THE PORTFOLIO PROBLEM IN AGRICULTURAL COOPERATIVES:

AN INTEGRATED FRAMEWORK

A Dissertation

presented to

the Faculty of the Graduate School

University of Missouri

In Partial Fulfilment

Of the Requirements for the Degree

Doctor of Philosophy

by

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JULY 2005

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THE PORTFOLIO PROBLEM IN AGRICULTURAL COOPERATIVES:

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Presented by Bradley Plunkett

A candidate for the degree of Doctor of Philosophy

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

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O'Brien

DEDICATION

I dedicate this work to my long suffering family who bring me such joy. It is especially dedicated to my father, from whom I have learnt perseverance.

ACKNOWLEDGEMENTS

I wish to acknowledge the many hours of discussion with, and support from, my committee, in particular my supervisor, Dr. Michael Cook, and fellow graduate students, in particular Frayne Olson and Elaine Farmer. It is this interchange within a prevailing collegial culture that has resulted in an experience so conducive to academic endeavor.

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ABSTRACT

A portfolio problem within agricultural cooperatives arises as a result of the traditional cooperative's property rights structure. As members' investment is proportionally tied to volume of patronage, they are prevented from adjusting their cooperative investment to reflect their appetite for risk *at the cooperative level*. If members develop differing preferences as to how the cooperative should best invest their capital, then conflict between sub groups of members may develop as to which forms of cooperative investment are preferred.

The study develops a framework to test and extend our understanding of the scope of the problem. It examines the business strategies and structures of three cooperatives and utilizes membership surveys to test if sub groups had different investment preferences. It conceptualizes a *lateral* portfolio problem as conflict arising between increasingly specialized members of a diversified cooperative. Highly specialized members will tend to prefer cooperative investment that reflects their on-farm specialization while more diversified members will prefer cooperative investment that reflects their on-farm diversification. It conceptualizes a *vertical* portfolio problem as conflict arising between members with different growth strategies within a single commodity cooperative. Members with high growth strategies will tend to prefer cooperative investment that will underpin their on-farm investment, while relatively low growth members will tend to prefer investment that increases commodity prices.

The study demonstrates that there are trade offs in designing strategies to deal with these problems. What may appear to be a successful strategy in the short run may present new challenges in the future.

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CHAPTER ONE

INTRODUCTION

The Portfolio Issue as a Topic of Interest to Economists

1. The Defined Scope of the Portfolio Problem to Date

The agricultural cooperative portfolio investment constraint, as it relates to farmer member investment preferences at the cooperative level, has been postulated to exist since Vitaliano first described it in 1985 as a property rights problem endemic to the cooperative form of business. He argued that the lack of a liquid secondary market for residual claims implied that members were unable to adjust their cooperative portfolio to suit their risk preferences and consequently members usually preferred business decisions associated with lower levels of risk.

Cook (1995) developed a framework which identified the portfolio problem as one of a family of five agency type conflicts that have potential to emerge in any type of business organization; two are related to control and three are related to investment constraints. He suggested that potential investment problems (free rider, horizon and portfolio) in particular are likely to be prevalent in cooperatives closely adhering to a traditional structure found across many countries. Chaddad (2001) found that US cooperatives are capital constrained, suggesting that one or all of these potential constraints are binding to some degree. Iliopoulos (1998) empirically tested for the three potential investment constraints in US cooperatives in 1998 by surveying cooperative CEOs and CFOs for their perceptions of the problem. He found strong empirical evidence that these decision makers's perceived a free rider problem and some evidence

of a perceived horizon problem. Evidence was also found with respect to their perception of an overall portfolio problem, although they more conclusively perceived what this study further defines as the lateral portfolio problem. Until now, the focus of analysis has been at the level of the cooperative's organizational architecture.

The Iliopoulos (1998) study is evidence that research at the *member* level is critical if we are to understand the organizational architecture of producer owned firms. This is because a dual level analysis of the interface between the cooperative and the strategic objectives of its owner patrons is required to understand how well that architecture accommodates any divergence between the objectives of member sub groups.

2. This Study's Contribution

This study makes three important contributions. First, it analyzes the cooperative portfolio investment problem from a dual perspective of the cooperative's existing architecture within the context of member sub groups' economic objectives. This is done theoretically (chapter 3) and by three case studies that place members' objectives within a context of each cooperative's organizational architecture (chapter 4). Second, by using a dual approach, another, important dimension to the scope of the problem is added to our understanding. That is, the problem's scope is expanded from a lateral to a vertical dimension. Third, it empirically tests these assertions at the member level. Conceptual contributions are taken from neoclassical economics (NCE) and new institutional economics (NIE) theories of the firm (property rights, agency conflict and the Coasian and Williamson approaches to firm formation), real options theory and value at risk analysis from finance and resource based theory (RBT) from management. The development of an integrated theoretical framework, to develop an opportunity cost of

capital approach to farmer members' preferred cooperative investment strategies, facilitates the conceptualization of the organizational efficiency implications of alternative property rights structures within producer owned firms.

This is done for the purpose of approaching Hansmann's (1999) argument that the class of firm patrons with the lowest total ownership costs is likely to assume ownership of the firm. He argues that the Investor Owned Firm (IOF) can be thought of as a cooperative of patrons supplying capital and that it is the simplicity of their objective function – return on investment – that results in low ownership costs relative to other classes of patrons and suggests that this is the primary reason for the dominance of the IOF form of cooperative in modern economies. In other words the question of 'what is a cooperative' should be related to the strategic objectives of those forming the business as the homogeneity of strategic interests[1] implies low ownership costs. If Hansmann's argument is accepted then a better alignment of cooperative strategy and the members' objectives will reduce the costs of ownership. Fundamentally the study's analysis revolves around the farmer member's opportunity costs of capital available from his strategic alternatives at the combined farm and cooperative levels and the implications this has for a divergence in member's cooperative investment preferences.

Dual level analysis

The dual focus on the interface between cooperative structure and member sub groups' economic objectives permits a more refined definition of the portfolio investment problem within agricultural cooperatives. This is achieved by widening the existing property rights definition of the problem's definition to examine, in particular, the

[1] The assumption is made that strategic interests are based on economic interests and therefore the terms are used interchangeably.

ramifications of the changing structure of production agriculture on the investment preferences of member producers.

Smaller scale members may find cooperative level investment to generate price increases relatively attractive because these returns are higher than can be achieved by further investment at the farm level. Consequently, they may prefer to invest greater amounts of capital at the cooperative level and adjust their on-farm practices to realize this strategy. The opposite is asserted to be case for the larger farmer, as the relative returns from value adding may be lower than the returns that can be generated by further on-farm investment and the attainment of scale. That is, larger scale members may be focused on reducing their production costs. They may prefer the traditional strategy of low per unit investment at the cooperative level to underpin on-farm production growth to achieve further scale economies. Further, larger farmers who are increasingly specialized compared to smaller farmers may also have a high value at risk and so the cooperative investment is a real option to underpin their on-farm strategy. They may also be reluctant to invest in cooperative services unrelated to their increasingly specialized production.

This possible divergence in strategy between member sub groups is linked to the opportunities presented by the changing demands of the consumer end of food sector continuum and the pressures arising from the structural changes at the production end of the food sector continuum. That is, increasing farmer economic heterogeneity is reflected in increasingly divergent farmer strategic objectives.

The study argues that as a result of these increasingly divergent strategic objectives, agency conflicts are likely within cooperatives that are not able to adequately align their

business' investment strategies with those of its members, because of their structure. A generic description of the cooperative portfolio problem of 'I want my investment to only benefit me' gains greater resonance as farmers become increasingly divergent in terms of their size, specialization, return on investment and their subsequent strategies to safeguard the value of their major wealth generating asset, their farms.

A second dimension to the portfolio problem

The study hypothesizes the problem has a greater dimensionality than previously recognized. It hypotheses that the problem not only exists in the lateral dimension as previously recognized, but also in a vertical dimension. A **lateral** problem arises as members are unable to adjust their cooperative asset portfolios to reflect their degree of specialization. This is quintessentially a problem in cooperatives spanning many commodity divisions with increasingly specialized members. For instance, the bundling of patronage and investment may result in a specialized grain farmer investing in facilities pertinent to a hog farmer. When many multi-purpose cooperatives were formed farmers within geographical regions were often characterized as having similar on-farm production portfolios. Accordingly, many regionally based multi-purpose cooperatives' functions spanned the diversified production mix of their members. The property rights structure of the traditional cooperative business results in pooled investment and patronage returns. Importantly, the cooperative property rights structure does not contain a means for members to realign their investment contribution to reflect their evolving preferences.

A **vertical** dimension is hypothesized to arise as members are unable to adjust their cooperative asset portfolios to reflect their preference for degree of vertical integration

and capital intensity within a specialized commodity. For instance, the bundling of investment may result in a commodity focused member investing in value adding facilities. This is a problem faced by marketing cooperatives with significant value adding *and* commodity processing opportunities coupled with members who have divergent preferences for these cooperative level opportunities. Like the multi purpose cooperatives, many of these cooperatives were originally formed to ameliorate market power induced holdup situations for a single commodity and a relatively homogeneous membership. The level of vertical integration was less important than it has subsequently become as their membership has become increasingly heterogeneous.

It is further hypothesized that the lateral portfolio problem is likely to emerge within a single commodity marketing cooperative and that a vertical problem is likely to emerge within a multi purpose input cooperative. The lateral problem within a single commodity marketing cooperative is likely to be a function of members altering their on-farm portfolio away from the commodity handled by the cooperative. Consequently, these members may become reluctant to invest any further capital into the cooperative. The effect of cooperative structure on this problem will be explored in a case study on a marketing cooperative and tested by survey. The vertical problem within a multi purpose cooperative is likely to emerge as larger specialized members face increasingly different risks and therefore seek different cooperative services to ameliorate those risks. Larger specialized farmers, for instance may face greater implied losses from production failures and favor greater investment into, say, timely, agronomy/application services, relative to smaller more diversified members who may seek lower cost crop inputs that they can

apply themselves. That is, both types of portfolio problem will exist in both types of cooperatives, but they will manifest themselves differently.

Member level surveys within the context of cooperative case studies

The study will survey three cooperatives in order to span a triangulation of structure, commodity and macro institutional frameworks to ascertain whether emerging divergences in member preferences is common across all three and whether these factors will heighten or lessen the degree to which they are binding.

3. Objectives of the Study

The objectives of the study are:

- To uniquely combine existing theory to develop a new perspective on the dimensionality of the portfolio problem.
- To develop four resulting operational hypotheses relating to the vertical and lateral portfolio problems in multi purpose and marketing cooperatives.
- To contextualize the impact of these problems within case studies of the cooperatives under study.
- To test these operational hypotheses.
- To examine ramifications of these findings on the trade offs that cooperative decision makers must make when seeking to ameliorate a binding portfolio constraint.
- To suggest possible public policy implications from the findings.
- To develop at least one general hypothesis at the cooperative level that may be tested cumulatively as further case studies are completed; and

- To suggest further appropriate research that may flow from this study.

In summary, this study is intended to be a contribution to the development of an integrated and empirically tested economic theory of the cooperative firm.

CHAPTER TWO

BACKGROUND CONCEPTUAL AND THEORETICAL FRAMEWORK

The Interplay between Inherent Structural Inefficiencies and the Degree of Heterogeneity of Economic Interests

1. Introduction

The strategy/structure interface is important in any business organization, but particularly so in cooperatives because the strategies of the investing members are intertwined with the strategic direction of the cooperative business. Nearly all studies to date have focused on cooperative strategy / structure level analysis (e.g. see Staatz (1987), Helmberger (1962), Chaddad (2000), and Cook and Iliopoulos (2000), Sexton and Iskow, (1993)). This study analyzes the interaction between the producer firm and cooperative firm levels.

The tenet of the argument developed in this study is that at formation any business has a group of founders with highly homogenous economic interests who have self selected into the business (or else the business would not have formed). Therefore, agency tensions are minimal and any shortcomings in the property rights structure are unlikely to negatively impact upon efficiency. This implies low ownership costs (Hansmann, 1999). However, it is argued that over time in a cooperative form of business members' interests may diverge. If the structure of the cooperative business is unable to accommodate an increasing divergence in economic interests, then ownership costs are likely to increase as a result of increasing agency tensions.

This study examines possible emerging agency tension from the *portfolio* perspective: are members able to adjust their portfolio of cooperative investments in line with their changing risk preferences? Does it result in emerging agency tensions? The problem has been hypothesized to exist but there is no conclusive empirical evidence that it does exist. Accordingly, the study's central task is to provide empirical support for the hypothesis that the problem does indeed exist.

The first section of this chapter outlines prominent economic theories of the firm useful to understanding internal cooperative architecture. Section two examines in detail the traditional cooperative property rights structure and section three examines cooperative firm formation from the perspective of the strategic intent of the member investors. Section four briefly outlines the importance of structural changes in agriculture impacting member on-farm investment strategies.

2. Theories of the Firm: A Brief Overview

Neoclassical economics (NCE) and new institutional economics (NIE) are the two main schools of economic thought that address the major issues regarding the organization of the business firm. The neoclassical paradigm of the firm is essentially one of a production unit. A single product firm is represented by a production function which specifies the output level obtained when a chosen level of inputs is applied. The firm is assumed to be run by a selfless manger with the objective of minimizing costs or maximizing profits subject to production or input constraints. The internal organization of the firm plays no part in its efficiency as the market prices act as both coordination and motivation mechanisms. Information asymmetries are assumed not to exist as actors possess all relevant information when making decisions, profit maximization is the

measurement of the firm's efficiency, no conflict exists between individuals at any level and all exchanges take place in the market with costless information, so contracting problems do not arise.

The theory is extremely useful in analyzing how the firm's optimal production choice varies as input and output prices change, in understanding the aggregate behavior of an industry and in understanding the strategic interaction between firms once the assumption of perfect competition is dropped (Hart, 1995). Similarly, it stresses the role of technology and scale as determinants of firm size. However, it does not deal with other important questions arising from the internal organization of firms.

NIE extends NCE by relaxing the restrictive assumptions of neoclassical theory to address the role of institutions within an economy, including the internal workings of the firm. A fundamental difference between NCE and NIE is the presumption of positive transaction/information costs. This train of thought emanates from Coase's (1937) observation that firms exist because they are a relatively efficient means of economizing on costs associated with transacting market exchanges. Indeed, any NIE theory of the firm will be based on its capacity to generate higher rents under internal organization relative to market contracting. NIE employs the neoclassical concept of trading off marginal costs and marginal benefits. However, NIE theory assumes that organizations consist of individuals seeking to maximize their own utility which increase the internal costs of the firm.

NIE is a melding of economics, law and organizational theory. NIE consists of the three general fields of organizational economics of property rights / incomplete contracting theory, agency theory and transaction cost economics. These theories are

linked through a common set of themes: information is costly, imperfect and frequently asymmetric; the allocation of decision rights (and property rights more generally) affects economic performance; and governance structures (ownership and contractual relationships) can be designed to mitigate hazards of the exchange relationship, or minimize transaction costs. Thus the allocation of value, uncertainty and key property rights between contracting parties will be determined by the characteristics of the transaction, the costs of monitoring and enforcement, the relationship between the parties and the negotiation skills of each party (Sykuta and Cook, 2001).

The principal NIE focus on the cooperative form of business has been the application of property rights / incomplete contracting theory in which the main economic issue under examination is the inherent efficiency of the cooperative business structure in terms of the alignment of residual rights of control and residual claimants. This is consistent with Milgrom and Roberts (1992), Hart (1995) and Hart and Moore (1998) who suggest that aligning the residual rights of control vested with the recipients of residual returns will lead to maximum economic efficient use of assets within any type of firm.

The legal notion of asset ownership generally rests on the right of possession, which permits the owner of an asset to refuse 'use of an asset to anyone who will not pay the price the owner demands' (Milgrom and Roberts, 1992). That is, the legal owners are the *residual claimants* – those entitled to receive the net income of the firm, or the *residual return*. Residual returns arise because complete contracts[2] cannot be written to contractually allocate all returns.

[2] Complete contracting requires that states of the world are observable to the contracting parties and verifiable to outsiders. See Grossman and Hart (1987) and Hart and Moore (1986).

For economic purposes, however, it is often useful to interpret 'owning an asset' to mean the possession of *residual rights of control.* Residual control rights are the rights to make any decision concerning an asset's use that are explicitly controlled by law or assigned to another by contract. They act as the default rules to the use of an asset. It is the impossibility of writing complete contracts that gives economic importance to the holder of the residual rights of control.

Pairing residual control rights and residual claimant rights ensures that default decision makers bear the full wealth effects of their decisions. If prior claims are fixed by contract, then maximizing the value received by the residual claimant is the same as maximizing the total value received by all claimants on the firm's income. That is, by pursuing their own interests, residual claimants tend to make efficient residual decisions regarding the use of the firm's resources (Grossman and Hart, 1986). This implies that there exists the *potential* for agency type conflicts to exist between decision makers, residual or otherwise, and the other claimants on a firm's revenues. A problem may exist because one party is assigned control of property rights that effect another party's wealth or utility function. That is, decision makers do not bear the full wealth effect of their decisions regarding an asset's use. Agency situations are commonly explained as a result of one party (the agent) having an information advantage over another (the principal) and exploiting that advantage to the detriment of the other party; or they could arise simply because parties develop diverging interests for which the prevailing property rights structure within a firm does not permit amelioration. Increasing heterogeneity of interests between firm owners suggests that assets may not be managed efficiently.

Hansmann (1999) argues that the degree of homogeneity of economic interests is an important determinant of which of a firm's 'patrons' – defined as all of those who transact with the firm – are likely to own it. Homogeneity of economic interests implies lower ownership costs of collective decision making. Ownership costs consist of the costs of collective decision making, monitoring and risk bearing. It is the class of patrons that impose the lowest sum of transaction costs, consisting of the sum of the reduction in market contracting costs as a result of ownership and the costs associated with assuming ownership, that largely determine which class of patrons will assume ownership. He argues that it is rare to see firm ownership 'shared by a group of patrons that exhibits any substantial diversity' … and that this 'suggests that the costs of collective decision making are very high for heterogeneous groups of owners'.

Hansmann (1999) argues that, 'rather than risk bearing or the need to accumulate capital … the real reason' why modern economies are heavily dominated by IOF's, is the high homogeneity of economic interests created by a very simple objective function of return on investment as this greatly contributes to lowering the costs of collective decision making. He views the IOF as a special case of a cooperative of capital providers and the cooperative form of business as the general case. He observes that 'if a highly homogenous class of patrons - besides investors - doesn't exist in a given industry, firms in that industry are unlikely to adopt the (non IOF) cooperative form of investor ownership' (1999).

Numerous authors have suggested that cooperatives work most efficiently when member heterogeneity is low (see Cook, Iliopoulos and Chaddad, in Hendrikse, 2004; Hart and Moore 1998). This study examines the agricultural cooperative portfolio

problem as a potential agency conflict between owners stemming from increasing heterogeneous economic objectives - which arise as a result of the structural changes in agriculture – within the context of a traditional property rights structure that those does not provide for amelioration of that conflict.

Besides the assignment of residual claims and rights of control, the property rights approach also emphasizes three other important characteristics of the property rights structure of any firm (Fama and Jensen 1983; Hart and Moore 1990; Hart 1995). These are the degree of transferability, the degree of redeemability and the time horizon of residual claims, and by implication, the ability of an asset to be correctly valued. Transferability refers to the ease of transferring a residual claim from one person to another. Redeemability defines the ease with which the owner of a residual claim can regain the return of the equity that purchased the rights to a firm's residual claim. Ownership horizon pertains to the length of time that the residual claim remains valid.

A property rights structure is unlikely to be efficient if it does not permit assets to be correctly valued and transferred to those who most value them. This is important, argues Hansmann (1999), as the collective decision making costs within a heterogeneous membership can be small if a property rights structure exists to balance their competing interests.

