need to account not only the redeployability attribute of farmland but also the financial implications derived from the non-depreciable and capital gains characteristics discussed above.

The farm activities grouped in the clusters with medium-high and high degrees of asset specificity (Clusters #1, #2, #3 in Table 10) are clear examples of farm activities in which land is not the dominant asset involved in the production process. In that respect grouping farm activities based on the attributes of the farm assets allows for exploring differences within the farm sector and, in particular, understanding better the implications for the use of equity versus debt. Farm activities differ in the attributes of the assets and, hence, in the lending risks associated with the properties of those assets used as collateral.

Farm activities in Clusters #4 and #5 involve low and medium-low degrees of asset specificity and, according to interviewed credit officers, are expected to have better access to debt capital. Although credit officers will also evaluate other credit factors such

as capacity and management abilities to grant credit to a specific farmer, low risk will be attached to the collateral factor.

Farm activities in cluster #3 rely, to a greater extent, on single-purpose assets. That is the case for broiler, hog, floriculture, fruit and tree nut production. Advance rates will be adjusted adversely for these farm activities when compared to cash crop groups in cluster #6 (cash crops). Hence, higher credit constraints are expected for these farm activities.

Farm activities in cluster #2 involve high degrees of temporal and site asset specificity that, from the lender's point of view, increases 'counterparty risk'. Lenders will evaluate not only aspects related to the farm operation and the investment project, but also the relationship with the processor/buyer and its viability. Assets in the farm activities in this group—berry, shellfish fishing, and food crops under cover—lose value in case of failure not only because of their single-purpose condition but also because the relationship with the processor becomes a relevant factor for the farm project. As discussed above, potential buyers in these industries will need not only the facilities and machinery, but also some type of specialized vertical coordination agreement with the processor. As a result, the number of potential buyers will be reduced, which will probably reduce the salvage value of those assets.

The same applies to the farm activity in cluster #1—broiler cage-free. The properties associated with equity might be a better fit for these farm activities when the cost of credit increases or the credit constraints become severe.

Lending approach

Credit organizations differ, among other factors, in the emphasis or importance that they assign to collateral characteristics versus the repayment capacity when granting credit to a farm project. Although credit organizations evaluate both aspects, some financial organizations grant credit more on the basis of collateral values, whereas other banks base their lending decisions more on farm plans and expected profitability and projected cash flow.

This distinction has important implications for the analysis of farm financing mechanisms. The taxonomy developed in this study captures the differences between farm activities based on the attributes of the assets involved and its properties as collateral for lending decisions. That is, this taxonomy is expected to be particularly useful to understand farm financing characteristics and lending decisions of banks focus more on the collateral characteristics when granting credit to a farm. For agricultural banks that rely more on the repayment capacity and less on the attributes of the assets as collateral, the explanatory power of this taxonomy might be lower.

This discussion needs further empirical analysis as it represents a testable hypothesis. Few studies have focused on the analysis of the bank's lending approach, which is surprising given the coexistence of different lending approaches. The agricultural sector in the U.S. is, in particular, an interesting setting for this analysis because different types of credit organizations coexist such as cooperative system (e.g., Farm Credit System), state owned, and regional commercial banks.

5 CONCLUSION

The farming sector has been traditionally approached as a sector with special or idiosyncratic characteristics. The most distinctive one is the exposure to unpredictable shock and random outcomes due to Mother Nature (Holmes 1928; In: Allen and Lueck 1998). A second, important distinction in the literature is the high capital intensity and low asset liquidity (Barry and Robison 2001). This characteristic is related to the dominance of farm real estate in the asset structure, where farm real estate comprises about 80% of total assets from year to year in U.S. farm sector.

The taxonomy developed in this study contemplates and goes beyond the differential attributes of farmland compared to other assets such as buildings, machinery, and equipment. It contemplates the differences in the attributes of the assets involved in the production process among farm activities and focuses on attributes such as redeployability of the assets, perishability, location specificities, and human capital specificities. Overall, this taxonomy shows a clear continuum of farming activities on the degree of asset specificity.

This taxonomy contributes to the understanding of the differences among farm activities and calls for further analysis to explore commonalities and comparison between the farm activities in this group and on how agricultural production is organized.

Cross-industry studies have largely relied on industry classification systems such as Standard Industrial Classification (SIC) to group industries within major economic sectors. The classification developed here offer an alternative way to group industries within the agricultural sector.

The advantage of this classification is that it is based on characteristics of the assets involved in the production process that have been identified as key factors in organizational economic theories such as transaction cost economics and an important stream of empirical research in several industries. That is, this classification is more theoretically sound and group farming activities that share great similarities in terms of the type of investments, contractual risks, and organizational challenges. This aspect facilitates the comparative analysis of industries in this sector.

This study contributes to the movement toward relying less on the traditional approach of treating capital as an undifferentiated kind, and rather, explores the differential redeployability of the assets involved in agricultural production settings. As articulated in the Transaction Cost theory, these attributes are the drivers of organizational choices such as the "make or buy" decisions and the use of alternative financing options.

Two limitations should be considered in future research. One limitation for generalization of the analysis of the financial implications of this taxonomy to other countries is that credit systems in other countries might have broader and more diffuse objectives. Although the assessment of the attributes of the assets involved in the production process of different farm activities could be used in other countries, the financial implications discussed in this study might be affected by the institutional environment and the lending approaches and objectives of the credit organizations. The second limitation is associated with the effect that the cospecialization of assets might have on the lending decision. That is, complementary assets needed to support successful

production or commercialization activities.[21] Credit officers might look at these complementarities when assessing lending projects, which are, in a great extent, not captured in this study.

A final consideration is that differences among firms within farm activities are not captured in the empirical analysis pursued in this study. Although this is not a problem for the present study, as it is the result of the empirical strategy of assessing the degree of asset specificity at the farm-activity (industry) level, future studies might be able to capture both dimensions (differences among firms in the same industry and difference between industries) As explained in the introduction, one of the gaps that motivate this study is the lack of studies exploring the difference between farm activities.

[21] Teece (1986) discusses the effect of cospecialized assets in innovating firms. One example of cospecialized assets provided by Teece is associated with containerization that requires "the deployment of some cospecialized assets in ocean shipping and terminals."

APPENDIX

A.1. Survey Questionnaire

Division of Applied Social Sciences,
Department of Agricultural & Applied Economics
University of Missouri

Peter G. Klein
135 Mumford Hall
Columbia, MO 65211-6200
pklein@missouri.edu
mcquinn.missouri.edu/pklein
573-882-7008

April 14, 2011

Dear Sir/Madam:

I am writing to invite you to participate in a research study sponsored by the McQuinn Center for Entrepreneurial Leadership at the University of Missouri. The study aims to understand better how the capital structure of a farm is affected by the nature of the farm's assets.

Why Did We Contact You With This Survey?

We are particularly interested in the economic concept of *relationship-specific assets.* These are investments that are tailored to particular buyers, suppliers, or partners and hence lose value when certain projects or relationships are terminated. Credit officers have the most knowledge and experience for evaluating assets involved in agricultural production, and we wish to rely on your expertise in measuring and characterizing relationship-specific assets used in the production of several agricultural commodities.

Benefits to Survey Respondents

This research will benefit financial organizations and producers in the agricultural sector. In particular, the results will help us understand the effects of market, industry, and individuals factors in farmers' financial choices. A better understanding of the financing decisions will inform the design of private strategies and public policies to promote economic development in states/regions with comparative advantages in the agrifood sector.

Instructions for Responding to the Questionnaire

We ask you to complete and return the enclosed printed survey **no later than May 20, 2011.** The survey takes approximately 20 minutes to complete. To ensure robust analysis, we ask you to focus on the **ten agricultural products that you are most familiar with.**

Data Confidentiality & Voluntary Participation

Participation in this survey is voluntary and your answers will be held in the strictest confidence. None of the responses will be linked to you or your place of work unless you volunteer that information on the form. Only the aggregate results, and no individual responses, will be shared with outside parties. As such, we do not expect this survey to impose any risks on you or your company.

If you have any questions or requests regarding the research project feel free to contact the principal investigator, Dr. Peter G. Klein at 573-882-7008 or pklein@missouri.edu. Alternatively, if you have questions regarding your participation in this study, you may contact the University of Missouri, Institutional Review Board at 573-882-9585.

Thank you for your participation.

Questionnaire

First, using the list of farm activities reported in the **attached table** (next page), please write below in the column at the left **the 10 farm activities** that you are most familiar with.

Second, for each farm activity, rate each question using a 7-point scale, in which '1' means low degree and '7' means high degree.

	Question 1	**Question 2**	**Question 3**	**Question 4**	**Question 5**	**Question 6**	**Question 7**
	To what degree would assets in this farm activity *lose value in the event of bankruptcy* (consider all assets as a bundle)*?*	To what degree are facilities and equipment used in the production process *specific to this product* (specialized/single use facility and equipment)?	How costly would it be for the producer to *switch where they sell* their product (consider all costs, including time and resources to find new buyers)?	How important are *bargaining problems caused by small numbers of potential buyers* (concentration in buyer´s market)?	How important is *timely delivery* of this product to processors/distributors (consider the time period within which the product must be sent to buyers)?	How important is it to be *close to buyer's facilities* for this product (consider the distance between farmers and buyers)?	To what degree are *skills, knowledge, or experience* of the farmer/ manager, specific to this production activity and to particular buyers?
Farm Activity	1_____7 LowHigh	1_____7 LowHigh	1_____7 LowHigh	1_____7 LowHigh	1_____7 LowHigh	1_____7 LowHigh	1_____7 LowHigh
1)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
2)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
3)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
4)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
5)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
6)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
7)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
8)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
9)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
10)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7

List of Agricultural Production Activities

	Group	Farm Activity
1	Cash Grains	Corn Farming
2		Rice Farming
3		Soybean Farming
4		Wheat Farming
5		Barley Farming
6	Field Crops	Cotton Farming
7		Peanut Farming
8		Potato Farming
9		Sugarcane Farming
10		Tobacco Farming
11		Hay Farming
12	Fruits and Tree Nuts	Berry Farming
13		Deciduous Tree Fruits (apple orchards and other noncitrus fruit)
14		Grape Vineyards
15		Orange Groves
16		Tree Nut Farming
17	Under cover	Mushroom Production
18		Food Crops Grown Under Cover (vegetables, hydroponic, other)
19		Nursery and Tree Production
20		Floriculture Production
21	Livestock	Beef Cattle Feedlots
22		Beef Cattle, Pasture-Based
23		Hog and Pig Farming
24		Sheep/Goat Farming
25	Dairy Farms	Dairy Cattle and Milk Production, Confinement
26		Dairy Cattle and Milk Production, Pasture-Based
27	Poultry and Eggs	Broiler, Fryer, and Roaster Chickens, Caged
28		Broiler, Fryer, and Roaster Chickens, Cage-Free
29		Chicken Egg Production
30		Poultry Hatcheries
31		Turkeys and Turkey Eggs
32	Animal Specialties	Apiculture
33		Finfish Farming and Fish Hatcheries
34		Fur-Bearing Animal and Rabbit Production
35		Horse and Other Equine Production
36		Shellfish Farming
37	Commercial Fishing	Finfish Fishing
38		Shellfish Fishing
39	Forestry	Forest Nurseries and Gathering of Forest Products
40		Timber Tract Operations

Demographic questions:

Question 8: In what year were you born? _____

Question 9: What is the highest degree you have attended?
High school ____; College ____; Master/MBA ____; Doctorate ____.

Question 10: How many years of experience do you have in the agricultural lending industry?
____

Question 11: Farm background. Are you involved in farm production? Or, were you raised in a farm?
Yes ___; No ___.

Follow up participation: If you are willing to respond to follow-up questions, or if you would like to receive a copy of the research report summary, please provide your contact information. Giving us your contact information is completely optional and will not affect the use of your previous responses. Contact information will be kept strictly confidential and will not be included in any published reports or summaries.

Send me a copy of the final report summary: _____

Name: _____

Company: _____

Phone: _____ Email: _____

A.2. List of interviews

- Chad McCollough, FCS Financial, Credit Officer. Maryville, MO.
- Curtis Litchfield, Lando'Lakes, Credit Manager. Cray Sumit, MO.
- Clay Akers., Capital Farm Credit, Senior Credit Officer in Agribusiness. Austin, TX.
- Rich Curtis, Growmark, Senior Credit Officer. Bloomington, IL.
- Robert L. Bock, FCS Financial, Director of Underwriting and Chief Credit Officer. Jefferson City, MO.
- Ronald E. Cobb, FCS Financial, Senior Capital Markets Analyst. Jefferson City, MO.
- Raymond Massey, University of Missouri, Extension Professor, Agricultural and Applied Economics. Columbia, MO.
- David Sparks, CoBank, Regional Vice President, Eastern Division. St. Louis, MO.
- Mike Smith, Rabo Agri-Finance, Senior Vice President Secondary Market. St. Louis, MO.

A.3. Agglomerative hierarchical clustering process

Table 11. Agglomerative hierarchical clustering process: complete linkage and average linkage for farm activity data.