3. Traditional Cooperative Property Rights Structure

The traditional cooperative structure can be compared with the publicly traded IOF by using the property rights approach to examine the assignment of residual claims and rights of control, the degree of transferability, the degree of redeemability and the time horizon of residual claims (Fama and Jensen 1983, Hart and Moore 1990; Hart 1995).

Table 2.1 illustrates that publicly traded companies with liquid secondary markets have the most easily transferable residual claims. Residual claims within a publicly traded company are generally not redeemable (i.e. capital is permanent), but the firms value is unlocked via the liquidity of the secondary market. Within a publicly traded company, this horizon is effectively limitless, again because of the liquidity of the secondary market. The transferability and limitless time horizon of the publicly traded firm's residual claims imply that a value can be established for those residual claims and that ownership can be easily transferred to those who place the highest value upon those claims. That is, within a publicly traded firm, property rights can be reassigned between owners such that their economic interests are constantly realigned.

Table 2.1: Residual Claims and Decision Characteristics in Traditional US Agricultural Cooperatives and Publicly Traded IOFs

Residual claim or decision characteristics	Publicly traded IOF	Cooperative principle	Traditional cooperative
Ownership	No Restriction	User Owned	Member Patrons Only
Valuation	Claims Traded in Secondary Market	User Owned	No Secondary Market to Value Claims
Horizon	Valid for the life of the firm	User controlled	Valid only while patron
Redeemability	Not redeemable	User controlled	Usually partly redeemable
Transferability	Freely transferable	User benefited	Generally, not transferable
Control Rights	Proportional to shares	User controlled	Non proportional to shares (typically)

Condon (1990); Chaddad (2003)

This can be contrasted with the structure of the traditional cooperative. The structure is based upon the principles first enunciated by the founders of the English Rochdale

cooperatives in the 1840s and many countries share this heritage in the formal legal frameworks that define the organizing principles of their cooperatives. The US has narrowed these principles to user ownership, user control and restricting the flow of benefits to the user on the basis of patronage done with the business (USDA, 1987). That is, the key defining organizational feature of an agricultural cooperative is the tying of the organization's residual claims to 'levels of patronage, rather than levels of capital contributions, and of assigning formal organizational control rights to farmers' (Condon, 1990).

The user controlled characteristic means that control of the cooperative by the owner stockholder must be structured democratically, so voting is not in proportion to equity investment although it may be in proportion to patronage. It implies that the residual claim is only valid whilst the member is a patron and that payment of the residual claim is only partly redeemable because payment of the residual claim is tied to patronage through product prices. Consequently, the residual claim is only valid whilst the member does business with the cooperative.

The user owned characteristic of a cooperative means that patron stockholders are the major equity providers to the cooperative. It implies that ownership is restricted to member-patrons only, that equity provision is tied to patronage and that no secondary market exists to trade, and create a value, for claims upon the cooperative. The value of capital is only usually partly redeemable[3]. The lack of a secondary market to value secondary claims has obvious ramifications for members' ability to adjust their cooperative assets portfolios with respect to their risk preferences.

[3] Equity is generally more redeemable in US cooperatives than cooperatives in many other countries because a comparatively greater proportion of capital is allocated to members.

The user benefit principle means that the benefits received by the patron stockholder who contributed equity capital to a cooperative are tied to the level of patronage that the member undertakes with the cooperative. It implies that the residual claim is generally not transferable; this also has obvious ramifications for members' ability to adjust their cooperative asset portfolios with respect to their risk preferences. Note the residual claims of firms not traded in liquid secondary markets (including unlisted IOFs and family companies) are often not easily transferable.

The three cooperative principles and much of the supporting institutional framework such as US tax codes create a property rights structure characterized by non transferable, partly redeemable and limited time horizon residual claims imply a misalignment of residual rights of control and residual claimant rights is likely. They also inhibit or complicate realigning these rights as the economic interests of the membership diverges.

Therefore, conflict arising due to a divergence between sub groups of members willing to accept differing levels of risk at the cooperative level is difficult to ameliorate within the property rights structure of the traditional cooperative. This is due to a lack of transferable, liquid and appreciable residual claims.

In addition, traditional cooperatives generally have open membership, so that new members are able to access the cooperative's existing assets for only a nominal membership fee. Therefore, a member with a large investment from many years of patronage has the same voting and control rights as a new member with little investment at risk. This may accentuate a portfolio problem.

4. Cooperation as Strategy

Cooperative formation and expansion has been characterized by three sets of arguments. Firstly, cooperatives may be seen as a *defensive* strategy to safeguard farmers' returns from vulnerability from trading partners' market power by backward or forward integrating the immediate first handler/processor or inputs supplier. Returns from this type of investment arise mostly at the on-farm level; these are termed *user* benefits. Defensive arguments form the basis of many explanations for the wave of cooperative formation experienced in many advanced agricultural economies during the late nineteenth and twentieth centuries. Secondly, once established, cooperatives were able to expand market share due to low ownership costs. Thirdly, cooperatives may also exist as an *offensive* strategy; that is, to extract additional returns at the cooperative level by further vertical integration/coordination. These are termed *investor* benefits.

Defensive Formation

Agricultural cooperatives, argues Vitaliano are 'widely viewed as an organizational response … to market failure' … arising from 'opportunistic behavior on the part of farm input suppliers and farm commodity purchasers capable of exercising market power to the detriment of farmers'. They are a means to internalize transactions 'previously mediated by markets within the context of an organization under formal control of farmers' (Vitaliano, 1985, p65). Vulnerability to opportunism can be usefully broken down into three parts: ex post contractual 'hold-up' and ex-ante market power and asymmetric information problems (Hansmann, 1999).

Williamson's (1985) TCE model is a NIE explanation of the degree of vertical integration firm based on ex-post contractual hold-up. Hold-up is defined as one party's vulnerability to *quasi-rent*[4] appropriation. Williamson's model employs the bilateral transaction between two business partners as its unit of analysis. The principal reason for vertical integration, according to Williamson, is to avoid quasi rents being appropriated as a result of opportunistic behavior by trading partners when locked into a bi-lateral monopoly in which the assets in question are highly specific, transactions are frequent and behavior is uncertain.

Transaction specific investments are the most important focus of Williamson's analysis. These include site, brand, physical, human, temporal specificities and investments made to specifically serve a large supplier (Shelanski and Klien, 1995; Mahoney, 1997). It is the transaction specific assets that create quasi rents which are vulnerable to appropriation, or hold-up if the other party chooses to act opportunistically; opportunism is defined as 'self seeking with guile'. In keeping with the NIE view of the firm as a nexus of contracts, complete contracting is viewed as impossible because available information is incomplete and human cognitive abilities are limited. The Williamson stream of transaction costs analysis rests upon a high degree of *behavioral uncertainty*.

In Williamson's model, the degree of vertical integration depends upon the extent that the parties can resort to 'private orderings', which are a substitute or supplement to the court system, such as the exchange of 'hostage' assets or the use of arbitrators in order to

[4] Quasi rents are payments to a factor of production beyond that necessary to keep that factor from leaving (excess of value over salvage value). Appropriable quasi rents are those that are above the factor's next best use.

protect the parties' interests. If private orderings are not possible, then the party with the greatest amount at risk from hold up is likely to integrate its trading partner (see also Grossman and Hart, 1986; Hart and Moore, 1990).

If this line of argument is correct, then it should be expected that agricultural industries that exhibit high degrees of some form of asset specificity, related to an input or procurement transaction, should have tight vertical coordination or vertical integration. For instance, milk production involves highly specific, capital intensive assets. Equipment such as dairies and vats cannot be easily used for other types of production. More importantly, milk is highly perishable and must be quickly chilled and processed. Milk production is highly frequent, as most farmers in advanced countries milk twice a day and they are unable to quickly cease production. These factors put dairy farmers in a very weak bargaining position and suggest that farmers are likely to have a strong homogeneity of economic interests to own the milk procurer.

This would appear to be a reasonable explanation for cooperative dominance of nearly all dairy industries around the world. In the US, cooperatives currently account for over 80% of milk procurement; in Australia, around 70% and in New Zealand cooperatives account for nearly 100% of milk procurement.

A second commonly observed reason for cooperative formation is spatial and temporal market power in input and procurement markets. Several authors have noted that this was often a reason for the major wave of cooperative formation in the early twentieth century (see Staatz, 1987; Le Vay 1983; Sexton and Iskow 1993; Cook 1993). These are essentially neoclassical arguments.

Thirdly, the technological conditions at the time also gave rise to severe asymmetric information between many input suppliers / commodity procurers and their farmer customers / suppliers (Hansmann, 1999; Cook, 1993). A firm that knew more than its customers about the quality of the goods or services that it sold (or visa versa), was especially common when the contracted-for goods or services were complex or difficult to inspect (Hansmann, 1999).

The wave of cooperative formation in the early twentieth century mirrored the beginnings of agriculture's shift from a structure based on a high degree of diversification in which inputs were typically produced on-farm, to a structure increasingly characterized by specialization where sourcing inputs became external to the production process. For instance, the 1920s saw the beginnings of the replacement of animal power with tractors. This necessitated the increased use of fuel, machinery and other inputs which had to be bought off-farm. A similar pattern of formation occurred across the developed world, suggesting common technological conditions gave rise to similar market structures.

However, within a given production region, farmers generally remained relatively homogenous in terms of their size and structure until the post war era in most commodities in nearly all advanced agricultural countries.

Two dominant forms of traditional cooperatives emerged at this time in the US. Multi purpose cooperatives formed to create a 'competitive yardstick' so as to ameliorate spatial monopolistic power. They are the most common cooperative form in the mid-west of the US. These cooperatives typically handle a number of farm inputs and market a number of farm commodities. One of the case studies analyzed in Chapter 4 is a multi purpose cooperative. Single marketing cooperatives also formed, in part, to ameliorate

farmers' vulnerability to market power. The additional offensive reasons for single marketing cooperatives formation is discussed later in the chapter.

The discussion so far implies that much of farmers' initial cooperative investment can be thought of as a *strategic investment*; of ensuring that farmers are on both sides of the transaction to reduce the expected costs that may arise from opportunistic behavior. According to Staatz (1987) such investment should not be seen as an exercise in risk diversification in a portfolio sense. That is, the members' primary objective function is not likely to be return on capital per se at the cooperative level, but to safeguard his on-farm returns.

The value at risk concept may be a useful conceptual tool to understand the farmer's defensive motivation for cooperative investment as his farm assets are likely to be a large proportion of his wealth portfolio. Linsmeier and Pearson (1996) define Value at Risk as 'simply a way to describe the magnitude of the likely losses on the portfolio'… 'due to normal market movements.' Generally, this approach has been used to examine portfolios that consist of highly liquid and divisible assets. Farm assets, on the other hand, are usually not easily divisible or liquid - for instance land - and switching costs are high, inferring that an adverse market outcome could cost a farmer a substantial portion of his wealth. This may be particularly so if the asset is capital intensive, highly specialized and has a low salvageable value. A milk parlor may be such an example.

Indeed, the defensive strategy underpinning this type of farmer decision to invest in a cooperative implies that this stream of cooperative investment analysis may also be thought of as a real option. Brealey and Myers (2000) describe real options as options found in real assets which managers exercise, for instance, to mitigate loss. The true

return of a project is therefore the discounted cashflow plus the value of the option embodied in the asset. The pertinent real option embodied in the defensive cooperative asset may be characterized as the value of follow-on investment opportunities (Brealey and Myers, 2000) at the *farm* level. That is, a defensive cooperative investment could be thought of as a call option in that the value of a successful initial cooperative investment could underpin a much larger payoff from subsequent investment at the farm level. This is because the farmer may avoid expected loss to his traditional discounted cash flow that could arise by a supplier or procurer's future strategic choices. The value of the real option would appear to be a function of the probability of an adverse outcome due to a trading partner exercising market power and the value of the wealth that the farmer has at risk. If this is correct, then given the high transactions costs associated with forming a cooperative, the initial option value of the cooperative organization should be high.

Based on the discussion in Rosso *et al*. (2003) the expected present value of the cash flows related to each strategy – to invest in the cooperative or not to invest – could be calculated through a backward dynamic programming approach, by calculating the expected values of each strategic option. This model approach, however, is beyond the scope of this paper, but is introduced as a part of the study's conceptual framework. The key application is that the value of the cooperative level return is only *part* of the overall return of the farmer's discounted cash flow calculation.

Accordingly, an analysis of the costs and benefits of assuring access to markets via a cooperative becomes an investment analysis exercise. If the investment increases the expected wealth and/or decreases the variance in net returns to members 'then the cooperative can be considered to improve access to markets' (Vitaliano, 1985). If this

access is improved to an extent 'that the resulting net farm incomes achieve some standards in terms of mean and variance, then the cooperative can be thought of as assuring access to input and product markets' (Vitaliano, 1985).

For the purposes of this study, these defensive on-farm level benefits are termed *user* benefits to differentiate returns made at the cooperative level which are termed *investor* benefits. If the reduction in expected cost at the farm level by avoiding monopoly rent extraction at the input or procurement level is high (user benefits), then overall total return to the farmer member can be high even if the return on capital invested (investor benefits) at the cooperative level is low. On a continuum of user to investor benefits these defensive market power ameliorating benefits may be thought of as toward the end of the user spectrum as they are most related to the farm business. This concept will be expanded upon as part of the next chapter's detailed discussion of the portfolio problem.

Cooperative Expansion due to Low Ownership Costs

It could be expected that the higher the level of potential opportunistic behavior farmers face within an agricultural industry the higher the level of cooperative ownership. Following this line of reasoning, it would also be expected that if technology changes were to reduce the possibility of opportunism then the level of cooperative activity would also fall within a given sector. For instance, the market costs of contracting for input supplies declined significantly over the course of the twentieth century as technological changes increased the scope of markets accessible to farmers and provided low cost testing procedures. This reduced the opportunity for spatial market power and lessened the importance of information asymmetries in many agricultural input and output markets.

However, as shown in Table 2.2 the market share of crop inputs held by cooperatives increased substantially between 1951 and 1993 and has generally remained stable since then. Hansmann (1999) argues that this is because the relative costs of ownership are still lower than the market costs of contracting, which is a Coasian rather than a Williamsonian transaction cost argument[5].

Table 2.2: US Farmer Shares of Farm Input Sales, 1951 – 2002, Selected Input Products in Percentages

Product/Year	1951	1961	1971	1982	1988	1993	1998	2002
Fertilizer	16	26	30	42	40	42	45	45
Petroleum	19	25	35	36	39	48	50	46
Ag Chemicals	12	16	20	30	28	31	34	34
Feed	18	18	17	18	18	21	21	17
Seed	17	16	15	17	17	11	10	13

Source: USDA – in Peltier (2004)

The percentages in Table 2.3 indicate that cooperatives' share of marketing in many sectors of US agriculture have followed a similar pattern of expansion and maintenance which may lend further support to Hansmann's view.

Table 2.3: US Farmer Cooperatives' Shares of Farm Marketings, 1951-2002, Selected Commodities in Percentages

Commodity/Year	1951	1961	1971	1982	1988	1993	1998	2002
Milk	46	58	70	77	76	85	83	83
Cotton products	10	19	25	36	41	35	43	43
Grains/oil seeds	35	33	34	36	30	42	39	38
Fruit/vegetables	20	22	25	20	24	21	19	19
Livestock	13	13	11	11	7	10	14	13

Source: USDA – in Peltier (2004)

It is interesting to note, however, that cooperative dominance in the agricultural inputs sector has declined in some countries relative to other countries. For instance US

[5] Indeed, Hansmann's view implies that the cost associated with maintaining the cooperative use real option may have declined more than the reduction in its value.

cooperatives appear to have a higher market share in the input supply market than Australian cooperatives. As technological conditions appear to be highly similar between developed countries, it may be argued that differences in property rights structures at either the macro institutional level or at the micro institutional level serve to alter the relative cost of ownership and this may explain the different levels of cooperative activity across countries within similar sectors.

For instance the public policy framework pertaining to US agricultural cooperatives, which includes limited exemption from anti-trust laws and single taxation, has more concessions to cooperatives than the Australian cooperative public policy framework. Further, the customary US practice of retaining comparatively high percentages of net income as allocated equity may be compared to the customary Australian practice of retaining very high levels of unallocated equity. The Australian practice arguably makes cooperatives more attractive to liquidation / conversion if shareholders no longer require them for their original purpose. That is, the relative net benefits of conversion outweigh the transaction costs of altering ownership structure relative to the transaction costs arising under the US property rights system.

Offensive Formation

Cook (1993), drawing on Sexton and Iskow (1988), expands on the defensive user reasons for cooperative investment. He lists five reasons that have historically been important in agricultural producers' decision to initiate collective action. Three of the reasons, avoiding the negative consequences of market power, risk reduction and the provision of missing services, are reflective of Vitaliano's argument of protecting the farm asset; that returns from these activities are largely generated at the farm level.

The fourth motivation, the drive to attain scale in procurement, services or marketing may accord with the argument presented by Hansmann above. The neoclassical framework usefully highlights scale as a means to reduce unit costs. Marketing and input cooperatives have sought scale economies and consequently the numbers of agricultural cooperatives declined over the twentieth century, even when the sector's cooperatives increased their percentage of business.

The fifth reason cited by Cook is to seek additional margins at the cooperative level. Scale economies and the attainment of addition margins are essentially concerned with generating additional returns at the cooperative level. These are the earlier referred to investor benefits generated at the cooperative level and passed to the cooperative member.

The drive for additional margins in traditional cooperatives was most notably pursued by marketing cooperatives that moved quickly to capitalize on their farmer ownership by developing extensive branding in the 1920s and 30s. Many brands driven cooperatives continue to be highly successful. This form of rent extraction is more in keeping with the resource based theory (RBT) of the firm, which stresses the firm's potential to yield *Ricardian*[6] rents from superior bundling of resources. RBT is also more of a Coasian explanation of the firm, in that environmental uncertainty, created by the firm assembling a unique package of heterogeneous, valuable, relatively scarce, difficult to imitate and relatively immobile resources to create Ricardian rents alters the costs of contracting in the market relative to contracting via the firm (Peteraff, 1993). The focus here is the creation of a *bundle* of assets that are specific to the firm to create the basis of rent

[6] Rents that stem from a more steeply sloped supply curve.

extraction by that firm. On a continuum of user to investor benefits this type of Ricardian rents may be thought of as toward the end of the investor spectrum as they are most removed from the farm business.

The other dominant form of traditional cooperative that emerged at this time was the single commodity marketing cooperative. Single marketing bargaining cooperatives form to exploit anti-trust immunity and avoid rent extract. Single marketing processing cooperatives avoid rent extraction through by passing IOFs and gaining direct market access via processing, distribution and branding. Indeed, their organizing philosophy was that farmers should ameliorate monopolistic market power by monopolizing the supply of a single commodity. Fonterra of New Zealand, one of the three cases in this study, is a single marketing cooperative, although with a greatly modified structure compared to the traditional form. At issue will be whether its structural modifications are likely to ameliorate or exacerbate a potential portfolio problem.

More recently, single commodity, value-added cooperatives have evolved from the traditional form. These are also known as New Generation Cooperatives (NGC) and this newer structural form has some similarities to an IOF in that its equity is largely tradable, transferable and appreciable. An NGC Missouri ethanol producer is one of three cases examined in this study. At issue, will be whether this cooperative's property rights structure ameliorates a potential portfolio problem.