	Complete Linkage (furthest neighbor)			Average Linkage (Between Groups)		
	Cluster Combined			Cluster Combined		
Stage	Cluster 1	Cluster 2	Coefficients[/a]	Cluster 1	Cluster 2	Coefficients[/a]
1	10	11	.22	10	11	.05
2	8	33	.29	8	33	.09
3	27	30	.52	27	30	.27
4	4	17	.61	4	17	.37
5	3	21	.62	3	21	.38
6	28	38	.64	28	38	.41
7	16	37	.65	16	37	.42
8	36	39	.66	36	39	.44
9	12	15	.70	12	15	.49
10	1	40	.77	8	40	.51
11	9	27	.84	9	27	.53
12	1	8	.85	1	8	.66
13	7	22	.86	7	22	.74
14	2	25	1.10	1	3	.81
15	1	3	1.12	10	12	1.17
16	10	12	1.22	2	28	1.21
17	2	28	1.30	16	25	1.31
18	26	29	1.30	4	32	1.37
19	4	32	1.33	2	6	1.52
20	2	6	1.48	7	10	1.60
21	7	16	1.55	26	29	1.69
22	9	26	1.84	9	26	2.20
23	7	10	1.95	2	16	2.56
24	1	36	2.13	2	7	2.85
25	2	7	**2.26**	1	36	**2.86**
26	1	23	**2.63**	1	9	**3.93**
27	4	5	2.75	2	4	4.62
28	1	9	3.03	1	23	4.96
29	2	4	3.87	2	5	9.28
30	1	2	6.73	1	2	12.50

a/ Euclidean distance between observations

CHAPTER IV THE DETERMINANTS OF EXTERNAL PRIVATE EQUITY FINANCING OF AGRICULTURAL BUSINESSES

1. INTRODUCTION

One salient feature of modern economic organization is the transition from small family firms to large-scale corporations. However, certain industries have resisted the transition to large corporate ownership, remaining privately held firms as the dominant organizational form. Even in the United States where the public corporation is well established, the total value of private equity is similar in magnitude to the public equity market (Moskowitz and Vissing-Jorgesen 2002).[20]

Private equity capital[21] has developed as an important source of funding for private middle market companies, firms in financial stress, and as growth capital. The private equity market has been the fastest growing financial market since the late 1980s, and during that period several organizational innovations have been developed to mitigate the problems that arise at each stage of the investment process (Gompers and Lerner 2001). Despite the growing literature that examines venture capital financing in industries such as biotechnology, software, and pharmaceuticals The private equity

[20] Moskowitz and Vissing-Jorgesen (2002), using data from the Survey of Consumer Finance, estimate that total individuals' investments in private businesses in U.S. was in 1998 $5.7 trillion, whereas the total holdings of public equity by households was $7.3 trillion.

[21] This research uses the following definitions for the terms private equity and venture capital. Venture capital refers to investment in earlier-stage firms (e.g., seed or start-up firms). Private Equity is a broader term that also encompasses later-stage projects, buyouts, and turnaround investments. Hence, the term private equity encompasses all private investment stages, including venture capital.

market has received relatively little academic attention in other sectors, in particular, if compared to the public equity market.[22]

In the study presented in this chapter, I examine the use of external equity finance by firms in the agricultural production, a sector in which private companies are the dominant organizational form. Specifically, this study investigates the determinants that influence a firm's decision to use external private equity in the agricultural production.

Scholars have recognized the benefits of external equity financing for the agrifood sector. The availability of external equity, that is equity capital derived from a source other than retained earnings and existing owners, allows firms to expand and take full advantage of business opportunities without incurring excessive financial risk from high levels of debt. External equity capital can be an attractive source of funding for promising firms that experience high financial risk associated with high debt ratios, as well as for firms/projects with prolonged periods of cash shortages by providing long-term funding with minimal cash flow drains (Collins and Bourn 1986; Fiske, Batte and Lee 1986; Raup 1986; Lowenberg-Deboer, Featherstone and Leatham 1989; Wang, Leatham and Chaisantikulawat 2002). Investors may benefit from diversification and become involved in a venture of choice that they could not manage on their own.

Since the late 1990s, the use of external equity as a funding source by firms in the agrifood production sector has increased. The literature on private equity in the farming sector is not abundant and discontinued over time. The empirical research is also restricted due to the lack of data on the use of external equity finance.

[22] Private equity securities do not involve any public offering and, hence, are exempt from registration with the Securities and Exchange Commission. This has been an obstacle for research in this area and explains the relative more abundant literature in finance focusing in the public corporation.

External equity capital enters agriculture through two mechanisms. First, when external investors buy farmland directly. In this case, investors generally lease the land to farm operators. Second, when agricultural producers attract equity through limited partnership or common stock. In this study, I focus on the second mechanism and on the following implications. When a firm raises equity from outside investors, several problems arise due to uncertainty and informational asymmetries. The firm shifts from a single owner to a mixed ownership structure with outside equity investors. Additionally, it is subject to the fundamental conflict between the objectives of investors and the owner-manager. The firm's problem is to choose the financial mechanism that minimizes the costs of external funding.

The asset specificity approach (Williamson 1988) offers insightful contributions to understand the use of different financial mechanisms across farming industries. This approach to financing decisions brings additional insights and complements agency theory that has been the dominant perspective in the finance literature. However, empirical analysis and test of the asset specificity approach to financial decisions has been limited, partially because of data constraints and difficulties to find good measures of asset specificity in databases of secondary data.

The differential attributes of the assets involved in agricultural production are an important source of variation across farm activities. Whereas some farm activities heavily rely on highly redeployable assets, farmland being the most distinctive one; other farm activities rely on single purpose equipment and facilities that are, in certain cases, non-redeployable.

This variation across farm activities justifies efforts to abandon the traditional approach of capital as an undifferentiated (composite) kind, and to explore the

differential redeployability of the assets involved in the production process, as well as its implications in terms of contracting and financial choices. In that respect, the farming sector provides an opportunity for application and refinement of the transaction cost approach to financing decisions.

The literature on agricultural finance has been successful at addressing the effect that the non-depreciable attribute of land has on the financial characteristics of agriculture (Barry and Robison 2001). However, little is known about the effect that other attributes of the assets involved in agricultural production have on the use of alternative financing mechanisms.

The capital structure literature examines decisions related to the level of debt capital used by firms. These types of studies do not discriminate, in general, the source of equity capital (internal versus external). This distinction is relevant because the use of external equity affects the ownership structure of the firm—that is, "the relative amounts of ownership claims held by insiders (management) and outsiders (investors with no direct role in the management of the firm)" (Jensen and Meckling 1976: 305). One important difference of this study is that I explore the factors associated with the use of external equity.

The empirical analysis is designed to test hypotheses of the determinants of the use of external equity finance by firms in the agricultural production industries. The dataset contains 99 private firms in agricultural production industries operating in North America (52), EU-15 (36), and Oceania (11). I use two data sources to construct an international dataset of companies that receive external private equity finance. I use the Venture Economics dataset to identify companies that received external equity. I use primary data from a survey to credit officers conducted to measure the degree of

relationship-specific investments for each farm activity in the agricultural production sector (dairy, beef, corn, etc.). Finally, to obtain additional information on the companies that receive external private equity finance I use other databases such as LexisNexis, Business & Company Resource Center; Hoovers Online, Factiva, and SEC online.

This study contributes to our understanding of what drives the use of external equity capital in the agrifood production. In particular, this research illuminates the effects of industry factors in the financial choice. A better understanding of the use of external equity capital informs the design of private strategies and public policies to promote economic development in countries/regions with comparative advantages in the agrifood sector.

The study proceeds as follows. Section 2 presents a literature review on existing approaches to inform the decision to use alternative sources of external capital (debt and equity). I focus mainly on agency cost analysis and entrepreneurship literature. Section 3 presents the theoretical framework and discusses the hypotheses tested in this study. Section 4 describes the data and method used in the empirical analysis. Section 5 discusses the results and Section 6 discusses the implications and consequences of these results for the theory and future empirical research.

2. LITERATURE REVIEW

2.1. Agency Theory[23]

The effect of managerial actions on the value of the firm was formalized by Jensen and Meckling (1976)[24] to inform the trade-off between debt and equity finance. In a firm with a single owner-manager, there are no incentives to shirk or get benefits at the firm's expenses. When adding an outside investor with no managerial role, the owner-manager's fraction of equity falls and this will tend to encourage him either to devote less effort in the firm's activities or to appropriate a larger amount of firm resources in the form of perquisites.

As the manager's ownership claims on the firm's outcomes falls, he or she will bear just a percentage of the benefit (perquisites) cost but will enjoy the full value of the benefit. In addition, as the manager's ownership claims fall, his or her incentives to devote significant effort to profitable but demanding/complicated projects falls. Moreover, entrepreneurs might be willing to invest in strategies or projects that have high personal returns but low expected monetary payoffs to investors (e.g., projects that bring recognition in the business community to the entrepreneur).

Agency problems are reduced through an appropriate scheme that aligns the manager's incentives with investors' interests. Although the manager's actions are not

[23] In this section, tax considerations are not taken into account. Although, tax system and tax policies in general can favor the use of equity or the use of debt, this discussion aims to explore other factors not previously integrated in a model to explain equity arrangement in agriculture.

[24] Jensen and Meckling (1976) analyze the agency costs that arise when a firm shifts from a single-owned to a mixed ownership structure with outside equity investors. The agency problem arises when investors cannot guarantee at zero cost that the manager will make optimal decisions from the owners' point of view. Separations of ownership and control generates positive agency costs associated with monitoring costs by the principal, bonding costs by the manager, and residual losses of the firm's value.

observable, the optimal incentive contract ensures that the manager puts enough effort by linking his or her compensation to certain firm outcomes.

There are also agency costs associated with debt capital. As debt levels increase, agency costs arise associated with (i) incentive problems; (ii) monitoring costs that these incentive effects engender; and (iii) bankruptcy costs. Large debt could induce the owner-manager (and equity holders in general) to engage in high-risk projects because the debtholders would assume the penalties of failure but equity holders would capture the benefits if the projects succeed. Hence, since lenders perceive this agency problem, debt will be available at higher costs as the leverage of the firm increases. Agency cost considerations illustrate that equity involves costs, but also that the costs of debt finance falls as equity increases and bond holders become less vulnerable to excessive risk-taking by the manager-owner and shareholders.

Based on the above discussion on agency costs associated with external sources of capital—debt and equity—it is expected that as the firm's debt level increases, agency costs of debt arise due to incentive problems, monitoring costs, and bankruptcy costs, which increases the probability that a firm uses external equity financing. Equity capital can relieve firms in distress from the liquidity pressure in making a loan payment.

Agency costs associated with external equity capital leads to the following analysis. As the number of owners increases, the costs of monitoring rise due to free-riding problems. Each additional outside investor has lower incentive to devote efforts to monitor the owner-manager (and to monitor the management team in general), as the incentives of the owners to free-ride on each other's effort to monitor the management of

the firm increases.[25] Hence, firms with a high number of owners will face higher agency costs associated with external equity. That is, as the number of owners increases, the lower the intensity of monitoring becomes, and the probability of the firm being financed with external equity capital decreases.

The presence of dominant shareholders is associated with active investors that have higher incentives to devote efforts in monitoring the management team. In addition, the higher the share of the owner-manager, the lower the agency conflicts. The owner-manager has higher incentives to devote efforts in firm-increasing value strategies and has lower incentives to appropriate perquisites, if compared to an owner-manager that owns a lower portion of the firm. Firms with higher ownership concentration are expected to face lower agency costs of external equity, which favors the use of capital from outside investors.

The following factors are expected to have a more severe effect on the cost of debt capital, making external equity more attractive than debt. Firms with greater discretionary investments are more difficult to monitor by financiers and opens room for opportunistic behavior by the owner-manager by appropriating private benefits from investments that may not be perfectly correlated with shareholders' monetary return (Gompers 1995). The increase in monitoring costs is higher for debt capital than equity capital because equity investors provide better monitoring of the manager and quality control of the investment decisions. Hence, debt becomes more expensive than equity as the degree of discretionary investments increase.

[25] Gorton and Schmid (1999) measure the degree of separation of ownership and control by the number of owners and show that agency costs are increasing in the degree of separation of ownership and control. Their empirical test is based on cooperative banks, an organizational form in which the ownership structure cannot adjust. This setting allows them to overcome the endogeneity problem described in Demsetz and Lehn (1985) where the ownership structure of the firm changes as long as there is profit to be made from eliminating managerial inefficiency.

Two proxies have been commonly used to capture the degree of discretionary investment—research and development intensity and advertising expenditure intensity. As the firm's research and development intensity increases, the owner-manager has access to higher discretionary investment, debt capital becomes more expensive than equity, and the firm is expected to use external equity finance. Similarly, firms with high advertising expenditure intensity have higher discretionary investment and are expected to use external equity finance.

Firms with a high level of intangible assets face higher agency costs of both sources of capital—debt and external equity. Gompers (1995) discusses agency costs considerations associated with intangible assets. Firms with high level of intangible assets would be subject to greater discretionary investment by the entrepreneur. Although this leads to increasing expected agency costs of both sources of external funding, agency costs associated with debt capital are expected to be more serious given that it involves weaker incentives and mechanism of monitoring.

This type of investment involves higher cost associated with debt capital because lenders have limited ability to control owner-manager's decisions. Equity capital, although not costless, involves control over the firm, which mitigates opportunistic behavior by the owner-manager. When assets are less tangible, investors would recover less of their investment in liquidation, and there are higher expected losses due to (inefficient) continuation of negative net present value projects (Gompers 1995). This increases the need to monitor tightly and favors the cost of equity over debt capital. This discussion informs the idea that firms with a higher level of intangible assets is more likely to use external equity finance.

Firms with high growth potential face different financial options. When the firm value is largely dependent upon investment in future growth options, debt capital becomes problematic because the owner-manager has higher discretion and can undertake investment strategies that are particularly detrimental to bondholders (Myers 1977). Equity investors can mitigate some of these problems by monitoring investment decisions and evaluating manager decision at each stage or round (Gompers 1995). Berger and Udell (1998) analyze small businesses and argue that the growth stage is an important determinant for the use of equity capital. In that respect, high-growth firms are more likely to use external equity capital. The idea here is that firms in growth stages involve higher monitoring costs for both—debt and equity. However, equity investors can mitigate this problem due to their control rights.

Firm size also affects the financial options available to the firm. Large firms tend to have better access to debt capital because they are able to provide better accounting standards and transparency. Privately held small firms suffer from greater information asymmetry, and hence, have higher costs for external sources of capital. Small firms have low levels of physical assets that can serve as collateral and, hence, have fewer borrowing opportunities. Asymmetric information problems might also reduce their access to external equity, leaving internal equity as the main financial source for their projects.

Scholtens (1999) argues that for small businesses it is more difficult to reduce information problems because small firms are more constrained in the use of control mechanism (e.g., ownership, collateral long-term relationship, and reputation). Overall, small firms will have reduced external finance opportunities than bigger firms. That is, smaller firms are expected to use lower levels of external equity finance than bigger firms do.

Financiers have less information about new ventures and the lack of reputation implies reduced borrowing opportunities. Although, the control mechanisms available to equity investors would allow them to better monitor and control quality of investment decisions, it is expected that younger firms will face greater financial constrains associated with both sources of external capital (debt and equity). Younger firms tend to rely more on internal sources of capital. Younger firms are expected to use less external equity finance than older firms.

2.2. Pecking Order Theory

The pecking order theory of finance (Myers and Majluf 1984; Myers 1985) suggests that firms have the following preference ordering. Firs, firms prefer to finance their investment from internally generated cash flow as their first best choice. Second, if external finance is required, "firms issue the safest security first. That is, they start with debt, then possibly hybrid securities such as convertible bonds, then equity" (Myers 1985, p. 349).

In view of this approach, there is a cost saving advantage from internal financing, and external financing is only applicable when there is an imbalance between internal funds and real investment opportunities. The overall evidence supporting this theory based on evidence from large established firms has been mixed (Frank and Goyal 2003).

Pecking order theory has similarities with the asset specificity approach to finance. For instance, both approaches predict that external equity is the financial instrument of last resort. However, the reasons are different and, in particular, pecking order theory makes no reference to the characteristics of the assets (Williamson 1988, p. 585).

2.3. Entrepreneurship Considerations

Entrepreneurship attributes also play an important role in financing alternatives and decisions. Recent studies in finance and entrepreneurship focus on the role of social networks in the investment process. For example, personal relationships between fund managers and firm board members play a significant role in the investment decision. Fund managers place larger bets in firms run by individuals in their own networks and these investments perform better than their non-connected holdings (Cohen, Frazzini and Malloy 2008).

Entrepreneur experience might facilitate access to external funding, particularly to outside investors. Experienced entrepreneurs might have a larger network and be able to attract more investors than younger entrepreneurs. Firms run by experienced entrepreneurs are expected to use more external equity capital.

Social networks created *ex ante* and for other purposes than doing business (e.g., prior education) not only affect how investors select the companies where to invest, but also attenuate two factors commonly found to reduce relationship forming such as geographic distance and strategic dissimilarity (Rider 2008). Firms with more educated entrepreneurs are more likely to use external equity capital.

Access to external equity might also depend on the firm's location. Regions with higher number of investors such as regions with high venture capital activity might facilitate the access to equity funding. Investors might select their investment projects within the boundaries of the area they live. The idea here is that firms located in areas with higher private equity investment activity are more likely to use external equity funding.

2.4. Transaction Cost Economics

The finance literature has evolved from treating profitability as independent of the way the firm is financed (Modigliani and Merton 1958),[26] to acknowledging that capital structure and managerial actions affect a firm's profitability, to recognizing that firm value depends also on the allocation of decision (control) rights between entrepreneurs and investors (Grossman and Hart 1986; Hart and Moore 1990).

Agency theory has motivated a large volume of empirical studies in corporate finance. The main finding of the literature on the agency problem is that the best way to deal with them is to put the agent on an optimal incentive scheme (Hart 2001). Agency problems are reduced through an appropriate scheme that aligns the manager's incentives with investors' interests.

Within agency theory, capital is assumed to be undifferentiated and there is no suggestion that debt is better suited for some projects and equity for others (Williamson 1988 p. 579). In that respect, Williamson argues that additional elements need to be taken into account to understand when it is optimal for a firm to use external equity finance.

Williamson (1988) develops an asset specificity approach to finance and argues that whether a project should be financed by debt or equity depends principally on the characteristics of the assets. Assets that are highly specific to the project will have lower value for other use in case the project is liquidated (lower salvage value). When the assets involved in a project/enterprise are highly specific and, hence, have lower value for other purposes, bondholders are subject to opportunistic behavior by the owner-manager of the

[26] Modigliani and Miller derived their results under the assumption of the existence of a perfect capital market, no taxes, and no incentive or information problems.

firm, as bondholder have no control over firm management. The effect of asset specificity in the cost of capital is associated with an ex-post occurrence of bankruptcy.

In this setting, asset specificity and agency theory perspectives are approached as complementary. Although the asset specificity perspective brings additional insights for the analysis of the decision to use equity capital, it has been very difficult to operationalize and to find good measures of asset specificity. This illustrates, to some extent, why Williamson's 1988 article has not been very influential in the empirical literature in finance.

Empirical studies have used proxies such as advertising intensity and R&D intensity, which are poor measures of the liquidation value of the assets involved in the project. Other studies use the ratio of tangible assets to total assets.[27] However, the "intangible breakdown is a very incomplete measure of asset specificity. Thus although intangible investments in R&D and advertising have poor redeployability properties, this is also true of many tangible assets." (Williamson 1988 p. 588) Tangible assets can also involve high levels of asset specificity such as physical assets in activities that involve high levels of temporal-asset specificity (e.g., dairy industry). Finding good proxies for asset specificity in databases of secondary data has and will probably continue to be a major challenge for empirical studies using asset specificity insights.[28]

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[27] Ratio of tangible assets to total assets has been used as a measure of liquidation value in empirical research on capital structure. Research on capital structure finds that the use of debt increases with the level of tangible assets (Titman and Wessels 1988; Rajan and Zingales 1995)

[28] For example, Balakrishnan and Fox (1993) perform an empirical investigation of the importance of specialized assets in explaining variance in capital structure across firms. They use the ratio of R&D expenses to net sales and the ratio of advertising to sales as measures of investment in relationship-specific assets. For a recent application on the use of external private equity capital that uses the share of intangible assets as a proxy for physical asset specificity, see Mann and Sanyal (2010).

As I explain in the data section, I attempt to avoid the common problem of using poor proxies for asset specificity when using secondary data, by using survey data to measure asset specificity variables.

3. THEORETICAL FRAMEWORK

This study deals with the firm's choice of using external private equity. This decision affects the ownership structure of the firm, and hence, the fraction of equity held by the owner-manager. As mentioned above, in this study the term private equity encompasses all private investment stages, including venture capital.

There are several finance options for a firm in the agricultural production sector. Farming enterprises, in particular, have the following choices: rent versus buy land; debt versus equity; internal versus external equity; and public versus private equity. In the literature review (Chapter II), I described how farmland can be an attractive option for investors and how renting land might also be a beneficial option for farmers. In this study, I focus on the external finance choice between debt capital and private equity.

A distinctive characteristic of the farming sector is that private firms, and hence, private equity dominates the landscape. In that respect, the option of using public equity is restricted for most farms and the use of public equity involves important organizational changes. Surprisingly, although there has been some debate on corporate farming and the feasibility of this organizational form in farming agriculture (cf, Raup 1986; Allen and Lueck 1998; Barry, et al. 2000), the use of external private equity and private equity partnerships has remained relatively unexplored. In that context, this study and the

discussion presented in this section focuses on the determinant of using external private equity.

Table 1 shows data on farm organization in the United States and Canada. The family farm dominates farming and non-family corporation represents less than 1% in the U.S. and less than 2% in Canada. However, partnerships made up 7.9% of all farms in the U.S. in 2007 and 26.7% in Canada in 2006. Moreover, the market value of agricultural products sold by partnerships increased in U.S. from 18.1% in 1997 to 20.9% in 2007. These facts indicate the importance and dynamism of partnership in the agricultural production sector.

Table 1. Farm organization in United States and Canada: acres, number of farms, and receipts by organizational form. 1997 and 2007.

	United States						Canada	
	Acres		Farms (N)		Receipts ($)[/a]		Farms (N)	
	1997	2007	1997	2007	1997	2007	1996	2006
Family or individual	62.8	62.3	86.0	86.4	52.2	49.7	60.8	57.0
Partnership[/b]	16.0	17.5	8.9	7.9	18.1	20.9	27.1	26.7
Family corporation	12.8	12.4	4.0	3.9	23.3	22.1	9.8	14.1
Non-family corporation	1.3	1.2	0.4	0.5	5.6	6.2	2.0	1.9
Other[/c]	7.1	6.6	0.7	1.3	0.8	1.1	0.3	0.3
Total (in percentage)	100	100	100	100	100	100	100	100
Total (in millions)	955	922	2.22	2.22	201,380	297,220	0.28	0.23

[/a] Receipts: market value of agricultural products sold. [/b] In the 2007 U.S. Census, partnerships include both—registered and not registered under State law, and also include family partnerships. [/c] Other: Trusts, municipalities, cooperatives, Indian reservations.

Sources: 2007 U.S. Census of Agriculture (Tables 1 and 61); Statistics Canada, 2006 and 1996 Census of Agriculture.

The asset specificity approach offers insightful contributions to understand the use of different financial mechanisms across farming industries. The differential attributes of the assets involved in agricultural production are an important source of variation across

farm activities. Whereas some farm activities heavily rely on highly redeployable assets, farmland being the most distinctive one; other farm activities rely on single purpose equipment and facilities that are, in certain cases, non-redeployable.

This variation across farm activities justifies efforts to abandon the traditional approach of capital as an undifferentiated (composite) kind, and to explore the differential redeployability of the assets involved in the production process, as well as its implications in terms of contracting and financial choices.

The literature on agricultural finance has been successful at addressing the effect that the non-depreciable attribute of land has on the financial characteristics of agriculture (Barry and Robison 2001). However, little is known about the effect that other attributes of the assets involved in agricultural production have on the use of alternative financing mechanisms.

The remainder of this section discusses the main determinants of the use of external equity capital from the lenses of transaction cost economics. This discussion is organized as follows. Section 3.1 discusses the asset specificity approach and states the hypotheses for this study. Section 3.2 discusses insights associated with moral hazard, monitoring problems and gains form specialization. Finally, I discuss additional factors that serve as guidelines for the inclusion of control variables in the empirical analysis.

3.1. Asset Specificity

The asset specificity approach to the firm's financing decisions approaches debt and equity as alternative governance structures rather than as financial instruments. The governance structure associated with debt is of a very market-like kind and that associated with equity is the administrative form.

The ‘debt versus equity’ question is treated in this framework as a ‘rules versus discretion’ tradeoff. [29] Debt represents a more rigid financial mechanism that follows the rules and equity is a more flexible and discretionary mechanism. In the event of failure, control over the underlying asset reverts to the creditor, who might exercise liquidation of the assets. Although the creditor might choose to concede some discretion allowing the borrower to work things out, the advantage of equity is that “it features administrative processes that are specifically designed to facilitate ‘working things out’.” (Williamson 2010, p. 245) While the need to work things out would be low for financing of projects with redeployable assets, the demand to work things out increases as redeployability diminishes.

Equity is much more intrusive and involves active role of investors in the management of the project. In this setting, the condition of asset specificity is the primary factor to explain the use of debt versus equity finance (Williamson 1988).

The problem faced by firms is to choose the financial mechanism that minimizes the costs of external funding. Debt is a low cost governance arrangement for projects involving highly redeployable assets, because if the project is successful, interest and principal will be paid on schedule and if the project fails, debt-holders can liquidate assets to recover their investments. The opposite applies when the assets involved in a project are highly specific (i.e., non-redeployable) and, hence, have lower value for other purposes in case the project is liquidated. In this case, the terms of debt financing will be

[29] Debt financing requires the debtor to observe the following: (i) stipulated interest payments will be made at regular intervals, (ii) the business will continuously meet certain liquidity tests, (iii) sinking funds will be set up and principal repaid at the loan-expiration date, and (iv), in the event of default, the debt-holders will exercise pre-emptive claims against the asset in question (Williamson 1988).

adjusted adversely as the degree of redeployability of assets declines, because the loss in case of failure increases as asset are less redeployable.

Creditors may not have the skills or means to actively monitor projects that involve few collateralizable assets. These projects involve high risk for banks and even if banks were to make loans to high risk projects, the interest rate required would be extremely high, creating liquidity problems for the firm (Gompers 1995).

Equity governance provides incentives for investors to monitor firms more closely. By taking equity ownership, investors in private companies can access the benefits if the firm does well. Equity governance has the following properties: (i) investors bear a residual-claimant status to the firm in both earnings and asset-liquidation respects, (ii) it is a contract for the duration of the life of the firm, and (iii) control rights are awarded to equity holders (usually exerted through a board of directors) (Williamson 1988).

As Williamson states, "not only do the added controls to which equity has access have better assurance properties, but equity is more forgiving than debt. Efforts are therefore made to work things out and preserve the values of a going concern when maladaptation occurs" (1988, p.580). Although the costs of both debt and equity finance increase as asset specificity deepens, debt financing rises more rapidly. In sum, equity capital, although not costless, involves control over the firm, which mitigates opportunistic behavior by the owner-manager, reducing the cost of capital for projects that involve limited redeployability (Williamson 1988).

Based on these insights, those farm activities that rely more on assets with low redeployability are expected to have higher equity requirements than those farming activities relying on multiple purpose facilities and equipment, and land.

Asset specificity considerations inform the following general prediction: *the higher the level of asset specificity, the higher the probability a firm uses external equity finance.* Equity governance can better coordinate the relationship between outside investors and the owner-manager when assets have low liquidation value. In addition, lower liquidation value reduces the firm's collateral, constraining access to debt capital.

Williamson (1991) discusses six types of asset specificity. The first three—physical, human, and site specificity—have received more attention in the empirical literature on contracting decisions. Physical-asset specificity refers to equipment, machinery and facilities that are required to provide a product or service. Human-asset specificity arises when specific knowledge, experience or human capital is required to support the transaction. Site specificity refers to situations where successive stations or assets are located closely to one another. The fourth is brand-name capital. The fifth is dedicated assets, which are substantial investment in general purpose assets made for a particular customer. Although not specific to that customer, because of the level of the investment their release to the market would depress the market value of the assets.

The sixth is temporal-asset specificity, which refers to assets that must be used in a particular sequence and where timely responsiveness is important. "'Temporal specificity' may arise because a product's value is inherently time dependent, like newspapers; because of the serial nature of production, as in construction projects; or because the product is perishable, as is the case, of course, with agricultural commodities." (Masten 2000, p. 180) Timing factors create temporal specificities in certain agricultural industries such as poultry and dairy milk. For example, because of the risk of contamination with pathogens, poultry has narrow range of time which it must be sent to processors (Martinez 1999).