The attainment of scale economies and cooperative brand development activities has *historically* involved low per unit cooperative investment. Indeed, Vitaliano (1985, p. 67) observed two decades ago that cooperatives faced difficulty in competing in downstream processing because of their reluctance to finance capital intensive

downstream activities. Cook (1995) noted that despite US cooperatives' success in integrating farmers into the immediate first handling/processing and inputs sectors, cooperatives have had far less success in backwards or forward integrating further along agri-food chains. Extended forward integration would be for the purpose of generating further margins. Rogers and Marion (1990) found that the largest 100 marketing cooperatives had only 6.9% of total value of shipments and only 3.6% of valued added shipments. Gruber *et al*. (2000) found that cooperatives advertise less than their IOF counterparts due to their predominance in industries with low margins and little product differentiation and these industries are characterized by low advertising intensity regardless of firm type. For instance, Table 2.4 indicates that US dairy cooperatives' production is concentrated in low value storable commodities relative to high value commodities.

Table 2.4: Approximate US Cooperatives' Market Share of Selected Dairy Product Production, 1997 in Percentages

Dry milk products	Cheddar cheese	Butter	Total cheese	Packages fuild milk	Ice cream mix	Cottage cheese	Ice cream
77	70	60	40	15	11	10	5

Source: USDA (RBCS, 2002)

Barry (1995) argues that agriculture is becoming increasingly industrialized, by which he refers to increased concentration and vertical co-ordination by agri-food firms through contract and supply chain management, along with the increased provision of farm inputs by off-farm businesses. Agri-industrialization leads to competition not just between farm sector production units but also competition between supply chains with an increased emphasis on quality assurance (Drabenstott, 1994; Boehlje, 1996). This implies that agricultural cooperatives will have to become more capital intensive if they

are to compete. However, Hendrikse and Veerman (2001) argue that from a transaction costs perspective, a marketing cooperative is likely to be efficient when the level of asset specificity at the processing level is low or immediate compared to the level of asset specificity at the farm level. This implies that further integration will involve the transaction costs of structural change within a marketing cooperative, as well as the adoption of specialty production practices at the farm level (see Bogetoft and Olesen, 2004; Goldsmith and Gow, 2000). At issue is whether sub groups of members may emerge favoring differing degrees of cooperative vertical integration in response to agriculture's structural change, and, ultimately, are prepared to bear the transaction costs of organizational transition.

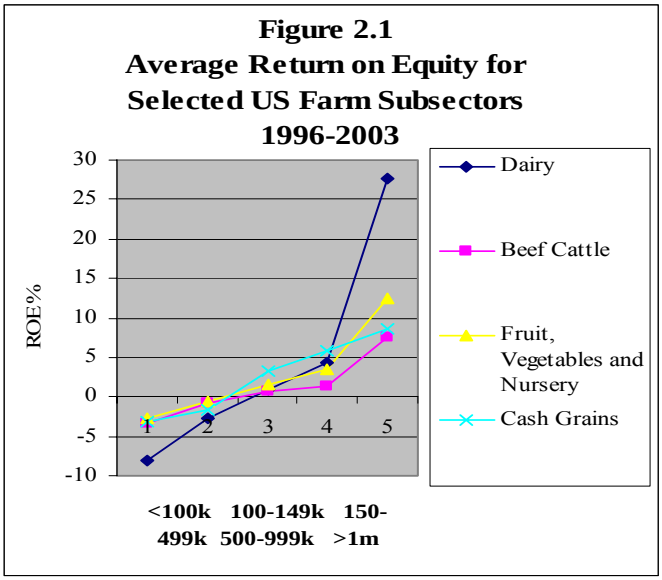
5. Structural Changes in Agriculture

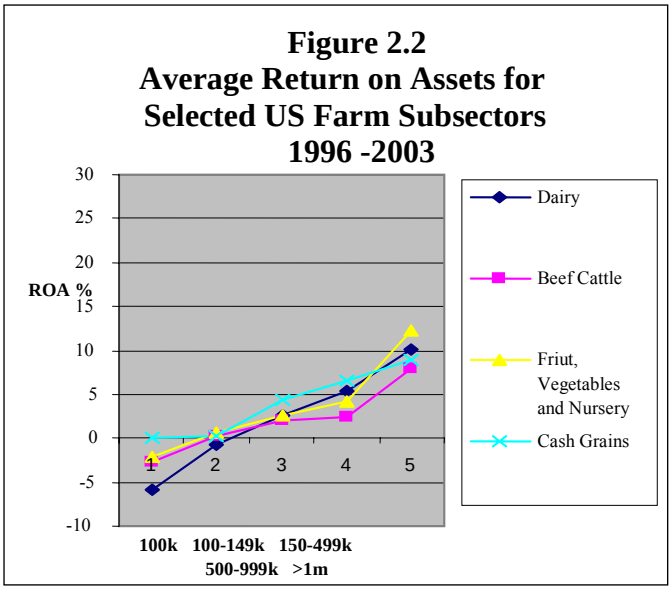
Many studies have been conducted on structural change within various agricultural industries (e.g. see Reimund, Martin and Moore's 1981; Barry, 1995; Martinez in the poultry, egg and hog industries, 1999, 2002; Dobson and Christ in the dairy industry, 2000; Sonka in the grains industry, 2003).

For the purposes of this study the salient point is that structural change is accompanied by a decline in farmer numbers, a growth in the average size of farms and a concentration of production by a very small number of large producers.

Increasing concentration in production agriculture also has implications for the rate of return available to different segments of the producers within a subsector. Empirical data presented in Figures 2.1 and 2.2 indicate a strong positive relationship between return on

investment (ROI) and scale across all the selected US industries of dairy; beef cattle: fruit, vegetables and nursery; and cash grains.





USDA (ERS 2004)

ERS (1999) data also confirms a positive relationship between size and specialization in commercial farms over $100,000 of annual sales. Although ROI may increase as scale

increases, greater specialization in operations presumably increases the business risks arising from biological production systems, as the number of possible sources of cash flow decrease. It is to be expected, therefore, that the required rate of return from larger, specialized production units will be higher. It may also increase the business risk arising from market access if farmers are vulnerable to the exercise of market power by trading partners.

The strong positive relationship between on-farm ROI and size / specialization has implications for the ability of farmers to expand their farm operations. Various studies indicate that smaller commercial farmers may be subject to a capital constraint relative to large farmers (for instance see Short, 2000 and Martinez, 2002). This is because the smaller farmer is unlikely to have the debt capacity of the larger farmer, suggesting that small farmers may be precluded from an on-farm growth strategy.

Therefore, it is observed that the structural change evident in most subsectors of agriculture is likely to result in an increasingly heterogeneous producer base from which cooperative membership is drawn. The potential membership is likely to be increasingly sorted into a bimodal distribution with the greatest percentage of production concentrated in the hands a very small percentage of members. These members are likely to be highly specialized relative to the smallest of the membership and enjoy greater net on-farm returns. The smaller producers are much more likely to earn a significant proportion of their income from off-farm sources (ERS, 2004).

It is argued that the implications of this are that the larger farmer's strategy to generate rents is likely to be concentrated on farm level growth, relative to the small farmer who is constrained from growing the scale of the farm operation.

The case studies will examine other relevant constraints to growth which may also play a significant role in constraining farmer's growth strategies in particular locations, such as environmental regulation and resource availability. This is entirely in keeping with Reimund *et al*.'s (1981) model of resource availability as a key factor in the relocation of subsectors.

If the small commercial farmer is unable to grow and reduce per unit fixed costs, then increasing revenue per unit of production may become increasingly important to his business strategy. Conversely, the larger more specialized farmer faces greater potential risk from production failure, implying a greater demand for services that ensure production can be successfully delivered to market. This suggests that a portfolio type agency divergence of interests may emerge between the member sub groups with regard to preferred type and intensity of cooperative investment. To date, empirical evidence establishing cooperative member investment preferences has not existed. This study generates empirical evidence for the cooperatives under study.

Whilst ERS data draws an empirical link between size and specialization in commercial farms, ERS data also indicates that an '∩' shaped distribution has emerged with respect size and specialization over the population of farmers, at least in the US. The ERS notes that ***'most of the operators of farms with sales less than $50,000 report a non-farm occupation or are retired'***. Thus, they are unlikely to have the time or the inclination to produce multiple commodities. Many of these operators also specialize in beef cattle—particularly cow-calf enterprises—that have relatively low labor requirements' (ERS, 1999). Presumably, this trend continues somewhat into the $50,000 to $99,000 bracket and at least partly explains the anomaly displayed by farms in this

bracket with respect to the relationship between size and diversification. Another major complicating effect may be the impact of farm subsidy programs implemented with the goal of underpinning the viability of the 'family farm'. This suggests that in terms of the range of services demanded of the cooperative, the very smallest and the largest farmers may have similar demands due to their similar degree of specialization.

6. Chapter Overview

Neoclassical and New Institutional Economics theories of the firm provide important insights into the reasons for cooperative formation, the likelihood of emerging agency tensions and the potential for the cooperative's structure to ameliorate conflict. Defensive reasons for formation are primarily to ameliorate market power arising from a bilateral monopoly (NIE), an asymmetry of information (NIE) and spatial and temporal monopoly power (NCE). These reasons for formation suggest a high degree of member homogeneity of economic interests. The cooperative sector's expansion over the twentieth century, despite the recession of many of these defensive reasons, indicates low marginal ownership costs relative to market contracting. Compared to IOFs, cooperatives have had limited success in penetrating higher value markets further removed from the farm sector. At the same time structural changes in agriculture suggest that a divergence of interests may have occurred between members who may be more interested in capital intensive investment and further integration to increase available market prices vs. those members who remain focused on the traditional attainment of on-farm scale. The ramifications of this divergence in terms of the ability of the existing cooperative property structure to ameliorate this potential conflict are examined in the next chapter.

CHAPTER THREE

THE PORTFOLIO PROBLEM

A Refinement

1. Introduction

Although hypothesized to exist, the portfolio problem has not been conclusively supported empirically in its lateral dimension and has not been hypothesized to exist in its vertical dimension. This section refines the problem by switching from the tradition of most studies of conducting a cooperative level analysis to a dual level analysis of contextualizing cooperative level investment choices within a growing diversity of producer investment preferences. This diversity of preferences is hypothesized to exist as a function of structural change within production agriculture. The overall aim of the study is to provide empirical proof that such divergence does exist.

2. The Portfolio Problem to Date: Theory and Empirical Testing

From an organizational economics point of view, the portfolio constraint was initially identified by Jensen and Meckling (1979) in labor owned firms. In these firms, worker's shares of cash flows are similar to non-marketable finite shares of stock[7]. As these 'shares' are non-marketable, worker firm owners cannot diversify their holdings across many firms and assets. This results in a non-Pareto allocation of risk as there is no specialization of risk bearing across individuals with different degrees of risk aversion and wealth. Worker investors are forced in the aggregate to bear risks that can't be

[7] Unlike the unlimited time horizon implied by traded IOF stock.

minimized through diversification. By analogy, the same situation pertains to member patrons in agricultural cooperatives.

The portfolio problem was first applied to farmer cooperatives by Vitaliano (1985) and was expanded by Iliopoulos (1998). Members are prevented from adjusting their cooperative asset portfolio to match their personal risk preferences because of the non-transferability, illiquidity and lack of appreciation of cooperative financial instruments. Thus sub groups of the membership 'pressure board members to rearrange the cooperative's investment portfolio even if the reduced risk portfolio entails lower returns' (Iliopoulos, 1998).

Iliopoulos (1998) prefaces Vitaliano's work with a thought experiment based on the Capital Market Asset Pricing Model (CAPM) in which cooperative members are provided with the option of purchasing shares that are marketable and transferable. Given their individual circumstances, members must then allocate their wealth to achieve the best possible investment portfolio. The traditional mean variance portfolio analysis is based upon the assumptions of:

1. risk aversion, implying members dislike risk, but like high rates of return, where risk is measured by the variance of the investment returns;
2. the existence of a riskless bond paying a safe rate of return r; and
3. perfect capital markets, so that members can freely trade securities without incurring significant transaction costs. ***It is apparent that this assumption implies a high divisibility of assets that facilitate ease of exchange.***

A portfolio is defined as a vector of numbers (P_1, P_2, …P_n) indicating the fraction of the total wealth is to be invested in each asset. "A" is a 'set of assets of which shares are

traded' … and so … 'a typical asset α yields an uncertain return R(α), expressed as percentages' (Iliopoulos, 1998). Therefore

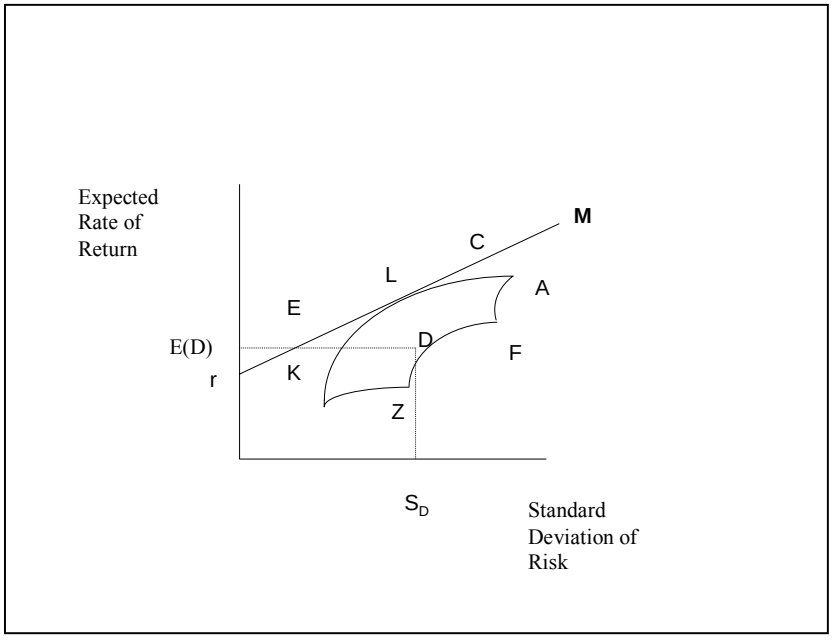
$$\sum_{a=1}^{A} P_a = 1$$

The member's realized return from the portfolio is equal to:

$$\sum_{a=1}^{A} P_a R(\alpha)$$

The mean and variance of this return is cooperative member's central concern. The set of combinations that the member can obtain from choosing a portfolio are illustrated in Figure 3.1.

Figure 3.1: The Portfolio Problem



The area AFZKL illustrates the combinations that can be attained from portfolios of risky assets alone. Each point in this region represents the return and risk from a single asset or a portfolio of assets available in the market. The point r on the vertical axis is the

rate of return from investing in the riskless asset only. The diagram illustrates the assumption risky investments exist and these investments have higher returns than r. Point L is the point of tangency between the line M and the efficient frontier of the risky assets portfolio.

By investing fraction 1-β of his wealth in the riskless bond and the remaining fraction β in the risky portfolio D with mean E (D) and S_D, the member can create a new portfolio with mean (1-β) r + βE (D) and the standard deviation (1 - β) 0 + $\beta S_D = \beta S_D$. For instance, a more risk averse member can lend money by investing a greater proportion of wealth in the riskless bond, the member can move along the solid line M towards r, for example to portfolio such as E. If the member has a greater appetite for risk, he may choose to borrow at interest rate r; then β takes a greater value and the member can move towards portfolio C.

The highest mean return for any level of standard deviation lies along the solid line connecting L to the rate of return on the riskless bond, r, which will be optimal for any member who only cares about the mean and standard deviations of returns. An important implication of the model is the derivation of a pricing formula that relates the returns of any asset available in the market to the R (L), the optimum portfolio:

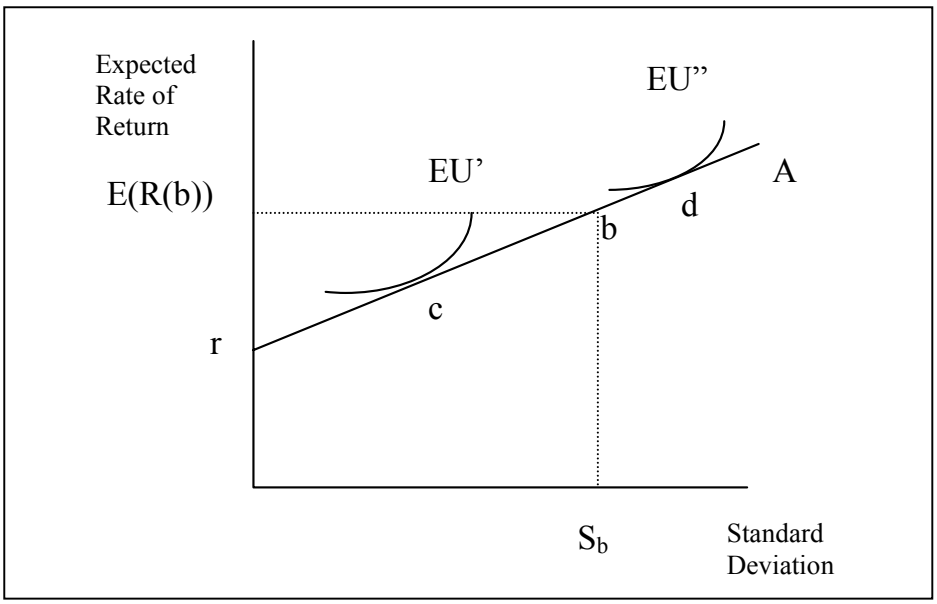
$$E(R) - r = [\text{Cov}(R, (R(M)) / \text{Var}(R(M)] \times (E[R(L) - r), \quad (1)$$

where R is uncertain returns from an asset and [E(R) – r] is the risk premium. That is, this formula relates the risk premium to the market's system risk. This paper will argue, shortly, that the farmer's benchmark asset will be the on-farm rate of return because it is the farmer's main wealth generating asset.

In the above model, individual utility functions are irrelevant because of the tradable nature of residual returns. However, in a cooperative in which residual returns are not tradable, investors are unable to adjust their portfolios to match their risk profiles. This is illustrated in Figure 3.2. Suppose the cooperative's bundle of assets yielded an expected rate of return R (β) with a $S_D(R\beta)$. If residual claims were transferable, then members with a utility function such as $EU^{/}$ could invest in a diversified portfolio that has a lower rate of return and risk, such as point c. Conversely, members with a utility function represented by $EU^{//}$ could invest more in a portfolio that has a higher rate of risk and return.

However, the non tradability of residual claims implies that members cannot adjust their cooperative portfolio to reflect their individual risk preferences. The combination of the role of residual claimant and patron makes it difficult, if not impossible for members to adjust their risk to a preferred level. If cooperative members are 'risk averse they will fail to support a cooperative strategy that yields a residual rate of return R (β) and favor cooperative investments that yield lower rates of return and lower rates of risk' (Vitaliano, 1985).

Figure 3.2: The Traditional Cooperative Portfolio Problem



The essence of the problem is that the member's investment decision is inextricably tied to the patronage decision (Cook, 1995), as members are generally required to invest an amount of equity in proportion to their use of the cooperative's services. This is in contrast to investors in a publicly traded IOF who can trade stock to adjust their portfolios to achieve lower or higher levels of risk in accordance with their individual preferences. Condon (1990) argues that since cooperative equity in most cases is a sunk investment, members will attempt to minimize their exposure to risk in ways other than exiting the cooperative; for instance by applying pressure internally via the board to accept lower risk and return investments.

Rhodes (in Royer, 1987) argues that farmers are unwilling to let their cooperatives diversify into businesses unrelated to farming because of the sunk nature of their cooperative investment. Further, he argues that farmers can receive the same level of investment services from investing in a publicly traded IOF with a liquid secondary

market for their residual claims. Consequently, farmers are willing to accept the illiquidity of the cooperative structure only when the investment underpins the viability of the farming operation.

Similarly Staatz (1987) argues that farmer's investment into cooperatives 'represents a deepening of the farmers' financial commitment to a particular line of business rather than a diversification of their portfolios.' Further, cooperative patrons tend to 'have all of their eggs in one basket' … and consequently … 'they may pressure management to adopt more conservative business strategies than those of competing IOFs' (Staatz, 1987).