In the setting of the choice of using external private equity by firms in the agricultural production sector, I focus on four types of asset specificity—physical, temporal, site, and human. Masten (2000) argues that temporal- and site-asset specificity are expected to play an important role in agriculture. Perishability is the most conspicuous attribute of agricultural products when compared to non-agricultural products. Similarly, many agricultural products have high weight-to-value ratio, which translates in economic incentives for producers and processor to be located in proximity of each other. As concluded in Chapter III, farming activities differ significantly in the attributes of the assets involved in the production process. Physical asset specificity is also expected to play an important role at explaining organizational choices in agriculture. Finally, human-asset specificity is also included in this discussion. Although *a priori* it does not appear to be a distinctive characteristic in agriculture, additional implications for the financing choices might be involved. In that respect, the asset specificity prediction need to be discussed for each type of asset specificity.

Physical-asset specificity

Physical assets that are highly specific to a firm's production or project usually cannot be used as collateral. If lenders decide to finance projects with low redeployable assets, the cost of finance will be higher, as the loss in case of liquidation is higher. Investments in this type of assets involve higher costs associated with debt capital because lenders have limited ability to control owner-manager's decisions. Equity capital, although not costless, involves control over the firm which mitigates opportunistic behavior by the owner-manager.

Farm activities with high physical-asset specificity are those that rely, in a great extent, on single-purpose assets and face small numbers bargaining. These conditions can

usually be found, for example, on poultry, hog, floriculture, fruit and tree nut production. Advance rates would be adjusted adversely for farm activities that rely on high level of relationship-specific assets if compared with farm activities that rely on highly redeployable assets such as cash crops. Hence, higher costs of debt capital are expected for those farm activities that rely on low redeployable assets.

As the number of potential buyers is lower for single-purpose assets with low degree of redeployability, this problem is particularly serious for these types of assets. Potential buyers know about this and use this information to negotiate down the price of the assets.

The alternative mechanism for external funding—equity—although not costless, it can mitigate part of the problems described above. In addition, in case of failure, equity investors who participate in other businesses in the same industry or in related industries might be able to repossess and redeploy the assets more efficiently than the bank. Unlike banks, equity investors can usually wait to sell the assets.

Physical-asset specificity considerations inform this hypothesis.

H_1: the higher the level of physical-asset specificity, the higher the probability a firm uses external equity finance.

Temporal-asset specificity

Firms that focus on farm activities that involve high level of temporal-asset specificity are, from the lender's point of view, more risky. Lenders evaluate not only aspects related to the farm operation and the investment project, but also the relationship with the processor/buyer and its viability.

Asset in farm activities in this group are more likely to lose value in case of failure because the relationship with the processor becomes a relevant factor for the

viability of the farm project. Potential buyers in these farm activities need not only the facilities and machinery for these farm activities, but also some type of specialized vertical coordination agreement with the processor. As a result, the number of potential buyers will be reduced and, hence, the salvage value of those assets is adjusted adversely.

Assets involved in farm activities with high temporal-asset specificity might lose value in case of failure because the relationship with the processor becomes a relevant factor for the farm project. The cost of debt increases as the salvage value of the assets decreases. Examples of farm activities involving high level of temporal-asset specificity can be found in dairy, berry, and shellfish fishing.

Temporal-asset specificity considerations inform this hypothesis.

H_2: the higher the level of temporal-asset specificity, the higher the probability a firm uses external equity finance.

Site specificity

The effect associated with higher levels of site-specificity is very similar to the one of temporal-asset specificity. Given the dependency that farmers in farm activities that involve high site-specificity have with the buyer, lenders evaluate not only aspects related to the farm operation and the investment project, but also the relationship with the processor/buyer and its viability.

In case of failure, potential buyers will need not only the facilities and machinery but also need to develop commercial relationship with the buyer/processor located closely to the farm operation.

Site specificity considerations inform this hypothesis.

H_3: the higher the level of site-asset specificity, the higher the probability a firm uses external equity finance.

Human-asset specificity

The effect human capital has on the use of external private equity leads to a different prediction than the other three types of asset specificity discussed above—physical, temporal, and site. Hart and Moore (1994) develop a model of financing decisions in which an entrepreneur who has access to a profitable investment project, does not have the funds to finance it, and he or she cannot costlessly be replaced (i.e., high human-asset specificity). They distinguish between physical assets (the project capital) and human assets (the entrepreneur's human capital), and analyze the financial implications of the inalienable nature of human assets—that is, the entrepreneur's human capital always resides with him.

Because of this condition, if the entrepreneur cannot costlessly be replaced, he or she "can always threaten to repudiate the contract by withdrawing his human capital." Hart and Moore show that the threat of walk away (by the entrepreneur) means that some profitable projects will not be financed. External investors (banks or private equity investors) foreseeing this hold-up problem will be less likely to provide capital when the knowledge and skills of the entrepreneur are important for the project and cannot be replaced.

One solution to this problem is that the entrepreneur should have a greater stake in the company. The prediction associated with this analysis is that the condition of high human-asset specificity reduces the probability that a firm will access to external investors (both debt and equity).

Human-asset specificity considerations inform this hypothesis.

H_4: the higher the level of human-asset specificity, the lower the probability a firm uses external equity finance.

Although Williamson (1988) does not explicitly state the effect that human-asset specificity is expected to have on the debt versus equity choice, his discussion on leveraged buyouts offers insights that are aligned with the prediction stated in hypothesis two. Within the asset specificity approach, leveraged buyouts—i.e., substitution of debt for equity—applies to "[F]irms that combine (1) a very high ratio of equity to debt with (2) a very high ratio of redeployable to nonredeployable assets." (p. 577) In the case of management buyouts, Williamson argues that it will be favored in firms where redeployable physical assets are equity financed and with high human-asset specificity.

Investors could use, to some extent, contract specifications to protect their investment from potential opportunistic behavior of the owner-manager, which would mitigate the effect of human asset specificity. However, due to the inalienable condition of the human capital there will be situations in which contract protections might not be feasible or plausible of specification.

3.2. Moral hazard incentives and gains from specialization

In addition to the asset specificity approach, other insight associated with moral hazard incentives, monitoring problems, and gains from specialization are also considered. Allen and Lueck (1998) develop a model to explain the organizational choice of farming venture—family farm, partnership, or corporate farm—based on a trade-off between *moral hazard incentives* and *gains from specialization*.

The model developed by Allen and Lueck (1998) is approached as complementary rather than substitute of the asset specificity approach. The empirical analysis of this paper focuses on the comparison between the asset specificity model and the Allen and Lueck (1998) model. I test whether, as argued by Allen and Lueck, asset

specificity is not a relevant factor for the explanation of the choice of organizational forms in farming agriculture.[30] Alternatively, the different types of asset specificity are important determinates to explain the use of external equity finance and, hence, the use of partnerships in agriculture.

The specific characteristics of the agricultural production sector that affect organizational choices, as developed by Allen and Lueck (1988), are the following. Mother Nature puts seasonal restrictions and random shocks, and the interaction of these attributes generates moral hazard, limits gains from specialization, and causes timing problems between stages of production. The production process involves several stages that are linked to biological processes (e.g., planting, flowering, harvesting) and are required to be performed in certain moments of the year and under certain conditions (e.g., temperature, rainfall). A high degree of moral hazard is a problem because monitoring and evaluation is typically difficult and limited.

The gains from specialization argument is explained by the increases in worker's marginal productivity when he or she spends more time working at a particular task, which depends also on how many tasks the worker is performing during a stage. Moreover, tasks might differ in the potential gains from specialization. For example, the quality of management decisions might be improved if the worker focuses in that activity. Hence, for a task with high importance of specialization, the greater gains from specialization occur, for example, when many production cycles can be completed in one year, there are few tasks, or each worker can specialize in one task.

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[30] Allen and Lueck state that "[a]lthough our approach does not depend on asset specificity, we do incorporate an agricultural version of "temporal specificity" (Masten, Meehan, Snyder, 1991)." (Allen and Lueck 1998, p. 345)

Allen and Lueck (1998) incorporate features that affect a production activity through the following parameters: *cycles* (number of times per year the entire production cycle can be completed);[31] number of *stages* in the production process; and number of *tasks* in a given stage (well-defined jobs such as operating a combine, planning activities, etc.).

The agricultural production activities that succeed in controlling the effects of nature (i.e., reducing the effects of seasonality and random production shocks) have greater potential gains from specialization and lower monitoring costs of wage labor. As a result, firms in these activities will require higher levels of capital and, hence, will be more likely to use equity capital to fulfill their financial needs. The inverse also applies, the gains from specialization will be limited and wage labor expensive to monitor for farming activities that cannot control the effects of natural forces, with short production stages, infrequent, and that require few distinct tasks. Those activities, as corroborated by Allen and Lueck, will be better organized by family farms (as opposed to partnerships and corporations) that require lower capital investments.

Based on the above discussion, two sets of variables are introduced into the model that refers to the idiosyncratic characteristics of agricultural production sector. First, factors that explain gains from specialization in agricultural production sector. Second, the importance of random shocks and farm product sensitivity to task timing in explaining the production output and, hence, the importance of the moral hazard problem

[31] For annual crops such as soybean, the number of cycles is one, for vegetables produced in greenhouses the number of cycles could be 4 or 5. For dairy farms, the production is daily. For timber production, the cycle last 20 to 100 years.

which results in increasing monitoring costs.[32] These factors capture situations of firms that are more likely to expand and, hence, face greater capital needs. Greater capital needs are associated with the use of external equity capital, considering that the access to debt capital is limited by the equity capital of the farm (collateral) and that the option of public equity is restricted for most companies in agriculture.

The moral hazard incentives and gains from specialization considerations for agricultural production activities inform the following predictions.

H_5: The higher the gains from specialization for a firm/project, the higher the needs for external funding, and hence, the higher the probability of using external equity capital.

H_6: The greater the effect of random shocks in farming output, the lower the probability of using external equity capital.

3.3. Other factors

The institutional environment in which the parties operate affects the financial contracts. Access to equity capital might be facilitated for firms in some countries but not in others. Although in this chapter I explore comparative analysis between country/regions, I do not test specific hypotheses for factors related to the institutional environment or country level effects. I do include country specific factors to control for macro-economic and legal environment effects that might facilitate/constraint financial contracts between private firms and investors.

[32] Note that the agency problem discussed in this part does not derive from separation of ownership and control, but from monitoring costs associated with hired labor in the specific context of farming activities. Timing problems between stages of production enhance the moral hazard problem, which leads the farm to integrate over multiple stages.

Additional factors on the decision to use debt versus equity capital are discussed in the literature review. Agency theory has informed an important volume of studies in corporate finance. Similarly, additional factors can be found in the entrepreneurship literature. I incorporate some of these factors in the empirical analysis as control variables.

4. DATA AND METHOD

4.1. Data

To construct a dataset of international companies that receive external private equity finance I use two data sources: the Venture Economics dataset to identify companies that received external equity; and primary data from a survey to credit officers designed to measure the degree of relationship-specific investments for each farm activity in the agricultural production sector (i.e., dairy, beef, corn, etc.). In order to obtain additional information on the companies that receive external private equity finance I use other databases such as LexisNexis, Business & Company Resource Center; Hoovers Online, Factiva, and SEC online.

The combination of primary and secondary data allows to overcome measurement problems on the asset specificity variables (using survey data), while avoiding sample size problems that are common in studies relying on survey data. That is, this strategy exploits the advantages of both sources of data—survey and secondary data.

Sample of companies that received external private equity finance

The Venture Economics dataset was accessed through Thomson Financial´s SDC Platinum VentureXpert. Venture economics data have been extensively used in previous studies (c.f., Gompers 1995; Kaplan and Schoar 2005; Dushnitsky and Shapira 2010).

Venture economics collects quarterly information on investment funds in the private equity industry. The collected data consists of voluntary reporting of fund information by the private equity firms (or general partners) as well as by their limited partners. Venture economics claims that there is little room for inconsistencies because they receive information from both—general partners and limited partners. Although this statement is difficult to validate, Kaplan and Schoar (2005) argue that if there is a bias it would take the form of underreporting by worse performing funds. This type of bias is of particular importance for studies using performance variables. In that respect, this type of bias is considered a minor problem for this study considering that I do not rely on performance variables for the empirical analysis.

As mentioned in the introduction, the use of external equity as a founding source by companies in the agrifood sector has increased since late 1990s. Table 2 reports the number of companies that received their first investment from external equity investors by decade and sector. The rapid increase in the number of companies that received external equity investment can be interpret as an increase in the overall amount external equity investment used in the agrifood sector. This phenomenon occurs in the agrifood sector in general, and also in agricultural production industries.[33]

[33] Unfortunately, the amount invested by year is not available in the SDC VentureXpert database.

Table 2. Number of agrifood companies that received external equity investment by decade and sector. North America, EU-15, Australia-New Zealand.

	number of companies that received their first external equity investment	
decade	agrifood sector[/a]	agricultural production
1970-1980	17	8
1980-1989	36	10
1990-1999	74	25
2000-2009	230	63
date not reported	68	19
Total	357	106

[/a] Includes: Agricultural inputs; Agricultural production; Agrifood processing; Wholesale; Service to agricultural production.
Source: Thomson Financial´s SDC Platinum VentureXpert.

The sample covers portfolio companies that received the first external private equity investment after 1990. Because of the rapid growth of the private equity industry in the 1990s, earlier periods contain less financing information. Moreover, it is convenient to avoid the financial crisis of the farming sector during 1980s.

Table 3 summarizes the screening steps to construct the final sample of companies in agricultural production industries that received external equity finance.

Venture Economics database contains information about companies receiving investments and their respective investors (private equity firms and funds). I rely on "industry affiliation" for each company to select firms in the agrifood sector that received external equity finance.

Table 3. Steps building the dataset of companies in agricultural production using external private equity

Step 1: Download database from SDC Platinum VentureXpert

- I identified companies in the agricultural production sector that received external private equity.
- I selected the companies in the following Company Venture Economics Primary Industry Class (VEIC): 9500 Agriculture, Forestry, Fishing; 9510 Agriculture related; 9520 Forestry related; 9530 Fishing related; 9540 Animal husbandry; 9599 Other Agriculture, Forestry, Fishing.
- In this dataset, I selected all variables that contained information about the companies that receive investments (portfolio companies) and about the investors (PE firms and PE funds).
- Based on the 'business description' and 'primary product description', I classified each portfolio company in the following groups.

  First, I classified them into 5 sectors--agricultural inputs; service to agricultural production; agricultural production; agrifood processing; and wholesale.
  Second, for those companies whose primary business description is agricultural production, I classified each company according to their farming activities using SIC codes (4 digits).

Step 2: Screening

- Selected companies in agricultural production industries
- Dropped companies with date that received first investment prior to 1990.
- Dropped companies with missing values in most relevant variables.
- Dropped public companies.

Step 3: additional information on portfolio companies in agricultural production in the U.S. and Canada

- Although this dataset has financial information on the companies that receive investments, it suffers from missing values in firm characteristics' variables such as total assets, debt, sales.
- Obtained additional information using the following databases: Hoovers, LexisNexis, Factiva, Business & Company Resource Center Compustat and SEC website. Each of these sources provides information on the financial reports and links to media and other types of reports involving these companies. I completed financial information on each company and tried to get financial information in the same year that the companies received their first investment.
- I used information from companies' websites when available.
- I tried to contact each company to corroborate/complete information.

The initial data sample contains 293 private firms in the agrifood sectors North America, European Union-15 and Oceania (Table 4). The final dataset contains 99 private companies in agricultural production industries operating in North America (52 companies), EU-15 (36 companies), and Oceania (11 companies).[34]

[34] It is important to mention that unfortunately cases such as the "New Generation Cooperatives" (with financing coming from members of the cooperative) are not reported in the Venture Economics database.

Table 4. Number of agrifood companies that received external equity investments by sector. North America, EU-15, Australia-New Zealand, 1990-2010.

Sector	North America (N)	EU-15[/a] (N)	AU-NZ (N)	Total (N)
Agricultural inputs	35	31	1	67
Agricultural production	**52**	**36**	**11**	**99**
Agrifood processing	35	19	3	57
Wholesale	9	3	2	14
Service to agricultural production	32	17	7	56
Total	163	106	24	293

[/a] EU-15: The 15 Member States are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the United Kingdom.
Source: Thomson Financial´s SDC Platinum VentureXpert.

Survey data for asset specificity variables

I use primary data from a survey conducted to measure the degree of relationship-specific investments involved in the production of each agricultural product. The survey designed for this study required each credit officer to rate the level of asset specificity of the assets in each farm activity (i.e., dairy, beef, corn, etc.). For each company, I matched the value of physical-asset specificity based on the SIC 4-digit membership of the company.

Credit officers are a relevant source of information because when evaluating a farm project to approve loans to farmers, they perform an assessment of the farm assets that serve as collateral. As discussed in Chapter III.3, the factors considered in the assessment of collateral by credit officers are, in great extent, related to the concept of asset specificity. In addition, credit officers have significant experience in evaluating farm assets in different commodity sectors.

The survey was mailed to 300 credit officers distributed in 38 States in the U.S. from agricultural banks and credit organizations of the Farm Credit System in April 2011. Each credit officer was asked to name up to ten farm activities with which they were

familiar with. The respondents rated each farm activity across seven questions that cover the four types asset specificity tested in this study (physical, temporal, site, and human). Table 5 reports the survey questions used to measure the four types of asset specificity variables.

Table 5. Survey questions used as indicator variables for asset specificity.

Variable	Survey question	Scale
Physical-asset specificity	To what degree would assets in this farm activity lose value in the event of bankruptcy (consider all assets as a bundle)?[/1]	1 to 7
	How costly would it be for the producer to switch where they sell their product (consider all costs, including time and resources to find new buyers)?[/2]	1 to 7
	To what degree are facilities and equipment used in the production process specific to this product (specialized/single use facility and equipment)?	1 to 7
	How important are bargaining problems caused by small numbers of potential buyers (concentration in buyer´s market)?	1 to 7
Temporal-asset specificity	How important is timely delivery of this product to processors/distributors (consider the time period within which the product must be sent to buyers)?	1 to 7
Site specificity	How important is it to be close to buyer's facilities for this product (consider the distance between farmers and buyers)?	1 to 7
Human-asset specificity	To what degree are skills, knowledge, or experience of the farmer/ manager, specific to this production activity and to particular buyers?[/1]	1 to 7

[/1] Adapted from Masten et al. (1991).

[/2] Adapted from Poppo and Zenger (1998).

Out of 50 returned questionnaires, 48 were usable and contained 319 case observations. A case refers to one individual respondent's assessment of a farm activity and these 319 cases cover 40 farm activities (on average, eight responses per farm activity). Although the variation in number of responses per farm activity is a natural consequence of the distribution of farm activities, to mitigate potential measurement problems I used observations of those farm activities rated by three or more credit officers. That is, I use measures of asset specificity for 31 farm activities. A more detailed

description of the survey and the asset specificity variables is presented in Section 3 on Chapter III.

Additional data

Ideally, the empirical design would include not only companies that have received external private equity finance (treatment) but also a control group of private companies that do not use external private equity (control). That way, it would be possible to construct a control sample that matches characteristics of firms that use external equity finance.

For example, a suitable database with information at the farm level in the U.S. is the Agricultural Resource Management Survey (ARMS) from the U.S. Department of Agriculture. This database is collected annually and would allow to construct a control sample that maximizes comparability between farms that use external equity financing and those that do not use capital from external equity investors.

With a database with those characteristics, one approach to construct control groups is to select certain firm characteristics such as size and primary industry or products. A control group could be designed including firms that are similar to a firm that received private equity finance (treatment) on two or three firm characteristics.

Although this approach has been previously used in the finance literature, it suffers from important limitations. The main problem is that there are many other possible reasons why firms may use external equity finance and relying on only two or three characteristics may lead to poor performance of the control group. The propensity score matching method solves this comparison problem and allows the construction of a matching sample that maximizes comparability between treatment and control units (Villalonga 2004).

The propensity score is defined as the probability of assignment to treatment conditional on a vector of independent variables X_i (Rosenbaum and Rubin 1983). It relies on the propensity score theorem that states that if the treatment assignment can be ignored conditional on X_i, then it can also be ignored conditional on the propensity score. This theorem implies that observations with the same propensity score have the same distribution on the full vector of variables X_i and, hence, maximum comparability between the two groups is attained.

Unfortunately, this dataset was unavailable for this study. Was this data available, the empirical analysis would address why some companies in agriculture chose external equity finance, and conditional on the quality of information on companies' performance, performance implications of this financial decision could be addressed. Nonetheless, the dataset available for this study on the companies in agriculture that use external equity capital allow to perform an empirical test on the levels of external equity capital that the companies use. That is, this dataset allows to test a model to understand the effect of the asset specificity variables on the level of external equity funds that a firm in agriculture receives.

4.2. Measures and Descriptive Statistics

Measures

The dependent variable indicates the level of investments that a firm receives from external private equity investors. That variable is captured by the 'number of investment funds received by the portfolio company' in the Venture Expert database. I use a dummy variable for multiple investment funds (*multiple_inv_funds_dummy*) that equals 1 if company receives two or more funds and 0 otherwise. Similarly, I also use an

ordinal variable containing the number of investment funds received by each company (*multiple_inv_funds_ord*).

Ideally, I would only use the variable 'total amount a company has received to-date from all investors' (*inv_total_rcvd_ord)* but unfortunately I cannot rely entirely on this measure due to missing values in 50% of the companies in the final sample. However, I report a model using this variable for robustness check of the results. That is, to support the use of the variable 'multiple investment funds' as a proxy for the level of investments received by a company I rely not only on the positive correlation of 0.35 between '*multiple_inv_funds_dummy'* and '*inv_total_rcvd_ord'*, but also on the estimates of the models using each of these dependent variables.

Table 6 presents a description of the variables used in the empirical analysis, expected signs and results. To represent H_1, I used a measure of 'physical-asset specificity' at the farm activity level. For each company, I matched the value of physical-asset specificity based on the SIC 4-digit membership of the company. When a company has more than one farm activity (e.g., soybean and wheat), I computed the average value among farm activities. As explained in the data section, asset specificity measures for each farm activities were obtained from a survey conducted to credit officers in agricultural credit organizations.[35] The matching procedure described here was used for all four asset specificity variables and for the variables associated with hypotheses five and six.

To mitigate measurement problems I used the information contained in four questions to derive a multidimensional measure of physical-asset specificity per farming

[35] This strategy of data collection is based on previous surveys by Masten, Meehan, and Snyder (1991), Poppo and Zenger (1998), and Anderson and Schmittlein (1984).

activity using factor analysis. These questions cover, for each farm activity, the salvage value of the assets involved, the switching cost, the degree to which facilities and equipment are specific to the product involved, and how sever bargain problems are.

Similarly, H_2 is represented by a measure of the degree of 'temporal-asset specificity' that captures the importance of timely delivery of the farm product involve to processors/distributors. H_3 is represented by a measure of 'site-specificity' that captures the importance of being close to buyer's facilities for the product involved in each farm activity. Finally, H_4 is represented by a measure of 'human-asset specificity' that captures the importance of the degree to which skills, knowledge, or experience of the farmer/manager is specific to the production activity and to particular buyers.

Table 13 in the appendix of this chapter reports the values of each type asset specificity variable by farm activity.

Table 6. Dependent and independent variables: variable name, definition, source, and expected sign.

Variable	Definition	Source	Hyp.	Pred sign	Result
multiple_inv_funds_dummy	Number of investment funds received by company. Dummy=1 if two or more funds were invested in company; 0 if 1 fund was invested.	*SDC*	--	DV	--
multiple_inv_funds_ord	Number of investment funds received by company. Ordinal (1-4): 1 if 1 fund was invested in company; 2 if 2 funds; 3 if 3 funds; 4 if 4 or more funds were invested in company.	*SDC*	--	DV	--
inv_total_rcvd_ord	Total known amount a portfolio company has received to-date from all investors. Ordinal (1-4): 1 if 'inv tot rcvd' < 25th percentile; 2 if between 25&50th; 3 if between 50&75th pctile; 4 if > 75th pctile. Comparison among companies in agricultural production in NA, EU15, Oceania.	*SDC*	--	DV	--
physical_asset_sp	Physical-asset specificity. 7-point scale in which '1' represented 'low degree' and '7' represented 'high degree./a	Survey	H_1	(+)	(+)
temporal_specificity	Temporal-asset specificity. 7-point scale in which '1' represented 'low degree' and '7' represented 'high degree./a	Survey	H_2	(+)	(+)
site_specificity	Site asset specificity. 7-point scale in which '1' represented 'low degree' and '7' represented 'high degree./a	Survey	H_3	(+)	(-)
human_asset_specificity	Human-asset specificity. 7-point scale in which '1' represented 'low degree' and '7' represented 'high degree./a	Survey	H_4	(-)	(-)
Control Variables					
sum_vc_invest_gral	VC activity by state/country. Mean 2000-2008 ($Mill)./b	/c		(+)	(-)
ag_gdp	Agricultural GDP by state/country in 2009 ($Mill)./b	/d			NS
merger_acquisition_dummy	Dummy=1 if portfolio company was acquired or merged with another firm; 0 otherwise.	*SDC*		(+)	(+)
lbo_dummy	Dummy=1 if portfolio company has received Leveraged Buyout (LBO) financing; 0 otherwise.	*SDC*		(+)	NS
ipo_dummy	Dummy=1 if portfolio company had an initial public offering; 0 otherwise.	*SDC*		(+)	(+)
start_early_stage_1st_round	Dummy=1 if startup or early investment stage at 1st round; 0 otherwise.	*SDC*		base	--
expansion_stage_1st_round	Dummy=1 if expansion investment stage at 1st round; 0 otherwise.	*SDC*			NS
later_stage_1st_round	Dummy=1 if later investment stage at 1st round; 0 otherwise.	*SDC*			NS
buyout_acquis_stage_1st_round_	Dummy=1 if buyout/acquisition investment stage at 1st round; 0 otherwise.	*SDC*			(-)
firm_size__mean	Total investment by investment firm(s) in all companies. Mean value when more than 1 investment firm. ($Mill).	*SDC*			(-)
sum_pe_invest_related	Private equity activity by state/country in agrifood related companies (VEIC 9500s) ($Mill)./b	*SDC*		(+)	NS

Allen and Lueck (1998) variables

cycles_less1	1 if farming activity has less than a production cycle per year; 0 otherwise./a	/e	H_5	(-)	--
cycles_equal1	1 if farming activity has on production cycle per year; 0 otherwise./a	/e	H_5	(-)	NS
cycles_more1	1 if farming activity has more than a production cycle per year; 0 otherwise./a	/e	H_5	base	--
under_cover	1 if farming activity under cover; 0 otherwise./a	/e	H_6	(+)	(+)
irrigated	1 if farming activity use irrigation; 0 otherwise.	/e	H_6	(+)	--

Note: DV=Dependent variable. 'Company' refers to portfolio company that received the investment. 'Firm' refers to investment firm. SDC= Venture Economics through Thomson Financial´s SDC Platinum VentureXpert. NS=Not statistically significant difference.

/a Average when company has more than 1 farming activity. /b By state for U.S. and by country for EU-15, Canada, Australia, and New Zealand. /c For U.S., Thomson Reuters, taken from the National Venture Capital Association 2009 Yearbook. For other countries (EU, Oceania), VentureXpert. /d For U.S., Regional Economic Accounts at the U.S. Bureau of Economic Analysis. For other countries (EU, Oceania), CIA World Factbook.[36] /e Based on Allen and Lueck (1998). Criteria for 'Cycles': "Included in CYCLES > I are hay crops, pasture, nursery crops, vegetables, and sugarcane (planted only once every 3-5 years); included in CYCLES = 1 are annual grain crops such as barley, rice, soybeans, and wheat; and included in CYCLES < 1 are tree fruits, nuts, and timber." (1998, p. 375)

The variables related to the Allen and Lueck (1998) model were computed for each of the 40 farm activities with measures on the asset specificity variables. Their values were adapted from Allen and Lueck's discussion and empirical analysis. Table 14 in the appendix reports the measures for these variables by farming activity. To my knowledge, there are not empirical applications of the Allen and Lueck (1988) model to explain organizational forms (family farm, partnership, and corporation) that I could use to adapt/refine the proxy variables in their empirical model.