Iliopoulos (1998) suggests that any attempt to alleviate the portfolio constraint must allow members to adjust their investment portfolio to match their risk preferences and provide the firm with enough flexibility to invest in profitable ventures that increase its value, whilst member's shares in this increased value are in proportion to their individual contributions.

Iliopoulos (1998) tested for the three potential investment potential investment constraints problems of free rider, horizon and (lateral) portfolio in a large sample of US cooperatives to ascertain the degree to which these were binding. These constraints were drawn from Cook's (1995) Vaguely Defined Property Rights (VDPR) framework. His study implied that WTI = f (CS), where WTI is the member's willingness to invest in his cooperative and CS is cooperative structure. WTI, expressed as 'members' investment incentives', was measured as a latent variable consisting of a modified ratio of member's equity to the number of members and a ratio of members' equity to total cooperative assets. The independent variables were the cooperative structural characteristics of open

or defined membership, existence of marketing agreements, NGC transferable delivery rights, NGC appreciable delivery rights, explicit equity redemption policies and separate or bundled capital pools.

Iliopoulos' separate capital pools variable was tested within multi purpose cooperatives, as separate capital pools are designed to deal with a ***lateral*** portfolio constraint. A lateral constraint occurs when the cooperative's service mix does not match the member's on-farm portfolio of enterprises. For instance, increasingly specialized members may be unwilling to invest in divisions unrelated to their on-farm portfolio, such as specialized hog producers who may be unwilling to invest in grain marketing within a cooperative that offers both services. His results yielded some support for the existence of the lateral problem. The focus of this chapter is on the ***vertical*** portfolio constraint, which is essentially concerned with the preferred capital intensity of investment within a single commodity by different sub groups within the membership, based on the sub group members' opportunity cost of capital. The vertical framework will then be applied to the lateral problem.

Iliopoulos' (1998) empirical test consisted of a survey of cooperative CEOs and CFOs. It was a survey of the perceptions of the members' agents. My study is a more complete study of the *principals'* actual investment preferences. That is, the WTI will be seen as a function of the principal's attributes (investment preferences based of their opportunity cost of capital) as well as the cooperative's structure.

3. A Further Refinement of the Portfolio Problem

The User vs. Investor Asset Continuum

The portfolio problem has been described, until now, as arising from only a structural defect in that the lack of appreciable, transferable and liquid residual claims may result in a binding investment constraint. The problem has been described only in terms of the single facet of structure.

This study's central proposition is that easing a portfolio constraint within a cooperative may be thought of as a two faceted problem of aligning the farmer member's opportunity cost of capital to financial instruments representing bundles of asset returns that reflect that opportunity cost of capital. It may be thought of as an extension of Iliopoulos' CAPM approach of a portfolio of cooperative assets a as vector of numbers (P_1, P_2, …P_n) indicating 'what fraction of the total wealth is to be invested in each asset' in that the '*set of assets of which shares are traded' (Iliopoulos, 1998) should reflect discrete groups of members' opportunity cost of capital*.

That is, WTI = f (AFI, OCC), where OCC is the member's opportunity cost of capital and AFI is an appropriate set of cooperative financial instruments that permit the member to match his OCC and the expected return from the cooperative investment.

This is conceptualized in either a vertical context within a single commodity marketing cooperative, or in a lateral context within a multi purpose cooperative. The bulk of this chapter will explore the vertical dimension within a single commodity marketing cooperative. Although the portfolio problem has been thought of, and tested, only in a lateral sense until now; this study suggests that it is more efficient to conceptualize the problem from a vertical perspective enhancing and deepening an

understanding of the user vs. investor continuum. This conceptualization can then be applied to the purely lateral problem.

Accordingly, it is purported that vertical cooperative investment should not be thought of as a homogenous bundle, but as a continuum of investments that are more linked to on-farm investment (user investment) and likely to generate most rents at the farm level to investments that are progressively decoupled from on-farm investment (investor investment) and likely to generate most rents at the cooperative level. This continuum can be described in terms of Mighell and Jones' (1963) stages of production, which they defined as 'any operating process capable of producing a salable product or service under appropriate circumstances'[8].

Table 3.1 presents a continuum that ranges from user assets that generate proportionally greater on-farm returns (NPV_F) - relative to cooperative level returns - to investor assets that generate proportionally greater cooperative levels (NPVc) returns - relative to on-farm returns.

[8] This definition appears to be equivalent to Williamson's 'technologically separable interfaces' (1996).

Table 3.1: A Continuum of Cooperative User and Investor Assets from Vertical Investment within a Single Commodity Marketing Cooperative

Asset function	Example	Returns to members in the form of …	Relative return flows to members …	Asset type
1. Assembly	Milk tanker/ collection station	On farm scale/ coop scale	$NPV_F > NPVc$	Strongly user
2. Simple processing	Spray drier/nut sheller	On farm scale/ coop scale	$NPV_F > NPVc$	
3. Bulk marketing	Container facilities and warehousing	On-farm scale/ co-op scale	$NPV_F > NPVc$	⇕
4. Complex processing	Specialty powder plant/ smoking and roasting facilities	Quality control/ co-op scale	$NPV_F < NPVc$	Strongly investor
5. Branding	Advertising and packaging	Co-op scale	NPVc only	Only investor

That is, in keeping with the view of cooperative user investment as a Real Option to underpin further farm investment, the milk tanker pick-up may yield a very low rate of return in itself, but the security afforded by the investment may provide the justification for further on-farm investment. Consequently, most returns to the member manifest themselves as on-farm returns as the farmer is able to expand production and reduce costs.

At the other end of the continuum, returns from investment in retail advertising and packaging are likely to manifest themselves at the cooperative level only, such as market access for processed products or monopoly rents from branding. Accordingly, this branding class of asset generating a single flow of returns would require a much higher cooperative level rate of return than the assembly class of asset generating, which generates a dual flow of returns. At the margin, we could expect that a member investor

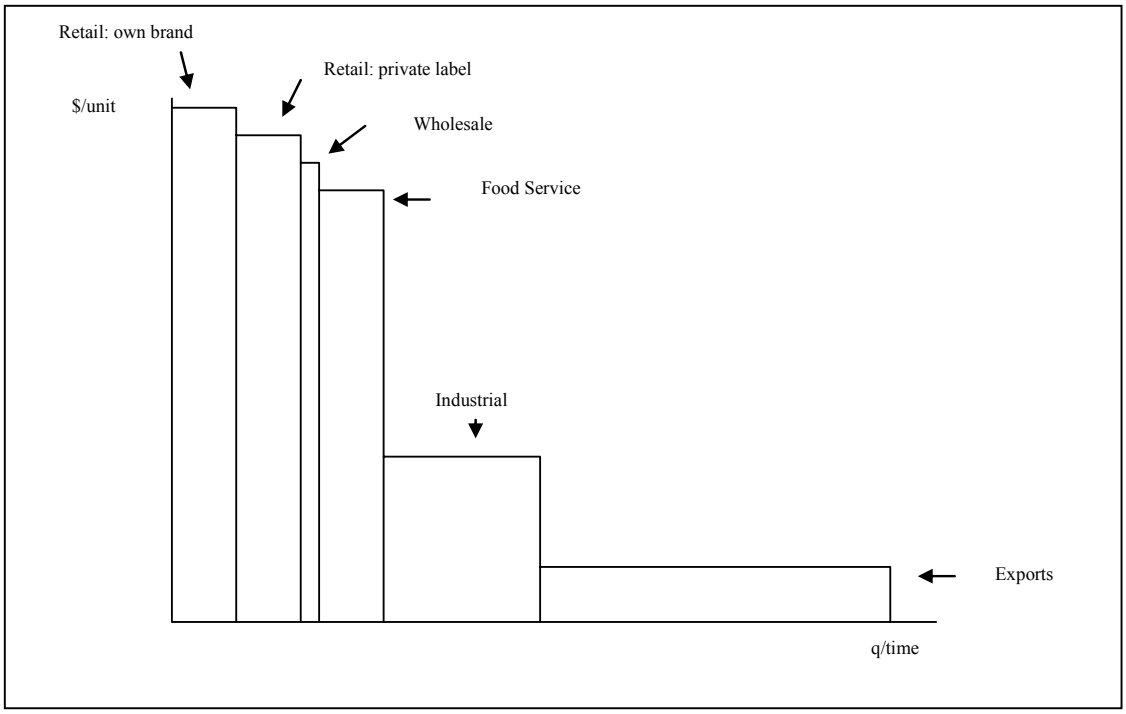
would be indifferent between the two classes of assets when the combined returns from the strongly user asset equated with the single return from the purely investor asset. If it is assumed that the member's on-farm return is his benchmark return and farmers have a fairly uniform rate of return, then the opportunity cost of capital will be similar across members. At issue though, is the likelihood that the opportunity cost of capital for members will diverge from each other. Farmers with a high combined return from the user asset may be more likely to have a higher single return from the investor asset and visa versa. This implies the potential for conflict as economic interests diverge.

The Member's Vertical Investment Decision

This can be seen more formally by making an extension to Iliopoulos' (1998) deductive thought experiment. Assume that:

1. a farmer's investment choices are limited to three options: on-farm, cooperative assets and outside investor assets. Cooperative assets can be further delineated into cooperative user assets and cooperative investor assets.
2. the cooperative provides appropriate financial instruments (AFI) so that the member is able to adjust his holdings of user and investor asset bundles, and the end market returns that they represent, via trade with fellow members within a liquid secondary market.
3. product payments to members from this open cooperative with no supply controls are made via AFI which separate the end market returns as represented by Figure 3.3.

Figure 3.3: Stylized Representation of Cooperative Returns from Specific Market Segments



That is, the farmer member's investment constraint consists of:

$$I_T = I_F + I_C + I_O \quad (2)$$

where I_T is total investment, I_F is on-farm investment, I_C is cooperative investment and I_O is investment in other investor assets. However, as $I_C = I_U + I_I$, - investment in the cooperative user asset + investment in the cooperative investor asset - equation (2) can be rewritten as:

$$I_T = I_F + I_U + I_I + I_O \quad (3)$$

Let the member's total net benefits, NPV_T, consist of:

$$NPV_T = NPV_F + NPV_C + NPV_O \quad (4)$$

where NPV_F is discounted cashflow from on-farm assets, NPV_C is discounted cashflow from total cooperative assets and NPV_O is discounted cashflow from other investor assets. However, as $NPV_C = NPV_U + NPV_I$ - the discounted cashflow from cooperative user assets + the discounted cashflow from cooperative investor assets - equation (4) can be rewritten as:

$$NPV_T = NPV_F + NPV_U + NPV_{I,} + NPV_O \quad (5)$$

However, as discussed, the member's on-farm return is a function of the member's investment in cooperative (user and investor) assets as well as his on-farm investment. That is:

$$NPV_F = f(I_F, I_U, I_I) \quad (6)$$

At the cooperative level these assets' return are purely a function of the capital invested in them.

$$NPV_U = f(I_U) \text{ and } NPV_I = f(I_I) \quad (7)$$

Therefore equation (5) may be rewritten as:

$$NPV_T = NPV_F(I_F) + NPV_F(I_U) + NPV_F(I_I) + NPV_U(I_U) + NPV_I(I_I) + NPV_O(I_O) \quad (8)$$

The additional terms in equation (8) of $NPV_F(I_U) + NPV_F(I_I)$ denote the additional value accorded to on-farm production from investing in the cooperative. It is the presence of these returns, typically associated with reducing expected losses in the case of user investment or increasing expected gains in the case of investor investment by

leveraging producer ownership[9] that underpin the logic of member investment. If all of the rent was earned at the cooperative level, then there would appear to be no intrinsic advantage to the cooperative structure holding these assets relative to an IOF structure.

At issue is how the farmer may equate the opportunity cost of capital between the four choices. Therefore, forming a Lagrangian function to incorporate the member's investment constraint yields:

$$NPV_T = NPV_F(I_F) + NPV_F(I_U) + NPV_F(I_I) + NPV_U(I_U) + NPV_I(I_I) + NPV_O(I_O) + \lambda(I_T - I_F - I_U - I_I - I_O) \quad (9)$$

Differentiating with respect to each of the choice variables yields:

$$FOC_{IF} = \frac{\partial NPV_F}{\partial I_F} - \lambda = 0 \quad (10)$$

$$FOC_{IU} = \frac{\partial NPV_F + \partial NPV_U}{\partial I_U} - \lambda = 0 \quad (11)$$

$$FOC_{II} = \frac{\partial NPV_F + \partial NPV_I}{\partial I_I} - \lambda = 0 \quad (12)$$

$$FOC_{IO} = \frac{\partial NPV_O}{\partial I_O} - \lambda = 0 \quad (13)$$

Optimal member investment occurs when the marginal benefit of each investment is the same:

$$\frac{\partial NPV_F}{\partial I_F} = \frac{\partial NPV_F + \partial NPV_U}{\partial I_U} = \frac{\partial NPV_F + \partial NPV_I}{\partial I_I} = \frac{\partial NPV_O}{\partial I_O} \quad (14)$$

[9] Recall the earlier discussion by Sykuta and Cook (2001) hypothesizing possible lower coordination costs in producer owner firms relative to investor owned firms in aggregating and processing difficult to measure product attributes.

As $NPV_F\ (I_U) > NPV_U\ (I_U)$ and $NPV_I\ (I_I) > NPV_F\ (I_I)$, then in each asset class a fall in on-farm returns must be exactly compensated by increased investor returns and visa versa if (14) is to hold. The further from the farm is the investment, the smaller will be the proportion of user benefits.

This implies that the member's required rate of return from cooperative investment will increase as the investment becomes further removed from the farm business.

A further assumption is added that as the farm is the member's main wealth generating asset, on-farm investment is the member's investment benchmark for cooperative investment over some defined period. The defined period in the survey is a five year strategic planning horizon. This assumption rests upon a divergence from the underlying portfolio theory assumption (3) outlined earlier in this chapter which assumed a highly divisible portfolio mix consisting of securities that facilitates ease of asset transfer and low transaction costs from altering the portfolio. Land, in particular, is likely to be a highly lumpy investment and is also likely to incur relatively high switching costs. This implies that the farmer benchmark rate of return is the on-farm return, as a very high proportion of the farmer's wealth is likely to be his farm; that is the lumpiness of the farm investment implies at high value at risk. Highly specialized capital intensive assets with a low salvageable value, such as a milk parlor, further imply a high possible value at risk.

Over time, the returns from the farm will equate with the returns from outside investment and resources will flow out of, or into, agriculture depending on the relative return. However, this adjustment may be further influenced by a range of sociological factors, such as cultural isolation and generational shifts in required rates of return, and

this may explain the slow transition of resources out of agriculture by smaller farmers in particular.

Bullock (2000) points out that a change in business structure may achieve an increase in the proportion of the portfolio that is held in liquid assets to better accommodate the risk of a large loss, with the aim of avoiding a forced bankruptcy; that is the business structure could affect the rate of adjustment. This implies that this benchmark is a continuum related to the degree of liquidity associated with farm assets. On one end of the continuum may be the farmer who contracts all of the farm's input, implying a faster adjustment rate, and on the other end is the farmer who has all of his wealth invested into the farm. For the purposes of this study, farm investment is assumed to be lumpy.

Equation (14) therefore will be assumed to pertain to the long run, which for the purposes of this study is the five year strategic planning horizon denoted in the member surveys. In the period under consideration, equation (14) may be rewritten as:

$$\partial \frac{NPV_F}{\partial I_F} = \partial \frac{NPV_F}{\partial I_U} + \partial \frac{NPV_U}{\partial I_U} = \partial \frac{NPV_F}{\partial I_I} + \partial \frac{NPV_I}{\partial I_I} \quad (15)$$

Equation (15) implies that the opportunity cost of investment for each member would be the same if each member's on-farm rate of return was the same (assuming that rate of return roughly equates with appetite for risk).

To re-emphasize, it is argued that the characteristics of farm investment imply a longer relevant time horizon than is commonly assumed in the literature. For this reason, the on-farm rate of return is assumed to be the relevant bench rate; this appears to be consistent with the slow rate of adjustment observed in agricultural industries.

Distortion in Investment Decisions

Suppose for some time after the cooperative's founding the variation in the size of member's farms was relatively small, their rates of return were likely to be roughly similar and most farmers in most commodity lines were diversified to more or less the same extent. A high homogeneity of economic interests had caused these farmers to self select into the cooperative membership and their opportunity cost of cooperative investment was relatively similar.

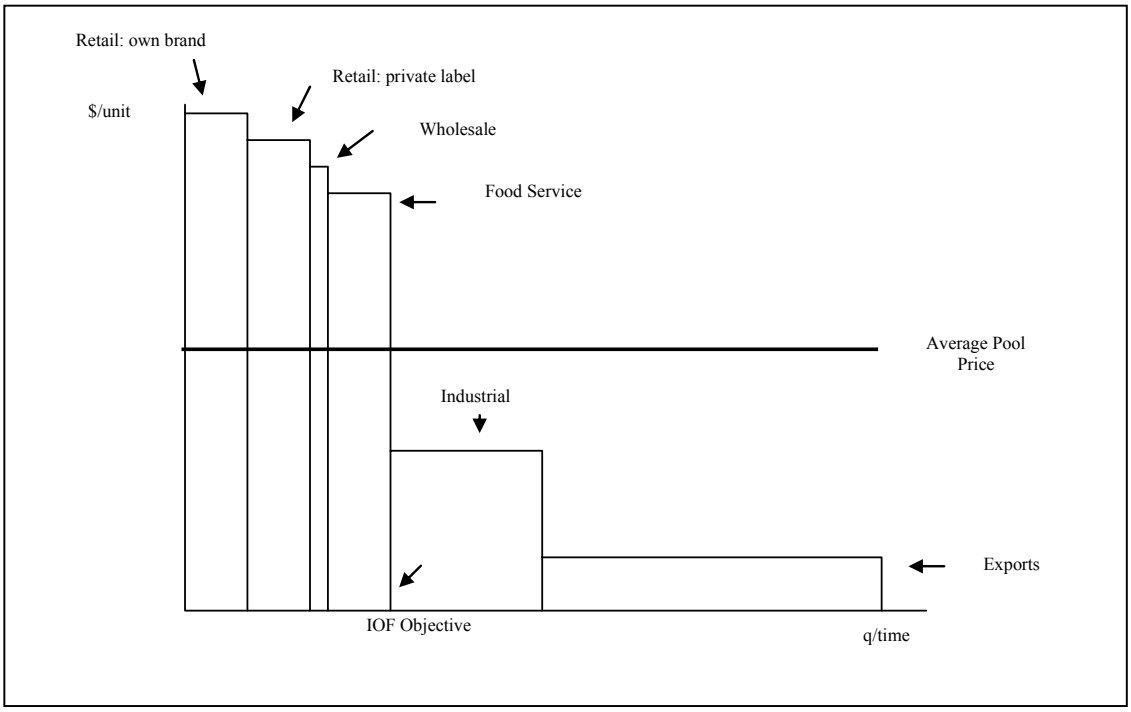
If members had predominantly defensive reasons to invest, which justified a continuing strategy of almost exclusive user asset investment, then even if members' NPV_F were to diverge, investment decisions were unlikely to be greatly distorted. This is because the majority of returns are accrued at the farm level, so all members had an incentive to invest, as the opportunity cost of cooperative investment was less than the expected cost of dealing with an IOF customer.

Suppose, however, that over time the cooperative's asset mix changed. User asset investment returns may have fallen as changing market conditions resulted in fewer market imperfections (Hansmann, 1999) and over supply induced price decreases greater than cost savings from cooperative scale efficiencies (Cook, 1995). Consequently, many single marketing cooperatives in maturing markets such as the US sought to maintain margins by investing more heavily into investor assets (Cook, 1995). These investments required larger capital injections to create Ricardian rents in down stream processing or to create a set of (monopoly or Ricardian) rents via branding.