Gains from specialization (H_5) is measured through the number of production cycles per year, where more cycles allows for specialization—'cycles<1', 'cycles=1', 'cycles>1'. *Variance in farm output (H_6)* (yield or productivity) is captured through an 'irrigation' dummy for crop/vegetable production; and an 'under cover' dummy for

[36] Access: https://www.bea.gov/regional/downloadzip.cfm; and https://www.cia.gov/library/publications/the-world-factbook/fields/2012.html, respectively.

farming activities such as fruit/vegetable production using green house or animal production under covered such as in poultry (non-cage-free). In both variables, I used a general classification for farming activity and information on the 'business description' of each company in the database to identify the use of irrigation or under cover production.

A set of control variables were included in the empirical analysis. I followed the established literature in corporate finance and included insights from the entrepreneurship literature as discussed in the literature review. Data constraints impeded the inclusion of some of the variables discussed in the literature.

Access to external equity was represented by venture capital activity (*sum_vc_invest_gral*) in the state/country where the portfolio company is located. I constructed another variable to capture access to external equity based on private equity activity in "related" industries (*sum_pe_invest_related*). For this measure, I relied on the 'total amount a company has received to-date from all investors' in agrifood industries (covering production, processing, and wholesale sectors, given by VEIC 9500s).

I used agricultural GDP (*ag_gdp*) by state/country to control for activity in the agricultural production sector. I also controlled by the size of the private equity firm(s) that invested in a portfolio company. I measured size of private equity firm through the sum of 'total investment by investment firm in all companies'.

Company stage and type of exit was controlled by three dummies—'IPO', 'LBO', and 'M&A'. Companies that go public (IPO) receive more total financing and a greater number of rounds than other companies such as those companies that are acquired (Gompers 1995).

Similarly, I included dummies to control for company development at the time it received its first investment from a private fund. Based on SDC VentureXpert classification of company development, four dummies were constructed—'startup/seed-early stage' (base), 'expansion', 'later stage', 'buyout-acquisition'.[37]

Another set of variables was computed based on SDC VentureXpert and other company databases but were not included in the regression analysis due to missing values problem. These variables are the following: total assets, number of employees, total sales, and total debt.

Finally, I included dummy variables for regions to control for macroeconomic and legal environment factors that might facilitate/constraint financial contracting between private firms and investors in the agricultural production sector, as well as the access to private equity investments. I included the following dummies: United States (base), Canada, European Union-15, and Oceania.

[37] SDC VentureXpert defines each stage of development as follows. *Startup/seed*. Companies that have not yet fully established commercial operations, and may also involve continuing research and product development. *Early stage*. Companies that are beyond the startup/seed stage with potentially continuing product development, as well as initial marketing, manufacturing, and sales activities. *Expansion*. Companies that have products and services currently available, but may require additional capital to expand production to increase revenue. *Later stage*. Companies that have an already established product or service that has already generated revenue, but may not be making a profit.

Descriptive statistics

Table 7 reports descriptive statistics of the variables used in the regression analysis and Table 8 reports the correlation matrix.

Table 7. Summary statistics for dependent and independent variables.

Variable	Unit/type	Obs	Mean	Std.Dev.	Min	Max
multiple_inv_funds_dummy	dummy	91	.23	.42	.00	1.00
multiple_inv_funds_ord	ord	91	1.42	0.84	1.00	4.00
inv_total_rcvd_ord	ord	46	2.54	1.13	1.00	4.00
physical_asset_specificity	(1-7)	97	4.76	0.81	2.60	6.80
temporal_specificity	(1-7)	97	4.93	1.31	2.73	7.00
site_specificity	(1-7)	97	4.62	.88	3.00	7.00
human_asset_specificity	(1-7)	97	5.37	1.00	3.82	7.00
sum_vc_invest_gral	($Mill)	98	3,398.83	4,798.23	13.80	15,567.07
sum_pe_invest_related	($Mill)	91	44.93	392.32	.43	1,154.14
ag_gdp	($Mill)	98	26,076.79	15,957.39	617.37	49,421.56
merger_acquisition_dummy	dummy	99	.05	.22	.00	1.00
lbo_dummy	dummy	99	.09	.29	.00	1.00
ipo_dummy	dummy	99	.09	.29	.00	1.00
start_early_stage_1st_round	dummy	80	.23	.42	.00	1.00
expansion_stage_1st_round	dummy	80	.45	.50	.00	1.00
later_stage_1st_round	dummy	80	.05	.22	.00	1.00
buyout_acquis_stage_1st_round	dummy	80	.28	.45	.00	1.00
(inv) firm_size_mean	($Mill)	80	9,263.75	20,081.91	.65	79,195.63
cycles_less1	dummy	97	.32	.46	.00	1.00
cycles_equal1	dummy	97	.07	.23	.00	1.00
cycles_more1	dummy	97	.62	.48	.00	1.00
irrigated	dummy	97	.03	.17	.00	1.00
under_cover	dummy	97	.32	.46	.00	1.00

Table 8. Correlation coefficients: dependent and independent variables

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	multiple_inv_funds_dummy															
2	multiple_inv_funds_ord	.91														
3	physical_asset_specificity	.45	.48													
4	temporal_specificity	.33	.24	.27												
5	site_specificity	.33	.16	.11	.67											
6	human_asset_specificity	.30	.31	.61	.40	.29										
7	sum_vc_invest_gral	-.37	-.35	-.05	.08	-.07	-.25									
8	ag_gdp	-.56	-.52	-.37	-.26	-.30	-.40	.08								
9	merger_acquisition_dummy	.25	.26	.17	.05	-.01	-.04	-.17	-.14							
10	lbo_dummy	.06	.18	.01	-.12	.07	.28	-.10	.01	-.07						
11	ipo_dummy	-.13	-.18	.02	-.01	.16	.06	.27	.13	-.12	-.08					
12	start_early_stage_1st_round	.08	.06	.20	.10	.11	.09	-.02	-.30	-.22	-.15	-.25				
13	expansion_stage_1st_round	.12	.10	-.05	-.01	-.02	-.14	-.11	.21	.14	-.15	.08	-.46			
14	later_stage_1st_round	-.21	-.19	.04	-.06	-.14	-.05	.19	.16	-.09	-.06	.47	-.19	-.18		
15	buyout_acquis_stage_1st_rd	-.09	-.05	-.17	-.06	-.02	.08	.03	.00	.14	.34	-.08	-.46	-.43	-.18	
16	(inv) firm_size__mean_	.26	.19	.24	-.08	-.06	-.12	.05	-.20	-.12	-.10	-.05	.14	-.02	.20	-.23

5. RESULTS AND DISCUSSION

5.1. Descriptive Analysis

Several differences emerge from the comparison of the private equity markets in the U.S. and Western Europe. The size of the private equity pool is significantly larger in the U.S. than elsewhere, even when measured as the ratio of the private equity investments to the size of the economy (GDP). For example, this ratio in 2007 was 0.9% for the U.S., 0.7% for the U.K., and 0.6% for France, Canada and Australia (Thomson Financial). When compared Western Europe versus the U.S., this ratio is two times higher in the U.S. Despite these important difference, there is a growing tendency of international private equity funds to invest in other developed countries (Manigart, De Prijcker and Bose

2010). For example, 1/3 of the private equity amount raised in Europe in the period 2003-2007 is dedicated to nondomestic investments (EVCA).[38] Similarly, the proportion of the private equity funds raised from foreign sources is 50% in Europe and 10% in the U.S. (Wright, Pruthi and Lockett 2005).

Before I get to analyze the determinants of the use of external equity finance with the help of regression analysis, I first investigate the differences between companies in agriculture that received external equity financing in Europe (EU-15) and North America. Table 9 reports this comparison for the 99 companies in the dataset distributed as follows: 32 in U.S., 20 in Canada, 36 in EU-15, 11 in Australia and New Zealand. I focus on the analysis of those variables that reported statistical significant difference in the mean test between the group of companies grouped in EU-15 and the ones in North America.

An interesting feature of the comparison between the companies in North America and EU-15 is that the difference on the dependent variables is not statistically significant. This is an interesting feature because it suggest that it is worthwhile asking whether the differences among companies that receive external equity capital are linked to industry- and company-specific characteristics rather than country or region differences.

The difference for the variable physical-asset specificity is statistically significant at 1%, which indicates that the farming activities of the companies that received private equity investments in EU-15 rely more on non redeployable physical assets that the companies in North America.

[38] European Venture Capital Association.

Table 9. Comparison of companies in agricultural production using external private equity: North America, EU-15, and Australia - New Zealand.

Variable[/a]	Unit/type	U.S.-Can Obs	U.S.-Can Mean	EU-15 Obs	EU-15 Mean	Mean-test U.S. v. EU [/b]	AU-NZ Obs	AU-NZ Mean
Companies	(N)	52		36			11	
firms_invested_in_company	(N)	46	1.5	34	1.2	N.S.	11	1.3
funds_invested_in_company	(N)	46	1.7	34	1.3	N.S.	11	1.4
total investments company received to-date from all investors	($Thou)	22	7,425.9	13	7,495.8	N.S.	11	17,060.5
Explanatory Variables								
physical_asset_specificity	(1-7)	50	4.5	36	5.2	***	11	4.1
temporal_specificity	(1-7)	50	5.2	36	4.7	N.S.	11	4.6
site_specificity	(1-7)	50	4.8	36	4.5	*	11	4.4
human_asset_specificity	(1-7)	50	5.2	36	5.7	*	11	5.0
cycles_less1	dummy	50	0.3	36	0.2	N.S.	11	0.5
cycles_equal1	dummy	50	0.1	36	0.1	N.S.	11	0.1
irrigated	dummy	50	0.0	36	0.0	N.S.	11	0.0
under_cover	dummy	50	0.4	36	0.3	N.S.	11	0.2
Control Variables								
sum_vc_invest_gral	($Mill)	51	4,546.7	36	2,529.0	**	11	923.7
same_econ_region (investor and company) [/a]	dummy	34	0.5	27	0.9	***	11	15.9
age_firm_vc[/a]	(Years)	42	28.6	31	24.8	N.S.		
merger_acquisition_dummy	dummy	52	0.1	36	0.0	N.S.	11	0.1
lbo_dummy	dummy	52	0.0	36	0.2	***	11	0.0
ipo_dummy	dummy	52	0.1	36	0.0	N.S.	11	0.3
start_early_stage_1st_round	dummy	41	0.2	30	0.2	N.S.	9	0.1
expansion_stage_1st_round	dummy	41	0.5	30	0.3	**	9	0.7
later_stage_1st_round	dummy	41	0.1	30	0.0	N.S.	9	0.0
buyout_acquis_stage_1st_round	dummy	41	0.1	30	0.5	***	9	0.2
firm_size_mean	dummy	39	13,356.4	30	6,422.5	N.S.	11	2,502.4
diversif_horiz_related[/a]	dummy	29	0.2	27	0.3	N.S.		
diversif_vertical_related[/a]	dummy	27	0.6	24	0.6	N.S.		

* Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level.
N.S.=Not statistically significant.

[/a] The description of the main variables is reported in Table 6. Additional variables are described here: *diversif_horiz_related*: =1 if company diversifies into horizontal related products (e.g., corn and beef); *diversif_vertical_related*: =1 company diversifies into vertical related products age_firm_vc: Age of PE firms invested in portfolio company (average); *same_econ_region*: dummy=1 if portfolio company and

investment firm are located in the same region; =0 otherwise. Economic regions refer are defined as follows. U.S.: 1 Appalachian, 2 Corn Belt, 3 Delta States, 4 Lake States, 5 Mountain, 6 Northeast, 7 Northern Plains, 8 Pacific, 9 Southeast, 10 Southern Plains, 11 Alaska/Hawaii. Canada: 11 Central Canada, 12 East Coast (CAN), 13 Northern Canada, 14 The Prairies (CAN). Europe: 15 Southern Europe, 16 Northern Europe, 17 Western Europe

[b] Two-sample t-test with unequal variances. I ran proportion test (prtest) for dummy variables and results do not change.

The agricultural companies that receive private equity in North America are located in states with venture capital pool (VC activity), on average, almost two times higher than the venture capital pool of the countries of the European agricultural companies. As described above, this feature has been documented as a characteristic of the private equity industry.

The percentage of the European agricultural companies that received investments from a private equity firm located in a different country is significantly higher than the proportion of companies in North America that receive investment from a firm located in a different state. This feature does not surprise given the description of the private equity industry discussed above and tendency of international private equity funds investing in other developed countries.

The proportion of companies that exit via leveraged buyout is higher for the companies in the EU-15 than in North America. This results is aligned with the statistics for the whole private equity industry, where the buyout industry in Europe is much larger than the early-stage financing industry (Manigart, et al. 2010, p. 396).

Similarly, based on the variables that indicate the company development at the time it received its first investment from a private equity fund, the 47% of the companies in the EU-15 were at buyout-acquisition stage when they received their first investment (compared to 15% of the companies in North America). The 54% of the companies in

North America were at expansion stage when received their first investment, a proportion that is statistically higher than the 27% for the European companies. These results are, to some extent, aligned with the statistics reported by (Kraeussl and Krause 2011). They analyze a sample data of 51,994 firms that received VC from the U.S. and all EU-15 (period 1985-2008) and find that for the U.S., nearly an equal number of mature versus infant companies were financed. A different picture is found in the EU-15 where almost ¾ of the companies financed were mature firms.