Consider firstly the case if the market returns illustrated in Figure 3.3, were *pooled* in an open cooperative with no supply controls as shown in Figure 3.4. Even if the NPV_F

remained uniform among members then distortions are likely to occur in the collective investment decision. Although all members would have roughly the same OCC, and thus roughly the same willingness to invest in the cooperative as the other members, they all receive an over inflated product price signal.

Figure 3.4: Cooperative Bundling of Specific Market Segments



The single flow of pooled payments from across highly different yielding markets is likely to inflate product prices to a level in excess of that required to draw sufficient supply to maximize both user and investor benefits, compared to separate revenue streams represented by user and investor classes of financial instruments. In Figure 3.4 the IOF competitor seeks to limit input supply to service only high value markets; this is a pattern observed in many agri-businesses. In other words, the higher prices from value added investment may keep the smaller high cost producer viable, but it creates a greater level of rents available to lower cost producers, which in turn stimulates these producers

to expand their supply. In this way, a cycle begins of falling prices, cooperative investment to lift prices, further production, falling prices and further pressure for the cooperative to invest in investor assets to lift prices[10].

This leads to:

General Hypothesis 1: **Pooling of cooperative returns across market segments creates an incentive for members to over produce in an open membership marketing cooperative as the average value of returns exceeds the marginal value from the least returning market.**

This hypothesis is not exhaustively tested in this study as that would require a number of further studies across marketing cooperatives.

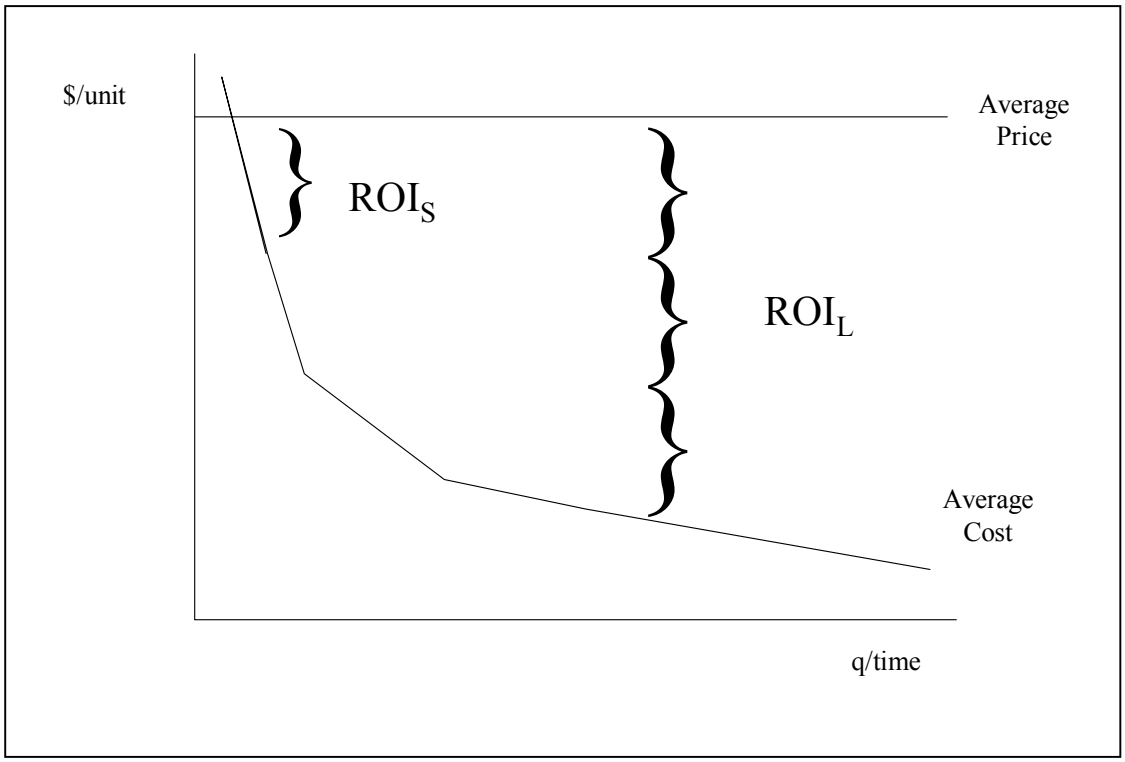
Further, in keeping with the structural changes outlined in the last chapter that members' NPV_F is likely to have steadily diverged since the cooperative's foundation, as some farmers were able to more aggressively pursue scale economies than others. Some farmers will have been constrained from pursuing the traditional on-farm strategy of scale economies. Chapter 2 suggested that a capital constraint may be a common constraint; other constraints to growth may also exist that are particular to each case considered in the next chapter. This will occur across all types of cooperatives.

The cooperative's membership increasingly came to be characterized by a lengthening continuum of NPV_F, because some farmers generated higher rents at the farm level through attainment of scale, relative to other farmers who became constrained from

[10] This scenario pre-supposes a major assumption that a structural feature, such as revolving equity redemption, common in US cooperatives or a feature of an Australian cooperative such as Co-operative Bulk Handling in West Australia, may preclude the conversion of the cooperative to an IOF when use benefits diminish and investors seek to limit rent dissipation from over supply of services. For instance, most major (largely producer owned) IOF grain handlers in Australia, such as Ausbulk, Graincorp and Grainco, are former cooperatives.

expansion. Figure 3.5 represents this scenario within a highly specialized membership employing the same production technology. It is a single time period snapshot of Return on Investment (ROI) of on farm return and while it does not capture the dynamics of growth over time represented by a discounted cash flow, it does illustrate the point of diverging on farm returns due to scale. Dairy farming may be the closest approximation to this representation, as dairy farms within a given industry tend to be highly specialized and employ similar technologies.

Figure 3.5: Return on Farm Investment between a Constrained Small Producer and an Unconstrained Large Producer



Accordingly, adjusting the model to incorporate two farmers of different size may better characterize the collective investment decision than the single farmer used earlier.

If $NPV_{FL} > NPV_{FS}$, where the NPV_{FL} denotes large farmer's on-farm return and subscript NPV_{FS} denotes the small farmer's on-farm return, then consider the following observations.

$$\text{If} \quad \frac{\partial NPV_{FL}}{\partial I_F} > \frac{\partial NPV_F}{\partial I_U} + \frac{\partial NPV_U}{\partial I_U} + \frac{\partial NPV_F}{\partial I_I} + \frac{\partial NPV_I}{\partial I_I} \tag{16}$$

Equation (16) implies that if the large on-farm return is greater than the total cooperative return, then the larger member will be unwilling to invest in the cooperative. Therefore it may be hypothesized that very large farmers who perceive little or no defensive reasons for investment are less likely to require cooperative services. The USDA (1991) noted that there was a strong positive correlation between dairy farmer size and cooperative participation, but that this participation was slightly lower for the largest size segment of farmers. Wadsworth (1991) confirms that this is also the case for US grain farmers. Richards (1996) confirmed a similar trend in California.

It also implies that if the user asset benefits are very small, then *investor benefits will need to be correspondingly large* to justify investment. For instance, the almost exclusive flow of cooperative level returns is one of the characteristics of many New Generation Cooperatives.

$$\text{If} \quad \frac{\partial NPV_{FS}}{\partial I_F} < \frac{\partial NPV_{FS}}{\partial I_U} + \frac{\partial NPV_U}{\partial I_U} + \frac{\partial NPV_{FS}}{\partial I_I} + \frac{\partial NPV_I}{\partial I_I} \tag{17}$$

If the small farmer's on-farm return is smaller than the total cooperative return then the smaller member will be willing to invest in the cooperative. Even if user asset returns have fallen substantially, *investor asset returns do not have to be as large* to induce investment from the small farmer compared to the larger farmer if the earlier noted positive relationship between scale and returns holds.

Large farmers may become more sensitive to remaining market imperfections as increasing size implies greater specialization, in keeping with the earlier discussion on the value they may have at risk. If so, the option value of the cooperative user based assets rises as size and specialization increases. Note the earlier empirical findings by the USDA (1991) and Wadsworth (1991) that size is positively correlated with cooperative participation, particularly in cash grains and dairy, although a slightly smaller proportion of the very largest farmers participate in cooperatives in some industries. This suggests a larger farmer's preference for lower risk, lower returning investments at the cooperative level in order to generate higher levels of rent at the farm level relative to the small, more diversified farmer. That is,

$$\partial NPV_{FL} / \partial I_U > \partial NPV_{FS} / \partial I_U \quad (18)$$

All else being equal, equation (18) suggests that larger farmers prefer a cooperative asset mix skewed towards user assets, relative to smaller commercial farmers. Collectively, observations 1 – 3 also suggest that smaller farmers prefer a cooperative asset mix skewed towards investor assets as they have relatively less at risk at the farm level and require a lower compensatory rate of return to invest in these assets.

This leads to:

Operational Hypothesis 1: The Vertical Portfolio Problem in Marketing Cooperatives: **Smaller members who are relatively more constrained from expanding their farm operation will prefer investment in cooperative investor assets (for offensive purposes) that provide higher cooperative returns relative to larger members who are relatively less constrained from expanding on-farm who will**

prefer investment into cooperative user assets (for defensive purposes) that provide higher on-farm returns.

This may suggest why larger farmers tend to participate in cooperatives more than small farmers (Wadsworth, 1991) and why cooperatives also are most heavily involved in the production of bulk commodities. Note the scale of dairy production is much smaller in Europe and dairy cooperatives much more involved in the production of capital intensive consumer ready products and branding. This also suggests the opportunity cost of capital is lower in European agriculture than the US.

The discussion so far on member characteristics' impact on the demand for farmer members' preferred cooperative investment patterns is summed in Table 3.2.

Table 3.2: Members' Hypothesized Preferred Pattern of Marketing Cooperative Investments as a Function of Member Characteristics

A continuum of Y variables: Farmers as members' preferred investment	**X variable**
	Member characteristics influencing on-farm Return on Investment (ROI_F).
Bundle of user assets (Benefit flows: $NPV_F (I_U) > NPV_U (I_U)$)	Large and growing • specialized • derive a larger portion of gross income from the cooperative
Bundle of investor assets (Benefit flows: $NPV_F (I_I) < NPV_I (I_I)$)	Small and constrained • diversified • derive a smaller portion of gross income from the cooperative

The vertical portfolio problem within a commodity line may also emerge in an input supply cooperative, although it is unlikely to be of the same magnitude as the vertical problem in a marketing cooperative. Therefore the variation in the value accorded to them is more likely to be solely dependent on the assets' implied real option value. This is because the cooperative assets involved are more likely to be characterized solely as

use assets. Further, if the use assets are not required to ameliorate market power in the purchase of inputs, then they are likely to be largely dedicated to managing production risks. Smaller, diversified, relatively constrained commercial farmers, who are relatively more capitally constrained and have greater on-farm diversification, may place a lower value on assets that underpin further specialization, relative to larger, more specialized farmers seeking greater control over production risks. For instance, smaller commercial farmers may be more likely to prefer competitively priced crop inputs, whilst larger, specialized, relatively unconstrained grain farmers may prefer timely custom agronomy application services.

However, because of the high levels of specialization among very small farmers noted in Chapter 2, these farmers may also place a relatively high option value on use assets that provide services, such as custom agronomy application, that remove a time constraint on their ability to generate significant off farm income, usually from labor.

This leads to:

Operational Hypothesis 2: The Vertical Portfolio Problem in Input Supply Cooperatives: **Smaller, diversified, relatively constrained commercial farmer members will prefer less investment in cooperative assets that underpin further specialization within a commodity line relative to larger, relatively unconstrained specialized farmers.**

and

Operational Hypothesis 3: **Very small, specialized, farmers will prefer investment in services that reduce the opportunity cost in pursuing off-farm returns.**

The Member's Lateral Investment Decision

A similar dichotomy can be thought of in relation to a continuum of lateral cooperative investment across divisions. In Table 3.3, a very simple multi purpose cooperative is assumed to consist of three divisions, each producing user type returns $\{NPV_F (I_U) > NPV_U (I_U)\}$ from each division. The membership is assumed to engage in one or all of beef, hog or grain farming.

Table 3.3: A Continuum of Cooperative User and Investor Assets from Lateral Investment within a Multi Purpose Commodity Cooperative

Asset function	Example	Predominantly user benefits accrue to members engaged in …	No user benefits accrue to members engaged ONLY in …
1. Animal feed	Mill/delivery truck	Beef Hogs	Grain
2. Grain marketing	Elevator/loading facilities	Grain	Beef and Hogs
3. Crop inputs	Container facilities and warehousing		

If all members were diversified into the three farming operations, then pooled investment and pooled product prices are likely to result in small, if any, distorted investment decisions, especially if the capital intensity of these cooperative assets is low. A diversified farmer with a production mix exactly reflecting the cooperative's asset mix, will face the same opportunity cost when investing in any one of the three asset classes if each farming enterprise return is the same.

Once members become specialized, however, their opportunity cost of investing in a division not related to their farm rises dramatically as all residual claims are tied to use of that cooperative asset. This member would have to receive a return at least equal to the on-farm return to justify investment.

This leads to:

- Operational Hypothesis 4: The Lateral Portfolio Problem in Multi Purpose Cooperatives: **Less diversified members will prefer cooperative investment into assets that reflect their specialization, whilst more diversified members will prefer a wider range of cooperative investment that reflects their diversification.**

A similar lateral problem may emerge in a single commodity marketing cooperative such that members could move their on-farm production out of the commodity in question. These members may be reluctant to further invest in the cooperative.

This leads to:

- Operational Hypothesis 5: The Lateral Portfolio Problem in Marketing Cooperatives: **Members altering their on-farm production portfolio, so as to reduce the volume marketed by the cooperative, will prefer not to invest any further capital in the cooperative.**

A Refinement of the Definition of the Cooperative Portfolio Problem

If the above argument is correct, then the **necessary** condition for the amelioration of a *binding* cooperative portfolio problem is the identification and separation of different rates of return from different asset classes and markets. Different asset classes represent different reasons for investment and different minimum required cooperative level Return on Investment (ROI) for those assets.

The **sufficient** condition for the constraint's amelioration is the creation of classes of transferable financial instruments based upon these different streams of returns. This would permit the member/investor/supplier to better judge the level of cooperative and on-farm investment that will maximize his returns across all classes of investment.

Thus a more refined description of the cooperative portfolio problem may be:

If member investors cannot accurately separate their cooperative investment returns, they cannot judge the optimal levels of investment required to suit their risk preferences as represented by their diverging farm level strategic plans. The lack of the necessary financial instruments for members to adjust a portfolio of cooperative investments may result in conflict between sub groups of members.

From a vertical perspective, in marketing cooperatives, investment preferences will diverge between larger farmers, with relatively high on-farm returns, seeking low risk, use benefit type investment, and smaller farmers, with relatively low on-farm returns, seeking greater investor benefit type investment. In multi purpose cooperatives, this divergence may emerge over the differences in the value of real option for user assets that arises between larger, more specialized farmers seeking to manage higher potential losses from a relatively undiversified farming portfolio and very small specialized farmers seeking services to relieve a time constraint arising from pursing off-farm opportunities vs. smaller, diversified farmers seeking lower cost inputs.

From the lateral perspective, in multi purpose cooperatives, investment preferences will diverge on the basis of difference in specialization between members. The problem will manifest itself in marketing cooperatives as a divergence in investment preferences between those planning to cease production of the commodity in question and those who plan to continue to patronize the cooperative.

When vertical or lateral portfolio problems are binding, they imply rising internal tension and increased ownership costs as an influence problem is likely to emerge as the Board of Directors is pressured by opposing sub groups within the membership.

The creation of Appropriate Financial Instruments based on an understanding of the member's preferred investment profiles could create the basis for the separation of cooperative assets into discrete revenue and investment flows.

4. Summary of Hypotheses

Table 3.4 lists the generated hypotheses flowing from the analytical framework presented in this chapter.

Table 3.4: A Summary of Hypotheses Related to the Portfolio Investment Constraint

Hypothesis	Description
General hypothesis	Pooling of cooperative returns across market segments creates an incentive for members to over produce as the average value of returns exceeds the marginal value from the least returning market.
Operational Hypothesis 1: The vertical portfolio problem in marketing cooperatives	Smaller members who are relatively more constrained in expanding their farm operation will prefer investment in cooperative investor assets (for offensive purposes) that provide higher cooperative returns relative to larger members who are relatively less constrained from expanding on-farm who will prefer investment into cooperative user assets (for defensive purposes) that provide higher on-farm returns.
Operational Hypothesis 2: The vertical portfolio problem in input supply cooperatives	Smaller, diversified, constrained commercial farmer members will prefer less investment in cooperative assets that underpin further specialization relative to larger, unconstrained specialized farmers.
Operational Hypothesis 3: The vertical portfolio problem in input supply cooperatives	Very small, specialized farmers will prefer investment in services that reduce the opportunity cost in pursuing off-farm returns**.**
Operational Hypothesis 4: The lateral portfolio problem in multi-purpose cooperatives	Less diversified members will prefer cooperative investment into assets that reflect their specialization, whilst more diversified members will prefer a wider range of cooperative investment that reflects their enterprise diversification.
Operational Hypothesis 5: The lateral portfolio problem in marketing cooperatives	Members altering their on-farm production portfolio, so as to reduce the volume marketed by the cooperative, will prefer not to invest any further capital in the cooperative.

CHAPTER FOUR

EMPIRICAL METHODOLOGY: CONTEXTUALIZING THE PORTFOLIO PROBLEM

Case Studies of Three Cooperatives and Membership Surveys

'This is the era of methodological pluralism in applied social science…'
Green and Caracelli in Sterns, Schweikhart, and Peterson (1998)

1. Introduction

This chapter outlines the rationale for combining case study and survey methodologies to test the hypotheses developed within the conceptual framework of this study. The chapter discusses and applies case study methodology to three business case studies. The case studies contextualize the conceptual problem, so as to emphasize the *economic* importance of the phenomena observed. A template survey is then discussed within the context of the operational hypotheses under test. The next chapter discusses the methodology underlining statistical analysis of the survey data.

2. Case Study Methodology

Sterns, Schweikhart, and Peterson (1998) list the three objectives of research as: i) testing existing theory; ii) developing new theory; or iii) conducting applied, problem solving research.

Yin (in Sterns, Schweikhart, and Peterson, 1998) argues that when the purpose of research is to test and clarify existing theory, the researcher can select a number of case studies to purposely challenge and test *a priori* assumptions and theoretical assertions. This approach is analogous to a laboratory scientist conducting a series of experiments,

the aim being to determine if the theory holds up under the specific conditions and parameters of a given case. The obvious *a priori* theoretical assertion of this study is confirmation of cooperative managers' perception of a lateral portfolio problem. Primarily, confirmation of this assertion is sought at the member level by way of survey. The case studies help to form an assessment of the potential *economic importance* of the problem within the unique parameters of the specific case.

Yin argues that when the purpose of the study is to build new theory, the researcher has two options. These are to choose a small number of archetypical firms that represent a decision set or choose a small number of 'outlier' firms that are unique. From the perspective of the unit of analysis employed in this study - the members' investment preferences - the chosen firms are 'archetypical'. Indeed one of the objectives of the study is to begin the process of determining how generalizable is the theoretical assertion that the portfolio problem exists across industries, countries and structures. The theoretical propositions developed in this study relate to the existence of a vertical portfolio problem and once again the cases contextualize the problem so that its degree of economic importance can be assessed.