Table 10 reports the number companies in agricultural production using external private equity by their primary product in North America, Europe (EU-15), and Australia and New Zealand. Among the 99 companies in the final sample, the most common primary product is fishing/aquaculture (25), followed by forestry (19), meat (16) and some type of vegetable production (15). Among the 52 private companies in North America, the most common primary product is related to forestry and followed by fishery.

Table 10. Number of companies in agricultural production using external private equity by primary product and region

Primary product group	North America	EU-15	AU-NZ	Total
Crop	4%	3%	9%	4%
Fish	19%	33%	27%	25%
Forestry	23%	14%	18%	19%
Fruit	8%	3%	9%	6%
Garden	13%	8%	0%	10%
Meat	13%	19%	18%	16%
Vegetable	6%	3%	0%	4%
Other	13%	17%	18%	15%
Total (N of Companies)	52	36	11	99

5.2. Regression Analysis

The empirical model is designed to test the influence of asset specificity variables on the use of external equity finance by companies in agricultural production. Table 11 reports the hypotheses tested in this study.[39]

The dependent variable multiple investment funds (*multiple_inv_funds_dummy*) indicates the level of investments that a company receives from external private equity investors. This is a dummy variable that equals 1 if the company receives two or more funds (and equals 0 otherwise). I use the probit econometric model that presents advantages over linear probability model using a binary dependent variable.

For robustness, I use two additional specifications for the dependent variable—use of external equity finance. I use an ordinal variable based on the 'number of investment funds received by company'. This dependent variable (*inv_funds_ord*) takes the value of 1 if 1 fund was invested in company, 2 if 2 funds, 3 if 3 funds; 4 if 4 or more funds were invested in company. The second specification is an ordinal measure of the 'total amount a company has received to-date from all investors' (*inv_total_rcvd_ord*). Ideally, I would use this variable in the preferred model but the number of observations used in the regression is significantly reduced due to missing values in this variable. For that reason, I use this variable for robustness check of the results. Because of the ordinal nature of these two dependent variables, I use an ordered probit model.

[39] Different from the capital structure studies, this research focuses on the use of external equity capital. That is, internal equity is not addressed in the empirical test or in the hypotheses discussion. A variable that captures the level of internal equity such as debt-to-asset ratio could be included as a control variable but this variable was not available for most companies in the database used in the empirical test.

Table 11. List of hypotheses.

H_1: the higher the level of physical-asset specificity, the higher the probability a firm uses external equity finance.
H_2: the higher the level of temporal-asset specificity, the higher the probability a firm uses external equity finance.
H_3: the higher the level of site-asset specificity, the higher the probability a firm uses external equity finance.
H_4: the higher the level of human-asset specificity, the lower the probability a firm uses external equity finance.
H_5: The higher the gains from specialization for a firm/project, the higher the needs for external funding, and hence, the higher the probability of using external equity capital.
H_6: The greater the effect of random shocks in farming output, the lower the probability of using external equity capital.

Regression results

Table 12 reports the regression results. In Model 1, I report the probit estimates of the asset specificity variables on multiple investment funds. The results in Model 1 indicate the following. As expected, companies in farming activities that involve higher levels of physical-asset specificity are more likely to receive external equity investment from a higher number of funds, which is interpreted as using more external equity finance. The positive and statistically significant at 1% level of the estimate of physical-asset specificity corroborates H_1.

As expected, companies in farming activities that involve higher levels of temporal-asset specificity are more likely to use higher levels of external equity finance. The positive and statistically significant at 1% level of the estimate of temporal-asset specificity corroborates H_2.

Table 12. Probit and ordered probit regressions estimating the use of external equity by companies in agriculture.[/a]

	Model 1	Model 2	Model 3[/b]	Model 4	Model 5
	Probit	Probit, A&L (1998)	Probit, (combined)	Ordered Probit	Ordered Probit
Dependent Variable:	*multiple funds dummy[/c]*	*multiple funds dummy[/c]*	*multiple funds dummy[/c]*	*multiple funds ordinal[/d]*	*investment received ordinal[/f]*
physical_asset_specificity	1.191 ***		1.259 *	1.383 ***	0.156
	(2.830)		(1.810)	(2.730)	(0.450)
temporal_specificity	0.863 ***		0.930 ***	0.495 *	0.464 ***
	(2.540)		(2.640)	(1.720)	(2.470)
site_specificity	-1.046 ***		-1.126 ***	-1.054 ***	-0.782 ***
	(2.880)		(3.220)	(3.100)	(2.990)
human_asset_specificity	-0.842 *		-0.658	-0.688	-0.318
	(1.890)		(1.400)	(1.520)	(0.760)
cycles_less1		0.180	0.954		
cycles_equal1		[/e]	[/e]		
under_cover		0.950 **	0.301		
irrigated		[/e]	[/e]		
Control variables					
L_sum_vc_invest_gral	-0.493 **	-0.535 ***	-0.546 **	-0.739 ***	0.080 ***
L_ag_gdp	-0.563	-0.164	-0.519	-0.055	-0.608
eu_15_dummy	-0.602	-0.348	-0.931	-1.548	0.621
canada_dummy	1.608	0.164	1.371	0.365	
au_nz_dummy	1.217	-0.200	0.960	0.272	0.163
merger_acquisition_dummy	2.548 **	2.243 ***	2.400 ***	1.558 **	0.321
lbo_dummy	1.105	-0.157	1.163	1.860 **	
ipo_dummy	2.316 **	0.469	1.937 **	1.639 *	0.039
expansion_stage_1st_round	-0.708	-0.466	-0.678	0.043	1.556 ***
later_stage_1st_round	-1.654	-0.469	-1.624	-1.071	0.288
buyout_acquis_stage_1st_round	-1.186 **	-1.275 ***	-1.152 **	-0.989 **	1.707
L_firm_size_mean_	0.356 ***	0.290 ***	0.363 ***	0.347 ***	0.091
Number of observations	74	71	71	74	43
Goodness-of-fit measures:					
Log pseudolikelihood	-16.665	-20.719	-16.144	-32.822	-47.360
Prob > chi2	0.001 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Pseudo R2	0.622	0.503	0.613	0.504	0.204
Correct predictions (%)	91.892		91.045		

Notes: * Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level
The table reports the probit coefficients and absolute values of z-statistics (in parenthesis). Estimations used robust standard errors.

[a] Included Farms Businesses in the U.S., Canada, EU-15, Australia, and New Zealand.
[b] Model (1) and (2) combined.
[c] DV: multiple_inv_funds_dummy; Dummy=1 if two or more funds were invested in company; 0 if 1 fund was invested.
[d] DV: multiple_inv_funds_ord; Ordinal (1-4): 1 if 1 fund was invested in company; 2 if 2 funds; 3 if 3 funds; 4 if 4 or more funds were invested in company.
[e] Variable dropped from the estimation (Stata).
[f] DV: inv_total_rcvd_ord; total known amount a company has received to-date from all investors. Ordinal (1-4): 1 if tot inv rcvd < 25pctile; 2 if b/ 25&50th; 3 if b/50&75th; 4 if >75th.

In relation to the effect of site specificity, the result is unexpected. Companies in farming activities with higher levels of site specificity are less likely to use external equity from several investment funds. With this result (negative sign and statistically significant at 1% level), H_3 is not corroborated. The interpretation of this result requires further analysis. For instance, the robustness check presented in the next subsection suggests that this result is not associated with multicollinearity problems. Lafontaine and Slade (2007) review the literature on vertical integration and firm boundaries and conclude that "The evidence concerning site specificity … is not very conclusive" (p. 655).[40] To my knowledge, there are no empirical studies testing the effect of site specificity on financial mechanisms.

Finally, as expected, human-asset specificity has a negative effect on receiving investment from several funds. In this case, the estimate of human-asset specificity has negative sign and is marginally statistically (significant at 10% level). This result indicates that companies in farming activities that involve higher levels of human-asset

[40] Of three studies that address the effect of site specificity on vertical integration identified by Lafontaine and Slade (2007) , one finds a significant positive effect on vertical integration (Joskow 1985), once has negative but not significant effect (Masten, meehan Jr and Snyder 1989), and the other one has positive but not significant effect (Masten, et al. 1989).

specificity are less likely to use investment from several funds, which is interpreted as using less external equity finance.

Model 2 and Model 3 are used to compare the asset specificity model discussed in this study with the Allen and Lueck (1998) model. The comparison of these two models is important for two reasons. As explained in the theoretical section, the Allen and Lueck (1998) model is a significant contribution to the analysis of organizational forms in farming agriculture. In addition, Allen and Lueck's model dismisses asset specificity as a relevant factor to explain organizational choices in agriculture.

In the specification of Model 2, I use the same control variables used in Model 1 and include Allen and Lueck's variables—cycles, under cover, and irrigation. The results of Model 2 indicate that cycles is not statistically significant, meaning that those farming activities that have more cycles per year, and hence, have higher gains from specialization, are not necessarily more likely to adopt the partnership organizational form that involves equity participation from several funds. Based on the results of Model 2, H_6 is not corroborated.

In relation to the variable 'under cover', the estimate is positive and statistically significant at 5% level. This result indicates that those farming activities that are performed in greenhouses (i.e., under cover), meaning that can control the effects of mother nature and have more stable output, are more likely to use external equity from several funds. This result corroborates H_6.

Overall, the estimates in Model 2 partially corroborate Allen and Lueck's model. The next step in the comparison of the asset specificity model and the Allen and Lueck (1998) model was to run a model that combines both sets of explanatory variables.

The specification of Model 3 combines the explanatory variables of the asset specificity model (Model 1) and the Allen and Lueck's model (Model 2) and its estimates leads to the following interpretation. The sign of all four asset specificity variables remained unchanged (compared with Model 1) and the estimates of temporal-asset specificity and site-specificity remain significant at the 1% level. The level of significance of the estimate of physical-asset specificity is 10% in Model 3 and human-asset specificity is not statistically significant. The estimates of the Allen and Lueck's variables are not statistically significant, which indicates that under the presence of the asset specificity variables those repressors do not have a statistically significant effect in the dependent variable. It is important to mention that the effect of the control variables remain roughly the same in these three models (Models 1, Model 2, and Model 3).

Although the repressors in the Allen and Lueck model do not have a significant effect in the regression analysis presented here, this result needs further analysis to reach a conclusion in the comparison of the models. As discussed in the theoretical framework, the model developed by Allen and Lueck (1998) and the asset specificity model are approached as complementary rather than substitute.

Control variables

Specific factors at the country/region were controlled with the inclusion of the following dummies: EU-15, Canada, and Australia - New Zealand (with companies in the U.S. as the baseline). These dummies control for factors such as macro-economic and legal environment that might facilitate/constraint the use of external equity finance by agricultural companies. Surprisingly, none of these dummies has a statistically significant effect on the use of external equity finance.

This finding indicates that the differences in the use of external equity finance may not be attributed to intrinsic difference between countries and regions, but to company- and industry-specific characteristics. This finding constitutes an interesting result that certainly complements the results discussed above based on the asset specific variables.

Robustness analysis

For robustness analysis, I run two additional models regressing the same explanatory variables used in Model 1 on two different specification of the dependent variable. In addition, I check for potential econometric problems such as heteroskedasticity and multicollinearity.

The specification of Model 4 shares the same explanatory and control variables used in Model 1 and the only difference is that the dependent variable is ordinal, indicating different levels of the number of funds received by each company. The purpose of this model is to check if the results change when using an ordinal specification for the 'number of funds received' (versus a dummy variable). The sign of the asset specificity variables remain unchanged and there is a slight change in the statistically

significance of the variable temporal-asset specificity, which remains statistically significant at 10% level. Overall, the results do not change substantially which shows robustness in the regression results.

In the specification of Model 5, the explanatory variables used in Model 1 are regressed on an ordinal measure of the 'total amount a company has received to-date from all investors' (*inv_total_rcvd_ord*). The comparison between the results of Model 5 and Model 1 are the following. The sign and statistical significance remain unchanged for temporal- and site-asset specificity (remain statistically significant at 1% level). Physical- and human asset specificity are no longer statistically significant. As explained above, this dependent variable suffers from missing values, which reduces the number of observations in the regression from 74 to 43. For that reason, this variable is used here for robustness check and, in particular, to justify the use of the variable 'multiple investment funds' as a proxy for the level of investments received by a company. In sum, although the estimates of this model do not fully corroborates Model 1, the results are in a great extent aligned considering the limitation of Model 5 associated with a lower number of observations.

To check for heteroskedasticity, I run the same variables (dependent and independent ones) in Model 1 using OLS regression and performed the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity (hettest command in Stata). The result is 'fail to reject' the hypothesis of constant variance which allows to argue that the model does not suffer from heteroskedasticity problems. However, the use of this procedure in the absence of a test for heteroskedasticity in probit should be interpreted as an approximation.

I check for potential multicollinearity problems among the following three asset specificity variables: physical-asset specificity, temporal-asset specificity, and site specificity. For this purpose, I run Model 1 but using one of these variables at a time. The sign and statistical significance do not change in the three regressions and are the same as Model 1 reported in Table 12. This result indicates that the estimates for these variables are robust.

6. CONCLUSION

The main finding of this study is that the asset specificity model has a significant effect at explaining why some companies receive investment from multiple funds as opposed to only one fund, which indicates the use higher total amount of investment from external equity investors. The differential attributes of the assets involved in agricultural production constitute an important source of variation across farm activities and a key factor to explain financing choices in agriculture.

External equity capital in the agricultural sector has received little academic attention. Although scholars have addressed the effect that the non-depreciable attribute of farmland has on the financing of agriculture, the literature on agricultural finance has little to say about the effect that other attributes of the assets involved in agriculture have on the use of alternative financing mechanisms. In this context, the contribution of this study to this literature is twofold. First, it goes beyond previous studies and identifies factors at the firm level that explain the use of external equity capital in farming

businesses. Second, it introduces and develops the analysis of differences across farm activities. In particular, it addresses the implication that difference in the assets involved in a farm activity has on the financial choices.

An implication of these results for the transaction cost literature is that the asset specificity approach to financing decisions is useful to understand financing problems in agriculture. The explanation to why the asset specificity approach has not been influential in the finance literature can be attributed, to some extent, to measurement problems as opposed to lack of explanatory power.