When the purpose of the research is to address a specific problem confronting a decision maker and/or a firm, two approaches are again available to the researcher (Yin, 1994). These are to either make a case study of the problem itself so that the problem is the central research question or examine how another decision maker solved the problem under study. Obviously, this approach is important to this study because the businesses involved have to derive value from it or else there is no logic for their involvement. The uniqueness of each business implies that the portfolio problem, even if common across

agricultural industries and countries, may manifest itself differently at the cooperative level because of each business' competitive environment, legal framework, structure and internal culture and history. This implies that each business should be dealt with on a case by case basis to identify relevant differences that impact the degree to which the problem is likely to be binding. Further, an objective of this study is to begin a process of developing a menu of potential solutions from which decision makers may choose. It is likely that each business will face a different set of trade-offs when attempting to ameliorate because of its particular circumstances.

Yin (in Sterns, Schweikhart, and Peterson, 1998) contends that 'case studies, like experiments are generalizable to theoretical propositions and not to populations or universes.' That is, the case study is not a sample and the researcher's task is to expand and generalize theories – analytic generalizations – and not to enumerate frequencies – statistical generalizations. A 'previously developed theory' should be used as a template to compare the empirical results of the case study. McCloskey (in Sterns, Schweikhart, and Peterson, 1998) extends this line of reasoning and asserts that the decision to reject a hypothesis 'cannot be purely on statistical grounds' as statistical significance testing is about 'merely one sort of unbiased error in *sampling*', while substantive significance determines 'whether a fitted co-efficient is large or small in an economically significant sense'. Accordingly, McCloskey cautions economists to avoid a 'fallacy of equivocation' that may happen when a 'result on page 10 that is statistically significant turns up as economically significant on page 20.' Whilst proving statistically the significance of the portfolio problem is a prime objective of this study, the role of the case studies is to *contextualize* the member level portfolio problem within the

circumstances of the three individual businesses. That is, does the context of each business have a material effect on the potential degree to which a portfolio problem is *binding*?

In this spirit, this study will also use Projected to Latent Structure (PLS) regression as its final statistical method to avoid Type II errors. This is because PLS modeling becomes more stable as multi-collinearity increases, thus increasing the chances that variables of interest to the *business*, as well as the theory *process*, are not dropped. Further discussion on statistical testing can be found in the next chapter.

3. Survey Methodology

A survey is a system for collecting information that is designed to collect relevant information. Accordingly, the design, sample population, administration, analysis and reporting all depend upon the objectives of the study (Fink 2003). This study's objectives have been outlined earlier and are based on theoretical and conceptual framework developed in earlier chapters of the study.

A self administered mail survey, embodying a simple cross sectional design, modified by quota sampling to capture the theorized effects within the identified sub groups of the target population was the chosen survey method to achieve these objectives. In this case, segmentation would be best structured along the dimensions of size and degree of specialization. One cooperative with several thousand members was segmented along size and specialization, and a total of 1800 surveys were sent. One very large cooperative's membership of 12,000 was surveyed. Another cooperative's membership only consisted of 310 members, so the entire membership was surveyed.

Where appropriate, cooperative leaders endorsed the survey and encouraged members to participate. Cooperative decision maker input greatly aided the design of the survey instrument by ensuring that the language was culturally appropriate.

The survey was designed to be answered within 20 to 30 minutes inferring a high test to re-test reliability. The Y variables were repeated to test for consistency. They were asked in discrete form – a series of "or" questions for three choices and a 'don't know' option – and in continuous form – using a LIKERT scale between the most likely two choices. The interaction of other Y variables collected for another study provides a further check, inferring the added robustness of the continuous Y variable questions.

Cognitive pre-tests and pilot tests were conducted.

4. Overview of Methodological Process

Case selection

A number of cooperatives in different industries across countries were pre-tested for suitability for inclusion in this study. Subsequently a small number were approached as candidates for this study. Table 4.1 indicates the final choice of sample candidates and the reasons for their selection. Fonterra of New Zealand, Effingham Equity of Illinois, US and North East Missouri Grain Processors Inc (NMGP) of Missouri, US were selected as the first round of cooperatives under study, based upon a preference for a triangulation of structure, industry and macro institutional factors to ascertain whether these differences affect the existence of a portfolio problem and the degree to which the problem is binding.

Table 4.1: Overview of Factors for Cooperative Inclusion in First Round of Study

	Structural type	Industry	Macro Institutional Environment
Fonterra	Sapiro 2	Dairy	NZ Corporate Law / Dairy Industry Restructuring Act (2001)
Effingham Equity	Nourse 1	Grain and Livestock	US Cooperative (State) Illinois Statute
NMGP / NEMO	Sapiro 3	Corn/Ethanol	US Cooperative (State) Missouri Statute

Preliminary research cases

Preliminary research cases were produced entirely from publicly available data. The purpose of exploring exclusively only public data was to: i) demonstrate an understanding of the business and the issues it faced; and ii) to provide the basis of an introductory dialogue that might lay the basis for a mutually beneficial exchange between the researcher and the business. After the preliminary cases were examined by cooperative leadership (board and management), individual interviews were then established with the firms to gather reactions, data, and permission to further the case and survey research approach. The cases were refined and expanded following management input. Detailed cases will be published subsequent to this research. What is presented in this study is a truncated version of each case retaining the material pertinent to contextualizing the business' potential portfolio problem. These are briefly presented in the following sections.

5. Dissertation Case Studies

Case Study 1: Fonterra of New Zealand

Figure 4.1: Regions of New Zealand

Table 4.2: Fonterra: An Overview of Some Key Events

Date	Event		
	Farm level	**Industry level**	**Regulatory level**
1930s		Beginning rationalization of over 400 cooperatives to capture scale economies.	Formation of the NZ Dairy Board to provide scale and coordination in exports, mainly to the UK.
1960s		Highly volatile export commodity prices increasingly impacted by tariffs and subsidies in other countries.	NZDB gains monopoly export power. Begins FDI to diversify markets.
1973		Rapid co-operative consolidation results in very low processing costs by world standards. Gradual emergence of disparities between industry's marketing (NZDB) and processing (co-ops) arms.	Substantial loss of UK markets.
1985 onwards	Strong farm productivity growth. Development of large South Island herds.		Beginning of liberalization of NZ economy: Loss of farm subsidies $NZ floated, becomes highly volatile.
2000		4 remaining co-operatives	
2001		Formation of Fonterra: 2 major co-ops (95% of production) and NZDB. Introduction of Fair Value Share (FVS) allocates co-op's market value to members. High Milk Solid (MS) payouts due to strong commodity prices and weak $NZ.	Removal of NZDB export powers. Act to govern Fonterra's structure and activities.
2002 onwards		Steady rise of FVS; lower average MS payouts.	

Introduction

The Fonterra Co-operative Group was formed in 2001 from an amalgamation of the country's previously two largest co-operatives, NZ Dairy Group and Kiwi Co-operative Dairies, and the NZ Dairy Board (NZDB), a statutory monopoly that had control over the industry's exports. The new co-operative processes 95% of New Zealand's milk. With around 12,000 shareholders Fonterra became the world's second largest dairy company by volume of milk received, the world's largest dairy exporter and responsible for over 20% of New Zealand's exports. However, such a dominant market position came with legislative restrictions on Fonterra's ability to compete for milk supply and on its internal organizational design. The purpose of this mini case is to contextualize the conditions within which Fonterra may be subject to a binding portfolio problem. Additional background information, relative to the other two mini cases, is provided in this case because of the likelihood that readers will be unfamiliar with New Zealand, its institutional structure and its dairy industry.

A Brief Overview of the Structure of New Zealand Dairy Farming

New Zealand consists of two islands roughly extending north and south (thus the names North and South Islands) over the latitudes of approximately 34 and 47 degrees south. As no part of the country is very far from the coast, it has a very temperate climate highly suitable for pasture production. Much of the country is also characterized by rich volcanic soils which augment its climatic advantage.

Much of New Zealand's agricultural production is exported due to its small population of approximately 4 million people. Agricultural products comprise more than

50% of the country's exports. Dairy and meat are the country's largest agricultural exports.

The locus of the dairy industry is in the North Island. However, production has been slowly moving south over the past decade. This is because land prices on the South Island have been lower as the returns to South Island's main agricultural industry, sheep production, have been lower than returns to dairy production.

Between 1999 and 2004 milk solids[11] (MS) production increased by approximately 30% in the North Island and 50% in the South Island. Although the locus of the industry is still in the North Island, particularly with respect to farm numbers, production is shifting south. The average North Island herd is significantly smaller than the average South Island herd. This is because South Island sheep properties have been converted to dairy to capture scale economies. This suggests that the dominant strategy of farmers in these Southern regions is on-farm expansion accelerating a bipolar distribution of dairy farmers generically described in chapter two.

The very high rates of production growth, within a context of an open membership-pooled price payment cooperative and value added production, suggests support for the general hypothesis that 'pooling of cooperative returns across market segments creates an incentive for members to over produce in an open cooperative as the average value of returns exceeds the marginal value from the least returning market.'

This disparity in growth rates between the two Islands is further illustrated by examining available farm level financial data (NZ MAF, 1999 – 2004). The data and the studies from which it is drawn indicate apparent constraints to growth in some regions,

[11] Milk Solids are the milk components of protein and butterfat upon which New Zealand farmers are paid. MS receipts are referred to as 'payouts'.

particularly in the north[12], such as difficult to amalgamate farms, labor shortages, environmental constraints and urban land pressures. Consistent with the description outlined in Chapter Two, small farmers appear to face a capital constraint relative to large farmers as they cannot sustain as high debt to equity ratios, suggesting a constraint to growth. Further, small farmers, particularly in the North, are more likely to generate high levels of off-farm income.

In the 2004 season, the rate of production growth diminished sharply, as land costs have continued to rise and payouts fell due to a strong $NZ and weak commodity prices. This may suggest a general preference for value added investment to lift per unit returns if the industry is generally constrained in its production growth.

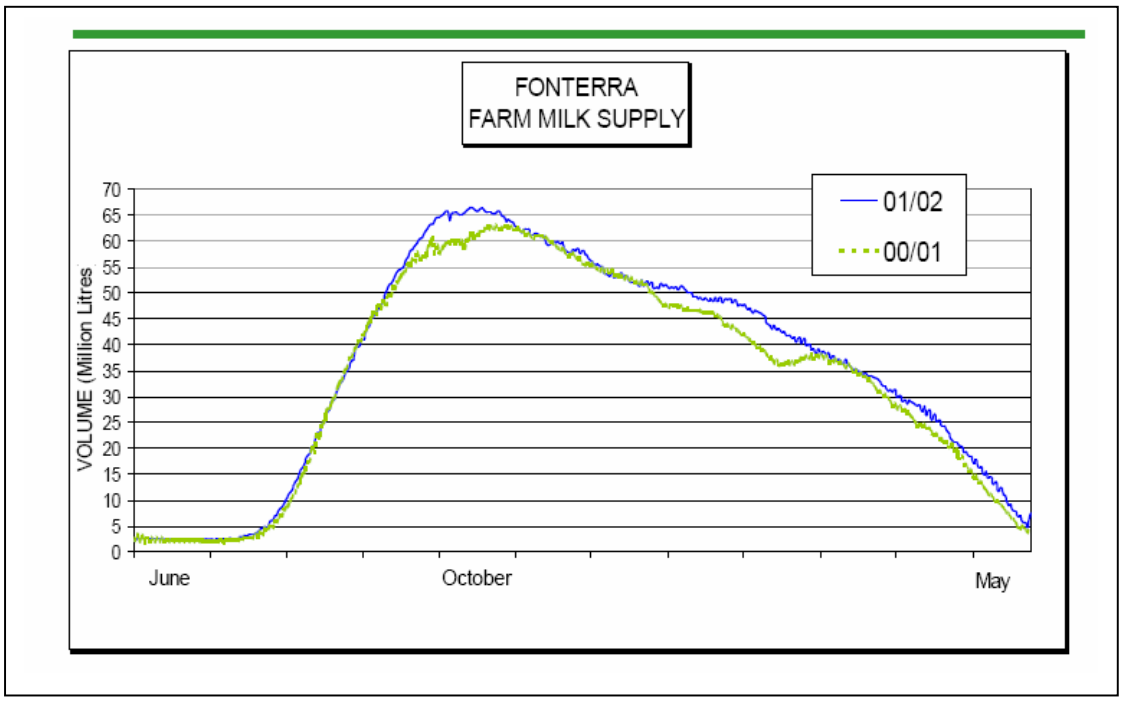
The Dominance of Commodity Production

New Zealand's pasture based system is very low cost by international standards. Consequently, it is also highly seasonal, as illustrated in Figure 4.2, which is in contrast to the grain based production systems used in Europe and the US. Cows are largely dried off over the winter months when feed availability is low.

The combination of New Zealand's highly seasonal milk production and its distance from markets favors the production of storable commodities such as cheese, powders, casein and butter. Removing the water content of milk reduces transport costs to its major markets, which are typically many thousands of kilometers away. Transforming milk into a storable commodity means it does not have to be sold at peak production time, but when demand conditions best suit the seller.

[12] For instance, a comparison of Development + Capital Purchases vs. Depreciation expenditure indicates, that despite low land costs in the Northland region of the North Island, rapid growth occurred only in two years of the five year period.

Figure 4.2: Seasonality of Milk Deliveries to Fonterra (volume, millions of litres)



Source: Stuart 2002

Growth in world dairy demand of 2% has outstripped growth in world production of 1% over the past decade. Consequently, forecast world demand for the storable commodities of milk powders and cheese is high as many Asian countries' incomes rise (Zwanenberg, 2001). This implies milk production growth can be most easily absorbed by the production of storable commodities.

While these products are best suited to absorb increasing milk production, the payout price for them is variable because of exchange rate and commodity market volatility. Commodity prices are also impacted by the developed world's high levels of tariffs and subsidies.

However, low US tariffs on value added caseinates and milk protein concentrates (MPC) and recent technological developments have stimulated New Zealand exports of

these products to the US. This is presumably, at least in part, a result of high domestic US prices for commodities because of internal subsidies which raise the opportunity cost of investment into these products for US producers and consequently discourage the development of domestic caseinate and MPC industries. These products use comparatively little additional milk and are capital intensive but have high rates of return at the cooperative level compared to bulk commodities.

H_1 states that "Smaller members who are relatively more constrained in expanding their farm operation will prefer investment in cooperative investor assets (for offensive purposes) that provide higher cooperative returns relative to larger members who are relatively less constrained from expanding on-farm who will prefer investment into cooperative user assets (for defensive purposes) that provide higher on-farm returns."

Compared to most other countries, dairy farming and dairy co-operatives in New Zealand have little institutional support. Farm subsidies were removed in the mid 1980s and the domestic market was deregulated in 1992. Co-operatives, such as Fonterra, are incorporated under the provisions of New Zealand company law and appear to have no regulatory advantages, particularly as the country has a single taxation system for dividends for all company types. This suggests that the reasons for the dairy industry's dominant use of co-operatives can be argued to be economic, which adds further support to the argument that dairy farmers will place a high use real option value on a cooperative. Furthermore, the Act regulating Fonterra's formation and dominant market position contains a number of restrictions. The Act restrict the cooperative's ability to control its supply as it must remain an open cooperative and Fonterra can have no more

than 33% of its milk supply under contract at any time. Further, key parts of its capital structure are also stipulated by the Act.

Fonterra's capital structure rests upon the non traditional innovation of its 'Fair Value Share' (FVS) system. It was developed to recognize the underlying value of the member shareholder's investment in the cooperative in line with the cooperative's increasing value added production. Each shareholder is required to hold shares in proportion to the quantity of MS supplied. An independent valuer sets an upper and lower range for the value of the shares, and the Board determines the final value within that range. As shareholders adjust their MS supply, each shareholder purchases or redeems shares at the underlying value of the co-operative established at that time. In this way the existing shareholder receives a payment that reflects the long term value of the investment made during the period of his membership (Bayless, 2003).

Fonterra's FVS structure may have accentuated farmers' medium term capital constraint by creating a barrier to entry, as the rising value of further value adding asset investment is included in the estimation of the share price. This may alter the relative returns from dairy production relative to other agricultural products. This suggests the cooperative may face a lateral portfolio problem, which is the subject of H_5 that "Members altering their on-farm production portfolio, so as to reduce the volume marketed by the cooperative, will prefer not to invest any further capital in the cooperative." The constraint's prevalence is tested by survey.

Announcements by banks (BNZ, 2001) to accept Fonterra shares as collateral, presumably because Fonterra fully redeems members' shares at exit, in cash, capital notes or preference shares, may relieve this constraint as members become increasingly aware

of these facilities. The extent to which collateralization of these shares relieves a perceived production constraint is tested by survey. Fonterra promoted the collateralization of its shares in discussions with the financial community.

From the shareholder's perspective, transferability of shares is not an issue because the co-operative assumes the responsibility of solving a member's problem of extracting his equity upon exit. This means that not only is the capital base of Fonterra *fully allocated* in much in the same way as many US co-operatives as explained in Chapter 2, but that the FVS process also releases an estimation of the *market* value of Fonterra to the exiting member.

This may exacerbate a vertical portfolio problem as the opportunity cost of further investment is increased for larger members with high on-farm returns relative to the cooperative level returns. It may also exacerbate a lateral portfolio problem as it may encourage members to exit the cooperative to diversify on-farm portfolios.

Early in 2004, a small number of farmers exited Fonterra and became members of another regionally based commodity cooperative, citing the reason for their departure as the ability to cash in their Fonterra shares and invest the capital on-farm (Otago Daily Times, 2004). Further, in April 2005, the largest dairy producer announced it would leave Fonterra and use its proceeds from its shares to establish its own processing plant (Bathgate, 2005). A high level of simultaneous exits would place the cooperative's capital structure at risk.

It would appear that serious tension is likely to be prevalent between large and small farmer sub groups because the cooperative's pooling price structure encourages production, while its capital structure serves to dissuade production and may even

encourage exit as its pooled investment strategy may be at odds with the interests of larger producers focused on milk production growth. These producers may prefer high share values if they intend to leave the cooperative.

Case Study 2: Effingham Equity of Illinois, US

Table 4.3: Effingham Equity: Timeline of Some Key Events

Date	Event	
	Firm level	**Industry level**
1919-1949	Incorporated as cooperative with 56 stockholders to collectively bargain for inputs. Entered grain storage and merchandising industry.	Increasing mechanization of agriculture: increasing need for purchased inputs. Rapid expansion of agricultural cooperatives to provide countervailing market power and capture margins via scale economies.
1950-1989	Entered crop protection, fertilizer, petroleum and feed manufacturing businesses. Further expansion through acquisitions of elevators and farm centers.	Ongoing consolidation of farm sector. Livestock production gradually moved away from the Eastern Corn Belt; expanding grain production in these areas. Technology and agricultural subsidies drive farm consolidation. Fertilizer, chemical and feed industries mature implying high competitive pressure and narrower margins.
1990-present	Built 60 car railroad loading grain facility. Expanded agronomy services.	Acceleration of farm consolidation. Ongoing consolidation in farm input sector and in commodity merchandising and handling industries.

Introduction

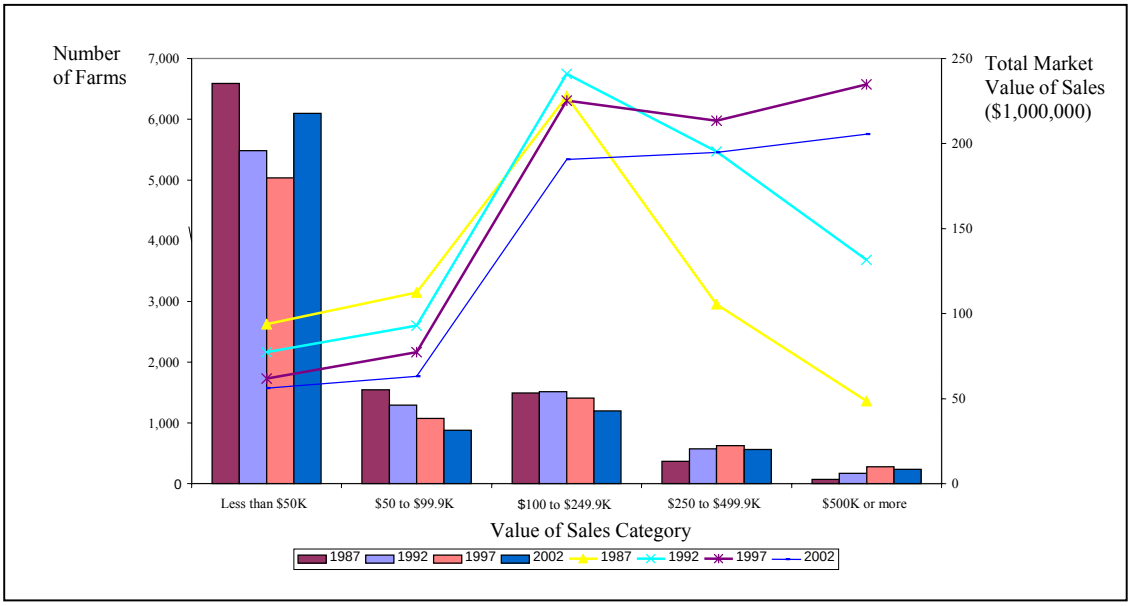
Effingham Equity is a multipurpose farm input supply and marketing cooperative located in southeastern Illinois within the eastern Corn Belt. It was organized in 1919 to collectively bargain for farm inputs such as coal, hay and feed ingredients. Over its 85 year history, Effingham Equity increased its membership to 4,600 stockholders and expanded its range of services and size of operations to become one of the largest local multipurpose cooperatives in Illinois. Its current operations extend to servicing farmers in 11 surrounding counties. In 2003 the bulk of its sales were generated from farm supply products and services (fertilizer, chemicals, petroleum and crop protectants), with most of its remaining sales generated from grain marketing and animal feed (Effingham Equity website). The purpose of this mini case is to contextualize the conditions within which Effingham Equity may be subject to a binding portfolio problem.

A Brief Overview of the Structure of Southeastern Illinois Farming

Figure 4.3 indicates that 22% of the operators in southeastern Illinois produce 83% of the total market value of agricultural products sold on farms with more than $100,000 of agricultural sales per farm[13], which is consistent with the structural change in production agriculture noted in Chapter Two. Figure 4.3 also indicates that the number of small farms in terms of market value of products sold increased, but the value of their sales decreased between 1987 and 2002.

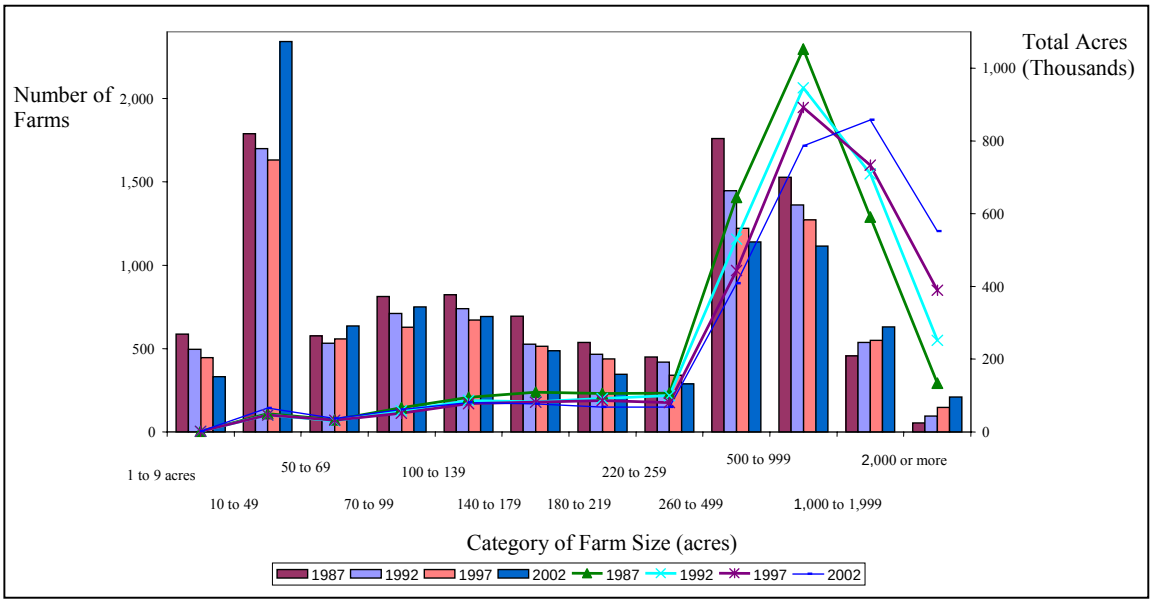
[13] Large family farms are defined as $250,000 to $500,000 sales and high sales small family farms are defined as $100,000 to $250,000 sales.

Figure 4.3: Number of Farms and Total Market Value of Ag Products Sold by Value of Sales in Effingham Equity's Area of Operation



Source: USDA 2002 Census of Agriculture

Figure 4.3: Number of Farms and Total Market Value of Ag Products Sold by Value of Sales in Effingham Equity's Area of Operation



Source: USDA 2002 Census of Agriculture

Figure 4.4 indicates that 85% of southeastern Illinois was farmed by the largest one-third of the farmers by 2002 (USDA 2002 Census of Agriculture). The University of Illinois (2003) indicated that farms with net losses in the area were predominantly small and mid sized farms. Consequently, small farms generate most of their household income from off farm sources. About thirty-nine percent of operators in southeastern Illinois worked full-time (more than 200 days) off farm (USDA, 2002 Census).

In short, these figures indicate an emerging bipolar distribution of members. It also implies that sub groups of members based on farm size differences and time constraints may need different cooperative service mixes.

Very large grain farmers may require timely agronomy service delivery relative to lower price crop inputs to ensure the minimization of production risk associated with increased specialization, and they may be able to afford these services as they have higher on-farm returns. It would appear that the value of their cooperative use (real) option with respect to full agronomy services rises as their on-farm return increases. Their relevant constraint is more likely to be land or time rather than capital. The USDA (2004) reports that Corn Belt cooperatives are leading innovators in developing integrated agronomy packages based on fertilizer application, crop protectants, fuel and monitoring technology such as GPS/GIS technology. Effingham Equity more than doubled its acres of custom crop input application between 1993 and 2003.

Smaller commercial farmers may require lower priced crop inputs because they face a capital constraint to their growth and because they have a more diversified on-farm portfolio, suggesting that the option value of timely agronomy services may not be so critical to the survival of their farming operation. Furthermore, the USDA (2004) reports

that whilst cooperatives have significant market share for crop inputs, the market is rapidly consolidating, and this implies a competitive market structure.

In addition to tending to be specialized, the very smallest members tend to generate higher off-farm returns. This suggests that they may face a time constraint, implying a preference for cooperative services such as custom agronomy application that permits them to earn off-farm income.

So, within grain farmers, a vertical portfolio problem may exist. This is H1 that 'smaller, commercial farmer members, who are more diversified at the farm level, will prefer less investment in cooperative assets that underpin further specialization relative to larger, specialized farmers'. 'Very small, specialized farmers may also prefer investment in services that reduce the opportunity cost in pursuing of-farm returns.' This is tested by survey.

Across all members, a lateral portfolio problem may exist because more specialized farmers are more likely to be to interested in a narrower range of services that reflects their farm portfolio while more diversified farmer are more likely to be interested in a wider range of cooperative services. This is tested by survey.

Effingham Equity might be considered to be a traditional agricultural farm supply cooperative in terms of the property rights structure laid out in Chapter Two. However, Effingham has modified this structure to operate separate patronage pools. This suggests a partial amelioration of the lateral portfolio problem because members have a better idea of the actual returns from each patronage pool. This would presumably send clearer signals to management and members as to the actual demand for investment, and it may

be expected that services would be concentrated in areas of greatest demand relative to cooperatives with common patronage pools.

Case Study 3: Northeast Missouri Grain Processors (NMGP/NEMO)

Table 4.4: NENO: Timeline of Some Key Events

Date	Event	
	Firm level	**Industry level**
1980-1990		Modest growth in ethanol industry.
1990 onwards		Industry growth 'kicked-off' by Amendments to the *Clean Air* Act, growth re-enforced by other regulatory support. Period of rapid growth in the ethanol industry. High rates of return.
1994-2000	LLC (Northeast Missouri Grain – NEMO) formed by equity partners: 310 member North East Missouri Grain Processors Inc. (NMGP), Broin Enterprises and other community investors. Ethanol plant built, operated and managed by Broin Enterprises. Broin also markets output and provides specialized R&D. NEMO plant operational May 2000; 15 mg capacity. Co-product production of DWGS. Increases corn basis in relevant market area.	
2000-2004	Plant expansion increased design capacity to MES of 36 mg; actual production 43 mg, which is Minimum Economic Scale (MES). Corn basis difference increased to 20 cents per bushel.	
2005 - ?	Equity to commercialize Broin's increasingly proprietary R&D?	Opening of nearby ethanol at Laddonia may significantly increase local basis for corn. Some commentators predict over capacity in ethanol in the Midwest and much tighter margins.

NEMO LLC was formed as a partnership between several investors, including NMGP Inc, a New Generation Cooperative which holds 82% of equity in the LLC (NEMO, 2004). A defining feature of an NGC is that patronage and equity provision are tied

through internally tradable and appreciable delivery rights. Participating producers were required to make a minimum investment of $12,500 to purchase the right and obligation to deliver 5000 bushels of corn annually to the cooperative (delivery rights). Thus the NGC's stockholders' equity is tied to the provision of corn to the plant. This implies that the cooperative's capital is permanent, similar to a listed company that trades its shares on a stock exchange. The cooperative has 310 members (NEMO, 2004) and elects the majority of Directors to the NEMO LLC Board.

NEMO's non producer investors are Broin Enterprises, Inc, Scotland, SD; Corn Energy Investors, Sioux Falls, SD; Missouri Corn Merchandising Council; and Ralls County Electric Cooperative. The management is under contract from Broin Enterprises, a specialist group of companies that provides turnkey design, engineering, construction, management and marketing services for its equity partners who are mainly NGCs. Broin also markets the plant's outputs of ethanol and its co-products of CO2 and Dry Distillers Grain with Solubles (DDGS). Broin's small South Dakota plant of 9 million gallons (m/g) is a major R&D hub within the ethanol industry, as well as a testing unit for the company's larger plants (Bryan, 2003). Broin's R&D includes research into new high value co-products such as pharmaceuticals.

Ethanol is a form of distilled alcohol from biomass that is primarily used as a fuel additive. Corn is the main feed stock used in the production of ethanol in the US. The demand for ethanol is highly related to the price of gasoline as ethanol is in some respects a substitute for gasoline. Most of NEMO's ethanol is sold within Missouri (NEMO, 2004). CO2 is sold for use in food products. DDGS is a highly nutritious livestock feed. The price of DDGS has declined since 1989 due to lower soybean meal prices.

The 15 m/g ethanol plant began operation in 2000. The plant was expanded to a designed capacity of 36 m/g by April 2003, and in 2004, the ethanol plant produces 42 m/g of ethanol per year. Whims (2002) reports that in 2002 the return on investment (ROI) for a 15 m/g dry-mill plant was 8.2% and for a 40 m/g plant was 42%. The dry milling process has a minimum economic scale of 40 m/g per year.

Since 1990 US ethanol production has been characterized by strong growth within a very supportive regulatory framework, which includes mandated use and large financial incentives including a reduction in federal excise tax, grants, loans to establish facilities and a 54¢/g tariff. The cost of US production of ethanol is around $1.00/g, compared to around 60¢/g in Brazil. The spread between ethanol and gasoline prices has narrowed slightly since 1989 as strong production growth has closely matched demand increases.

Thompson (2004) credits amendments to the Clean Air Act of 1990 as responsible for 'kickstarting' the ethanol industry. These amendments required gasoline refineries selling into large urban areas to add oxygen (reformulated gasoline) to reduce airborne pollutants. Reformulated gasoline is primarily sold in cities on the east and west coasts of the US. Many other cities are also required to add oxygen to gasoline during winter months to reduce carbon monoxide levels. Methyl tertiary butyl ether (MTBE) and ethanol are the only substitute fuel oxygenators available. MTBE has been prohibited or is in the process of being prohibited in 18 states because of its potential to pollute ground water and release carcinogens when vaporized (Bryan, 2004).

The plant appears to face some competitive threats to its margins. Kapell (2004) forecasts that regardless of regulatory requirements, production surplus to regulatory requirements will occur by 2006. Consequently, he argues that price spreads between

gasoline and ethanol will narrow and stabilize as refiners and blenders increasingly switch their use of ethanol and gasoline based on cost savings rather than regulatory requirements. This has the potential to squeeze producers' margins, limiting the ability for plants to absorb higher corn prices.

Since corn provides 95% of the feedstock for US ethanol production, the industry is largely centered in the midwest Corn Belt and upper prairie states. Corn accounts for up to 70% of an ethanol plant's costs. Ethanol production has lifted the average national basis by 30¢/bushel (RFA, 2004). The highest impact is found in 'upstream' grain markets closer to the plant. McNew and Griffith's (2004) Ethanol Plant Analyzer indicates corn price effects for corn price paid at Macon will increase 12¢/bu as a result of a new plant planned at Laddonia.

Selected Caribbean and Central American countries are able to export without a tariff to a maximum of 7% of the previous year's domestic ethanol production (MacDonald *et al*. 2003). In 2003 around 65 million gallons of ethanol were imported from these countries. Cargill announced that it intends to source Brazilian ethanol to refine into fuel grade in El Salvador, with California as a likely market.

Based on the preceding description, it would appear that the feasible strategy set for the LLC will include a choice: further vertical integration (a similar size, but a more capital intensive plant producing an additional range of high value products) or no further investment given. At issue is whether members with growing production will favor more cooperative vertical integration relative to their opportunity to capture farm level ROI from scale. That is, although the NGC has a mechanism for members to capture the appreciated value of their investment, which would solve for a vertical portfolio problem,

the pooling of this investment implies that returns may be insufficiently unbundled for a divergence of member opinion as to the desirability of further investment. This is H1 and is tested by survey.

6. Survey process, sample size, generic design template with expected results

The development of the generic template was an iterative process spanning a number of months. Following extensive negotiations with cooperative decision makers, a final form of the survey for each business was agreed upon. Each survey is based upon a common template, but adapted for the circumstances of each business in order to increase the likelihood of the surveys' communicability and the member response rate.

Eighteen hundred mail surveys were sent to Effingham Equity members in mid November 2004, enclosed with a return business reply envelope to the University, and members were asked to respond in 10 days. The response rate was 18%. Similarly, 310 surveys were sent to members of NMGP Inc. on December 3 and members were asked to respond within a week. The response rate was 30%. Fonterra members were surveyed via an insertion in the Dairy Exporter magazine, which is an industry trade magazine recently divested by Fonterra. All members receive a copy. Members received the survey on November 26 and were asked to respond to the magazine by December 3. The response rate was 10%.

Each survey is based upon the following template designed to generate information necessary for the production of X and Y variable matrices suitable to test the study's working hypotheses.

The generic dependent (Y) variable survey questions covered the following topics: member choice of preferred vertical investment options (commodity vs. value added, cost

competitive inputs vs. timely agronomy services) and preferred lateral investment options (all service divisions vs. divisions that reflect on the member's specialized on-farm production portfolio and no further investment required). Y variable questions relating member characteristics to horizon investment issues were also included; these permit the researcher to distinguish between those preferring no further investment due to a lateral portfolio preference and a horizon issue.

The key generic independent (X) variable survey questions are those related to size, specialization, degree of income earned off-farm and planned production growth. Additional generic independent variable survey questions were included to inform further theory development and to act as checks to the key X variables. These are: change in volume of major commodities production in the last five years, physical productivity, constraints to on-farm growth over the last five years, projected constraints to on-farm growth over the next five years, the number of years as cooperative member, relative farm and cooperative return (if possible), age, succession planning and geographic location.

Generic template survey design

Table 4.5 presents the generic form of Y variable question to test H_1 that 'within a marketing cooperative smaller members who are relatively more constrained in expanding their farm operation will prefer investment in cooperative investor assets (for offensive purposes) that provide higher cooperative returns relative to larger members who are relatively less constrained from expanding on-farm who will prefer investment into cooperative user assets (for defensive purposes) that provide higher on-farm returns'. Farm size, production growth history and projected growth are the relevant X variables.

The question also tests H_5 that "Members altering their on-farm production portfolio, so as to reduce the volume marketed by the cooperative, will prefer not to invest any further capital in the cooperative."

Table 4.5: Generic Y variable question to test H_1 and H_5, the Vertical and Lateral Portfolio Problems with marketing cooperatives

Of the three following statements which is closest to your point of view? Please circle only one. A. I most prefer the co-operative to invest in the core commodity processor, to absorb expansion in my commodity production. This is likely to result in a lower commodity price. OR B. I most prefer the cooperative to invest in the value added business, to increase the payout on my existing commodity production. This is likely to result in a higher price but is unlikely to absorb very much of my new commodity production. OR C. No further investment is required to support my on-farm strategy. OR D. I really don't know

Preference A is expected to correlate with members with relatively large farm size and high production growth projections in the commodity under examination. They may also have a record of high production growth and fewer or different historical or projected constraints on production growth. (H_1)

Preference B is expected to correlate with members with relatively small farm size and low production growth projections in the commodity under examination. They may also have a record of low production growth and more or different historical or projected constraints on production growth. (H_1)

Preference C is expected to correlate with members that plan to change their on-farm portfolio mix in a way that does not reflect current cooperative commodity coverage provision either because of a higher rate of return available from the production of another commodity or because of investment horizon issues. (H_5)

Preference D is included in the survey to identify and eliminate respondents with uninformed investment preferences.

Table 4.6 presents the generic form of the continuous Y variable check the results for H_1.

Table 4.6: Generic continuous Y variable question to test H_1

I would prefer the cooperative invest in commodity production rather than value added production. **Please circle <u>one</u> only**						
STRONGLY DISAGREE			INDIFFERENT			STRONGLY AGREE
1	**2**	**3**	**4**	**5**	**6**	**7**

Table 4.7 presents the generic form of the continuous Y variable check the results for H_5.

Table 4.7: Generic continuous Y variable question to test H_5

I prefer no further investment in thecooperative. **Please circle <u>one</u> only**						
STRONGLY DISAGREE			INDIFFERENT			STRONGLY AGREE
1	**2**	**3**	**4**	**5**	**6**	**7**

Table 4.8 presents the Y variable question to test H2 and H3 that ‘smaller, diversified, relatively constrained commercial farmer members will prefer less investment in cooperative assets that underpin further specialization relative to larger, specialized,

relatively unconstrained farmers.' 'Very small, specialized farmers may also prefer investment in services that reduce the opportunity cost in pursuing off-farm returns.'

Table 4.8: Y question to test H_2 and H_3: The Vertical Portfolio Problem in Input Supply Cooperatives

Which would you most prefer the cooperative provide? Please circle only <u>one</u>. A. I most prefer the cooperative provide a full range of timely delivered crop input services. <u>OR</u> B. I most prefer the cooperative provide crop input products that are competitively priced. <u>OR</u> C. I really don't know

Preference A is expected to correlate with grain producing members who are relatively specialized. These are expected to be very large grain producers and very small grain producers with significant off-farm income.

Preference B is expected to correlate with grain producing members who are relatively diversified. These are expected to be medium sized producers.

Preference C is included in the survey to identify and eliminate respondents with uninformed investment preferences.

Table 4.9 presents the continuous Y variable question to check for the results for H_2 and H_3, the vertical portfolio problem in multipurpose cooperatives.