In addition, this study contributes to the discussion on what types of asset specificity play an important role in agriculture. Masten (2000) argues that temporal-and site-asset specificity play an important role in agriculture, suggesting that physical- and human-asset specificity are of limited importance. Moreover, Allen and Lueck (1998) explicitly dismissed physical-asset specificity from their model and argued that they incorporate an agricultural version of temporal specificity. The results presented in this chapter suggest that asset specificity should be included in a model that attempts to explain organizational choices in agriculture and that physical-asset specificity plays a relevant role in agriculture.

While controlling for country-specific factors, this study explores the differences at the company and industry level that explain differences in the use of external equity finance. The results of this study suggest that the intrinsic differences between country/region characteristics do not play a relevant role to explain financing differences of companies in the agricultural sector. Key differences across industries are relevant to explain this phenomenon. Moreover, the interaction between company strategy and the

attributes of the assets involved in the productions of the primary products seems to have an important role at explaining financing issues in agriculture. In this context, this study constitutes a step towards explaining difference in the use of external equity finance in agriculture and the results suggest that it is worthwhile continuing in this direction for future research.

This study suffers from the following limitations. As discussed in the data section (4.1), ideally the dataset for the empirical analysis would include not only companies that received external private equity finance but also a control group of private firms that do not use external private equity. Such control group would allow to test the effect of the asset specificity variables on the decision to use external equity capital. Nevertheless, the model employed in this study provides unique information to understand the effect of the asset specificity variables on the level of external equity funds that a firm in agriculture receives.

The data available in SDC database provides information on each company that received private equity funding. The variables associated with the characteristics of the companies encompass information on the last year the company information was updated. That is, this database does not provide company characteristics at each investment round that a company receive investments. This limitation is relevant because, were they available, company information by year or at each investment round would allow to build a panel. This would allow to pursue further analysis on how changes in firm characteristics and strategies (e.g., diversification) affect the decision to use external equity capital.

Finally, this study suffers from a common limitation in the empirical literature on transaction cost economics, which is the selection problem. That is, the idea that the observed contractual arrangements are the efficient ones, meaning that the market forces are strong enough to select the most efficient arrangements (Masten 1993; Yvrande-Billon and Saussier 2005; Sykuta 2008). This assumption is more or less problematic depending on the data and the sector under study. The less precise are companies in their organizational choices, the smaller will be the estimated effect of a given characteristic of the transaction on the arrangement choice (Yvrande-Billon and Saussier 2005).

Private equity investors play an important role in the review of proposed investments and, hence, companies that receive external equity are usually extensively scrutinized. Moreover, the use of private equity capital is less influenced by government programs designed to help farmers though, for example, subsidized credit capital. In that respect, it is possible to argue that there are no clear forces that might lead to less precise decisions on the use of external equity capital. In that respect, the selection problem, although existent, might be less problematic in this study.

In addition, as pointed out by Yvrande-Billon and Saussier (2005), "Without controlling the selection process at stake in studied transaction and collecting data on performances, empirical researchers are not able to assess how much organization choices matter for performance." In that respect, it is important to mention that this study does not address the performance implications of the decision to use external equity capital by companies in agriculture. This is certainly an avenue for future research and this consideration about the importance of controlling the selection process should guide the empirical design.

APPENDIX

Table 13. Measures of asset specificity by farming activity.

Farming activity	SIC /a	NAICS	Asset specificity variables			
			Physical /b	Temporal /b	Site /b	Human /b
Corn Farming	0111	111140	2.7	3.0	3.8	4.6
Rice Farming	0112	111160	3.6	4.3	5.0	5.8
Soybean Farming	0115	111150	2.6	3.3	3.9	4.6
Wheat Farming	0116	111110	2.6	2.7	3.5	4.1
Barley Farming	0119a	111199	2.7	3.4	3.6	3.8
Cotton Farming	0131	111920	3.7	3.6	3.8	4.8
Tobacco Farming	0132	111992	4.7	5.4	3.4	5.7
Sugarcane Farming	0133a	111930	5.3	7.0	7.0	6.0
Sugar Beet Farming	0133b	111991	4.0	7.0	7.0	7.0
Potato Farming	0134	111211	5.0	5.0	4.7	6.0
Hay Farming	0139b	111940	3.4	3.4	3.7	4.1
Peanut Farming	0139c	111992	4.1	4.0	4.5	4.8
Berry Farming	0171	111333, 111334	4.3	6.2	5.8	5.4
Deciduous Tree Fruits (apple orchards and other noncitrus fruit)	0172	111332	4.4	6.2	4.2	5.8
Grape Vineyards	0173	111335	5.7	6.0	6.0	7.0
Orange Groves	0174	111310, 111320	3.1	5.0	4.7	5.0
Tree Nut Farming	0175	111331, 111339	4.2	4.8	4.5	6.3
Nursery and Tree Production	0181a	111421	5.2	4.6	3.9	5.4
Floriculture Production	0181b	111422	5.3	5.8	3.4	5.2
Mushroom Production	0182a	111411	5.7	7.0	7.0	7.0
Food Crops Grown Under Cover	0182b	111419	4.6	6.2	5.6	5.0
Beef Cattle Feedlots	0211	112112	4.2	4.9	4.4	5.2
Beef Cattle, Pasture Base	0212	112111	3.0	3.6	3.5	4.5
Hog and Pig Farming	0213	112210	5.5	6.0	4.3	6.0

Sheep/Goat Farming	0214	112410, 112420	3.8	4.0	4.3	5.0
Dairy, Confinement	0241	112120	5.2	6.6	5.0	5.5
Dairy, Pasture Base	0241b	112120b	5.1	6.6	5.0	5.7
Broiler, Caged	0251	112320	5.3	4.8	5.3	5.5
Broiler, Cage-Free	0251b	112320b	6.4	6.3	6.7	6.7
Chicken Egg Production	0252	112310	5.9	5.5	4.7	5.5
Turkeys and Turkey Eggs	0254	112340	4.3	3.0	4.0	3.3
Duck Farming	0259a	112390	6.7	6.0	3.0	4.0
Horse and Other Equine Production	0272	112920	4.4	3.5	3.0	5.7
Finfish Farming and Fish Hatcheries	0273a	112511	5.7	4.0	4.5	7.0
Shellfish Farming	0273b	112512	4.1	7.0	5.5	5.0
Finfish Fishing	0912	114111	4.6	6.0	4.7	6.2
Shellfish Fishing	0913	114112	4.4	6.7	6.3	6.0
Forest Nurseries and Gathering of Forest Products	0811	113110	5.1	3.5	4.0	4.5
Timber Tract Operations	0831	113210	3.8	3.1	4.3	3.8

/a Letters after SIC code (4-digits) indicate variations not contemplated in the SIC classification.

/b Source: Survey to credit officers conducted for this study.

Table 14. Measures of Allen & Lueck (1998) variables by farming activity.

Farming activity	SIC /a	NAICS	Cycles<1 /b	Cycles=1 /b	Cycles>1 /b	Under cover /b /c
Corn Farming	0111	111140	0	1	0	0
Rice Farming	0112	111160	0	1	0	0
Soybean Farming	0115	111150	0	1	0	0
Wheat Farming	0116	111110	0	1	0	0
Barley Farming	0119a	111199	0	1	0	0
Cotton Farming	0131	111920	0	1	0	0
Tobacco Farming	0132	111992	0	1	0	0
Sugarcane Farming	0133a	111930	0	0	1	0
Sugar Beet Farming	0133b	111991	0	0	1	0
Potato Farming	0134	111211	0	0	1	0
Hay Farming	0139b	111940	0	0	1	0

Peanut Farming	0139c	111992	0	0	1	0
Berry Farming	0171	111333, 111334	0	0	1	0
Deciduous Tree Fruits	0172	111332	1	0	0	0
Grape Vineyards	0173	111335	1	0	0	0
Orange Groves	0174	111310, 111320	1	0	0	0
Tree Nut Farming	0175	111331, 111339	1	0	0	0
Nursery and Tree Production	0181a	111421	0	0	1	1
Floriculture Production	0181b	111422	0	0	1	1
Mushroom Production	0182a	111411	0	0	1	1
Food Crops Grown Under Cover	0182b	111419	0	0	1	1
Beef Cattle Feedlots	0211	112112	0	1	0	0
Beef Cattle, Pasture Base	0212	112111	1	0	0	0
Hog and Pig Farming	0213	112210	0	0	1	1
Sheep/Goat Farming	0214	112410, 112420	0	1	0	0
Dairy, Confinement	0241	112120	0	0	1	1
Dairy, Pasture Base	0241b	112120b	0	0	1	0
Broiler Caged	0251	112320	0	0	1	1
Broiler Cage-Free	0251b	112320b	0	0	1	1
Chicken Egg Production	0252	112310	0	0	1	1
Turkeys and Turkey Eggs	0254	112340	0	0	1	1
Duck Farming	0259a	112390	0	0	1	0
Horse and Other Equine Production	0272	112920	1	0	0	0
Finfish Farming and Fish Hatcheries	0273a	112511	0	0	1	0
Shellfish Farming	0273b	112512	0	0	1	0
Finfish Fishing	0912	114111	0	0	1	0
Shellfish Fishing	0913	114112	0	0	1	0
Forest Nurseries and Gathering of Forest Products	0811	113110	1	0	0	0
Timber Tract Operations	0831	113210	1	0	0	0

/a Letters after SIC code (4-digits) indicate variations not contemplated in the SIC classification.

/b Source: Adapted from Allen and Lueck (1998). Criteria for 'Cycles': "Included in CYCLES > I are hay crops, pasture, nursery crops, vegetables, and sugarcane (planted only once every 3-5 years); included in CYCLES = 1 are annual grain crops such as barley, rice, soybeans, and wheat; and included in CYCLES < 1 are tree fruits, nuts, and timber." (1998, p. 375)

/c Related to reduction of random forces and, hence, reducing variance in output.

CHAPTER V DISSERTATION SUMMARY

This dissertation analyzes several issues on external equity financing in agriculture. The use external private equity by companies in agriculture has increased since the 1990s and it represents a relevant phenomenon for several reasons. Agriculture is an interesting setting where, traditionally, capital for investment projects comes either from internal equity (the farmer, retained earnings, or other family members) or from credit organizations as debt capital. In addition, the option of public equity is usually restricted for companies in agriculture.

The private equity capital has developed rapidly in several sectors as an important source of funding for private middle market companies, firms in financial stress, and as growth capital. This source of capital plays a critical role at financing companies that pose numerous risks and uncertainties that discourage other investors. Moreover, private equity capital is associated with entrepreneurial activity.

The farming sector has been traditionally approached as a sector with idiosyncratic characteristics. The most distinctive one is the exposure to random shocks due to Mother Nature and the seasonal forces of the biological production process (Holmes 1928; In: Allen and Lueck 1998). Another important distinction addressed in the agricultural finance literature is the high capital intensity and low asset liquidity of the sector, which derives from the dominance of farmland in the asset structure (Barry and Robison 2001).

This dissertation focuses on the analysis of another important characteristic of the agricultural sector, which is the differential redeployability of the assets involved in the

production of different agricultural products. Whereas some farm activities heavily rely on highly redeployable assets, farmland being the most distinctive one; other farm activities rely on single-purpose equipment and facilities that are, in certain cases, non-redeployable. That is, this study abandons the traditional approach of treating capital as an undifferentiated kind.

The two main results of this dissertation are summarized here. First, I develop a taxonomy of farming activities that share similar attributes of the assets involved in the production process. More than 30 farm activities are grouped in six clusters that conform a clear continuum on the different types of asset specificity—physical, temporal, site, and human.

This taxonomy contributes to the understanding of the differences among farm activities and allows to explore commonalities and comparison between the farm activities in each group, and its implications in terms of contracting and financing decisions. On the financial implication, there is a high association between the key determinant within the transaction cost approach—relationship specific assets—and the factors taken into account by credit officers when evaluating the collateral in the lending process. That is, because the attributes of the assets used as collateral allows to distinguish groups of farming activities that involve higher risks from the lender's point of view, this taxonomy is particularly useful to analyze financial issues in the farming sector.

Cross-industry studies have largely relied on industry classification systems such as the Standard Industrial Classification (SIC) to group industries within major economic sectors. The classification developed here offer an alternative way to group industries

within the agricultural sector. This classification is more theoretically sound and groups together farming activities that share similarities in terms of the type of investments, contractual risks, and organizational challenges. This aspect facilitates the comparative analysis of industries in this sector.

The second mayor finding is that the asset specificity approach to finance has a significant effect at explaining why some companies in agriculture receive investment from multiple funds as opposed to only one fund, which indicates the use higher total amount of investment from external equity investors. This result suggests that the differential attributes of the assets involved in agricultural production constitute an important source of variation across farm activities and a key factor to explain financing choices in agriculture.

An implication of this result for the transaction cost literature is that the asset specificity approach to financing decisions is useful to understand financing problems in agriculture. The explanation to why the asset specificity approach has not been influential in the finance literature can be attributed, to some extent, to measurement problems as opposed to lack of explanatory power.

In addition, this study contributes to the discussion on what types of asset specificity play an important role in agriculture. Masten (2000) argues that temporal-and site-asset specificity play an important role in agriculture, suggesting that physical- and human-asset specificity are of limited importance. Moreover, Allen and Lueck (1998) explicitly dismissed physical-asset specificity from their model and argued that they incorporate an agricultural version of temporal specificity. The results presented in this Chapter IV suggest that asset specificity should be included in a model that attempts to

explain organizational choices in agriculture and that physical-asset specificity plays a relevant role in this sector.

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VITA

Mario Mondelli received his doctoral degree in applied economics from the University of Missouri in 2011. Before moving to Columbia-Missouri in 2007, he completed his master studies in economics at the University of São Paulo and performed research in the Agribusiness Intelligent Center (PENSA-USP). He pursued his undergraduate studies in agronomy at the University of Uruguay (UDELAR) and worked as a research assistant at the Centre for Economic Research (CINVE-Uruguay). His research fields are economics of contracts and organizations, agribusiness economics and entrepreneurship.