Table 4.9: Y variable question to test H_2 and H_3

I prefer the cooperative provide a full range of crop input services rather than competitively priced crop input products. **Please circle <u>one</u> only**						
STRONGLY DISAGREE			INDIFFERENT			STRONGLY AGREE
1	**2**	**3**	**4**	**5**	**6**	**7**

Table 4.10 presents the Y variable question to test H_4 that 'less diversified members will prefer cooperative investment into assets that reflect their specialization, whilst more diversified members will prefer a wider range of cooperative investment that reflects their diversification.'

Table 4.10: Generic Y variable question to test H_4: The Lateral Portfolio Problem in Input Supply (Nourse 1) Cooperatives

Of the three following statements, which is closest to your point of view?

Please circle only one.

A. I most prefer the cooperative invest in all service categories.

OR

B. I most prefer the cooperative to invest only in those services that I can use on my farm. Please circle which services:

Service A Service B

Service C Service D

OR

C. No further investment is required to support my on-farm strategy.

OR

D. I really don't know

Preference A is expected to correlate with members who are relatively diversified.

Preference B is expected to correlate with members who are relatively specialized.

Preference C is expected to correlate with members who plan to change their on-farm portfolio mix in a way that does not reflect current cooperative service provision either because of a higher rate of return available from the production of another commodity or because of investment horizon issues.

Preference D is included in the survey to identify and eliminate respondents with uninformed investment preferences.

Table 4.11 presents the continuous Y variable question to check for the results for H_4, the lateral portfolio problem in Nourse cooperatives.

Table 4.11: Y variable question to test H_4

I prefer the cooperative invest only in the service categories which reflect my on-farm production rather than all service categories. **Please circle <u>one</u> only**						
STRONGLY DISAGREE			INDIFFERENT			STRONGLY AGREE
1	**2**	**3**	**4**	**5**	**6**	**7**

7. Summary

Table 4.12 summarizes the methods for generating data used in testing hypotheses.

Table 4.12: A summary of Hypotheses Related to the Portfolio Investment Constraint and Methods to Vertify Hypotheses

Hypothesis	Description	Method of verification
General hypothesis	Pooling of cooperative returns across market segments creates an incentive for members to over produce in an open cooperative as the average value of returns exceeds the marginal value from the least returning market.	Case study
Operational Hypothesis 1 (H_1): The vertical portfolio problem in marketing cooperatives	Smaller members who are relatively more constrained in expanding their farm operation will prefer investment in cooperative investor assets (for offensive purposes) that provide higher cooperative returns relative to larger members who are relatively less constrained from expanding on-farm who will prefer investment into cooperative user assets (for defensive purposes) that provide higher on-farm returns.	Survey
Operational Hypothesis 2 (H_2): The vertical portfolio problem in input supply cooperatives	Smaller, diversified, relatively constrained commercial farmer members will prefer less investment in cooperative assets that underpin further specialization relative to larger, specialized, unconstrained farmers.	Survey
Operational Hypothesis 3 (H_3): The vertical portfolio problem in input supply cooperatives	Very small, specialized farmers prefer investment in services that reduce the opportunity cost in pursuing off-farm returns.	Survey
Operational Hypothesis 4 (H_4): The lateral portfolio problem in multi-purpose cooperatives	Less diversified members will prefer cooperative investment into assets that reflect their specialization, whilst more diversified members will prefer a wider range of cooperative investment that reflects their enterprise diversification.	Survey
Operational Hypothesis 5 (H_5): The lateral portfolio problem in marketing cooperatives	Members altering their on-farm production portfolio, so as to reduce the volume marketed by the cooperative, will prefer not to invest any further capital in the cooperative.	Survey

CHAPTER FIVE

EMPIRICAL METHODOLOGY II: STATISTICAL METHODOLOGY

1. Descriptive and Inferential Statistics: Their Use in this Study

The mean, mode, median range and percentiles are used to describe the data gathered by survey. Qualitative data are also summarized in frequency tables for measured variables. Contingency and cross tabulation tables are used when two or more variables are involved.

Inferential statistical techniques are used as these provide insights into possible associations and relationships between variables. Key response (Y) variables in these surveys are qualitative variables as are some important design (X) variables. Some are measured on nominal scales and some on ordinal scales. Chi-square (χ^2) tests and correlation analysis are used to assess the relationships between the variables under study. Where these relationships are found to be statistically significant the ordinal probabilistic measure of Kendall's Tau is used to measure the strength of the association between variables. The response variables are also asked in a more truncated, continuous version and the relationships between the continuous Y variable and the continuous X variables are examined using linear regression and binomial regression. These themes are fully expanded upon in section 2.

2. *Testing the Statistical Significance of the Survey Data: the Chi Squared χ^2 test of Significance*

The chi-squared χ^2 test of statistical significance is the most frequently used test in survey research because most of it consists of qualitative data that lends itself to bivariate tabulation. It is a non-parametric test and therefore is a rough estimate of confidence in that it accepts weaker, less accurate data as input than parametric tests (like t-tests and analysis of variance, for example) and therefore has less status in the pantheon of statistical tests. Nonetheless, according to Connor-Linton (2004), 'its limitations are also its strengths; because chi square is more 'forgiving' in the data it will accept, it can be used in a wide variety of research contexts.'

It is also the only test of statistical significance available for data with both variables measured on the nominal scale. It can also be used with data measured on either nominal or ordinal scales.

The chi squared test is essentially a test of the differences observed between the frequencies that are obtained from the sample survey and the frequencies that are expected to be obtained if there are no differences between the categories of variables. The null hypothesis is the assumption that no difference exists among the categories of variables and the purpose of the chi squared test is to ascertain whether the perceived differences are genuine or a result of sampling error.

The chi-squared statistic χ^2 is calculated by measuring the difference between the expected frequencies and actual frequencies obtained from the surveys. The following calculation is used:

$$\chi^2 = \Sigma \frac{(f_0 - f_e)}{f_e} \qquad (5.1)$$

where f_0 is the frequency observed in each cell and f_e is the frequency expected in each cell under the assumption of no difference.

The first step in calculating the chi-squared χ^2 is the construction of a chi-squared matrix table with obtained and expected frequencies as follows:

Table 5.1: Sample Contingency Table

	Columns				**Row totals**
Rows	a	(Ea)	b	(Eb)	a + b
	c	(Ec)	d	(Ed)	c + d
Column totals	a + c		b + d		N

Ea, Eb, Ec, and Ed denote the expected frequencies, whilst a, b, c and d denote the observed frequencies for each of the four categories. The expected frequencies are calculated via the equation:

(E) = (Row Total) (Column Total) / (Total Sample Size) (5.2)

For example, the expected frequency of a is:

(Ea) = (a + b) (a + c) / N (5.3)

Interpretation of the calculated chi-squared statistic rests upon comparison of a table of critical chi-squared values. If the calculated chi-squared statistic (χ^2) is equal to or greater than the table chi-squared (χ^2) value, then the differences between the obtained and the expected frequencies within the cells are considered to be a reflection of genuine difference between the categories of the variable. This difference indicates that a statistically significant relationship exits between the variables. If the calculated chi-square (χ^2) statistic is less than the critical chi-square (χ^2), then no relationship between the variables has been identified, leading to the conclusion that no genuine relationship exists between the variables under consideration.

The discussion implies the selection of an appropriate level of confidence (usually 95%) and assumptions of independence between the variables (i.e. the choice made by the respondent is exclusive of another possible choice so that each choice can only be assigned to one cell) and that the observations are randomly drawn. Further, the degrees of freedom must be determined. Unlike a *t* distribution, the degrees of freedom do not depend upon the number of observations in the sample, but on the number of rows and columns in the cross-tabulation. That is, the degrees of freedom for the chi-square (χ^2) statistic are:

$$df = (r - 1)\,(c - 1) \tag{5.4}$$

where df = degrees of freedom

r = number of categories of the dependent (row) variable

c = number of categories of the independent (column) variable

Therefore, the degrees of freedom for the sample contingency table (4.1) are:

$$df = (2 - 1)\,(2 - 1) \tag{5.5}$$

The value of the chi-squared statistic depends upon the number of observations in the sample, implying that small sample sizes may result in a small calculated value and an inability to reject the null hypothesis even when its false. Similarly, overly large samples may result in rejection of the null hypothesis even when it is likely to be not false. This is one reason why dependent variable checks are constructed as continuous variables to permit the use of regression.

Norusis (1998) argues that as a general rule, the chi-square test should not be used if more than 20% of the cells have expected values of less than 5, or if the expected frequency is less than 1. If the table in question has more than two rows and two columns and the expected frequency is less than 5, then rows and columns can be combined to increase the expected frequency.

If a 2 x 2 table contains cells with expected frequencies of less than 5, then the rows and columns cannot be collapsed. In this case, the **conservative** *Fisher's Exact Test* may be used (Norusis, 1998). SPSS automatically employs a Yates correction if any one cell contains an expected frequency of less than 10. The Yates correction reduces the magnitude between the observed and expected frequencies in each of the cells by 0.5.

When interval variables are under examination, the Pearson's *r* statistic will be the presented. This is calculated as:

$$\text{cov}(x,y) = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{N - 1} \tag{5.6}$$

That is, Pearson's *r* is a test of the strength of the linear relationship between two variables.

3. Multiple Linear Regression Analysis

Multiple Linear Regression (MLR) Analysis is a method of analyzing the relationship between a set of independent variables and a single dependent variable. That is:

$$Y = B_0 + B_1X_1 + B_2X_2 + ... + B_nX_n + \varepsilon_i \quad (5.7)$$

where, Y is the outcome variable; B_1 is the coefficient of the first predictor variable (X_1), B_2 is the coefficient of the second predictor variable (X_2); B_n is the coefficient of the *n*th predictor variable (X_n); and is the difference between the predicted and the observed value of Y for the *i*th case.

The seven main assumptions of MLR are (de Vaus, 2002):

1. The *Y* variable is measured at the interval level.
2. The *X* variables are measured at the interval level. If the *X* variable is not an interval variable it must be dichotomous (dummy variable).
3. The *X* variables should not be highly intercorrelated, as significant multi-collinearity leads to an unstable correlation matrix, which in turn can lead to unreliable regression co-efficients, significance levels and confidence levels. According to Field (2004), *the main problem with multi-collinearity is that 'high levels of collinearity increase the probability that a good predictor of the outcome will be found non-significant and rejected from the model (Type II error)'.* This will be returned to in the discussion

of Projected to Latent Structure (PLS) linear regression later in this chapter. In SPSS, collinearity measures are available to assess the extent of multi-collinearity. The Variance Inflation Factor (VIF) indicates whether a predictor has a linear relationship with other predictor(s); Myer (in Field, 2004) suggests that a value of 10 is the score at which collinearity becomes a serious problem. Others suggest (in Field, 2004) that if the average VOF is greater than 1, the multi-collinearity may be biasing the results. A tolerance level (1/VIF) of below 0.1 similarly may indicate a serious problem with multi-collinearity.

4. The absence of outliers, as these can inflate or deflate estimates. In SPSS, these are tested for by examining case summary variables and residuals such as Cook's distance and Mahalanobis distance. Samples with a Cook's distance of greater that 1 would indicate an undue influence on the model (Field, 2004) and Mahalanobis distance values greater than 15 may also indicate a sample with undue leverage upon the model.
5. A linear relationship between variables, as a multiple regression model is based on Pearson's *r*. Scatter plots of residuals will be used to check this assumption.
6. Normally distributed variables. Histograms will be used to check this assumption.
7. Homoscedastic relationships between variables. That is the variance on one variable will be consistent across all values of the other variable. A hetroscedastic relationship underestimates the extent of the correlation

between variables. Scatter plots of residuals will be used to check this assumption.

In addition, Field (2004) also cites the use of the Durbin Watson statistic to check if variables are independent (i.e. not auto correlated).

Assessing the overall accuracy of the model requires its cross validation. The most common method is the use of the adjusted r square measure. Whereas the r square informs as to how much of the variance in assessing the overall accuracy of the model requires cross validation of it. The most common method is the use of the adjusted r square measure. Whereas the r square (SS_M / SS_T) , where SS_M is the model Sum of Squares and SS_T is the total Sum of Squares) informs as to how much of the variance in Y is accounted for by the regression model from the sample, the adjusted value tells us how much variance in Y would be accounted for if the model had been derived from the population from which the sample was taken (Field, 2004). The closer the adjusted value is to 1, the greater the model's explanatory power.

Individual predictor variables are tested using *t* statistic tests of the null hypothesis that the value of *B* is zero. That is:

$$t = \frac{B_{ob} - B_{ex}}{\mathrm{SE}_B} \tag{5.8}$$

Where, B_{ob} is the observed value of *B*; B_{ex} is the expected value of *B* and SE_B is the standard error of *B*. As a rule of thumb, an observed significance of less than 0.05 ($p < 0.05$) results in a t score of 2 or greater.

4. Binomial Logistic Regression Analysis

Binomial logistic regression is a form of regression which is used when the dependent variable is a dichotomy and the independents are of any type.

The assumptions that are common to OLS and logistic regression are that: the independent variables are interval, ratio or dichotomous; all relevant predictors are included; expected value of the error is zero; no autocorrelation, no correlation between the error and the independent variables and the absence of perfect multi-collinearity between the independent variables (Field, 2004).

Logistic regression applies maximum likelihood estimation after transforming the dependent variable into a logit variable, which is the natural log of the odds of the dependent variable occurring or not. That is:

$$\ln (Odds) = \alpha + B_1X_1 + B_2X_2 + \dots B_kX_k, \quad (5.9)$$

where, the odds are related to the probability by:

$$Odds = \Pr(category) / 1 - \Pr(category) \quad (5.10)$$

That is, logistic regression estimates the *probability* of a certain event occurring. Logistic regression calculates changes in the log odds of the dependent variable, not changes in the dependent variable itself as Ordinary Least Squares (OLS) regression does. When the dependent variable has only two values, there is only one non-redundant logit that can be formed; the redundant logit is the *baseline category logit* against which a comparison is made. Modeling either logit [ln (Pr (*category)* / 1 – Pr*(category))*] would

result in the same logistic regression functions for the independent variables, but the signs would be reversed.

The first coefficient identifies the logit and the second identifies the variable. For the baseline category, the coefficients are all zero.

Logistic regression is similar to OLS regression in that: logit coefficients correspond to b coefficients in the logistic regression equation; the standardized logit coefficients correspond to beta weights and a Wald statistic is available to test the significance of the independent variables. These statistics, along with the change in - 2 Log Likelihood statistic, are summarized in Table 5.2 for the dichotomous Y variable, the categorical Investment Option "Ingredients" from Question 4 of the Fonterra survey.

Table 5.2: Sample Parameter Estimates Table
Binomial Regression: Standardized Variables

	B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**Change in -2 log likelihood**
Predictor 1				1			
Predictor 2				1			
Constant				1			

The Exp (B) column indicates how much more likely it is that a large size producer will select B relative to other investment choices. A significance score of under 0.05 indicates a significant variable within a 95% confidence interval. A change in the -2 log likelihood ratio of above 4 indicates a significance of greater than .05; in this respect it may be thought of as analogous to a 't' statistic.

In SPSS, the log likelihood statistic is not reported; the value is multiplied by -2 (-2LL), as it has an approximate chi-square distribution (Field, 2004). It is the basis of the *pseudo* r square measure (the Nagelkerke), which may be interpreted as a comparable

to the r square in multiple regression. It is also the basis of the Hosmer and Lemeshow goodness of fit test, which is calculated by dividing the model chi-square by the original -2LL. Thus this test measures the correspondence of actual and predicted values of the dependent variable; a good overall model fit is indicated by a non-significant chi-square value.

The Hosmer and Lemeshow test and the Nagelkerke r square will be reported with each binomial model.

Unlike OLS regression, logistic regression does not assume: linearity of relationship between the independent variables and the dependent variables, normally distributed variables, and homoscedasticity. Estimates of the number of sample sizes required for correct inference range between 20 and 50 (see Field, 2004; de Vaus, 2002; and Hair *et al*. 1998).

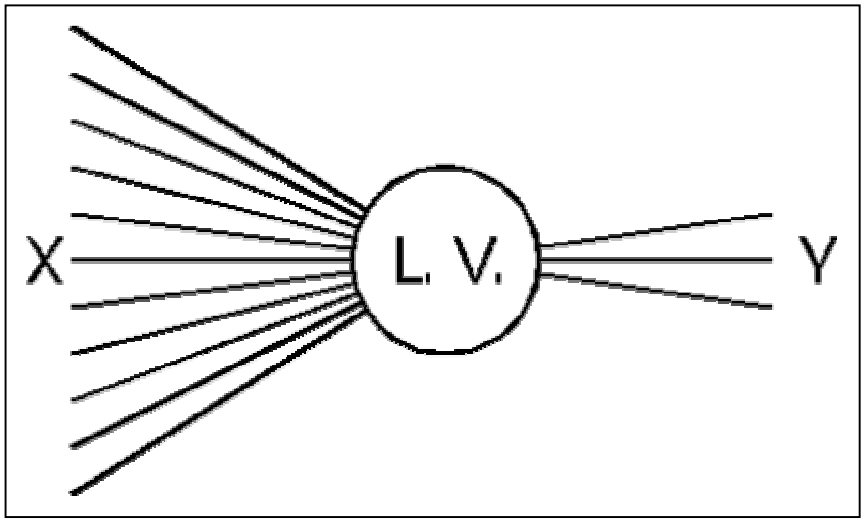
5. Partial Least Squares Regression or Projected to Latent Structure Regression (PLS)

Ideally, the modeler has a strong knowledge of the processes underlying the situation he or she is observing. This implies a robust theory and a complete and tractable data set with which to test that theory. However, a complete theory of the firm, and its interaction with other firms, is a work in progress that this study aims to inform. Dropping explanatory variables as a means of correcting for multi collinearity may not be desirable as unexplained relationships between the postulated X and Y variables may exist. The emphasis of PLS modeling is to avoid a Type II error, that is to avoid omitting something of importance. For this reason PLS focuses on the signal within the data rather than the noise contained within the error term. For practical purposes, cooperative decision

makers may be very interested in additional collinear attributes of their sub groups of members.

PLS is a form of regression that is less restrictive than MLR in that smaller data sets can used, samples with missing data are not dropped from the regression (they are averaged) and the resultant model is more stable as multi-collinearity increases. This is because multi-collinearity is the basis by which principal components (or latent variables) are constructed in this form of structural equation modeling. It is a bi-linear method is which the original X data is projected onto a small number of latent variables termed PLS components which are defined by Esbensen *et al*. (2002) as 'linear functions of the original variables and the observations.' It is for this reason the technique is also called bi-linear modeling. This can be illustrated as:

Figure 5.1: Construction of Latent Variables



Therefore, in one respect, PLS is an extension of OLS in that the results given by the two methods are identical if multi-collinearity does not exist between the X variables.

These principal components are orthogonal to each other and they are constructed with reference to the Y variable(s). That is, Principal Components (PCs) are composite variables, i.e. linear functions of the original variables, estimated to contain, in decreasing order, the main structured information in the data. A PC is the same as a score vector and is also called a latent variable.

Unlike other forms of structural equation modeling that constructs latent variables, PLS modeling does not require imposition of any structure on the data such as specifying start values as required in AMOS or LISREAL.

The algorithm examines 'both X and Y data and extracts components which are directly relevant to both sets of variables … in decreasing order of relevance'; that is, it is an iterative estimation procedure (Martens and Martens 2002). Martens and Martens (2002) highlight that 'only relevant covariance eigenvalues are extracted … and that … only large eigenvalues with predictive power are used in the final models, which are validated by graphical interpretation and cross-validation/jack knifing.' Collinearity in this modeling procedure is an advantage in that it 'stabilizes the modeling and facilitates subsequent graphical model inspection.' (IBID)

Cross validation establishes the number of PCs that the PLS procedure must extract from the X space in order that the full PLS model is to sufficiently model the Y variable. Cross validation is the process of checking the model's predictive ability and parameter stability. It is necessary because without it, the PLS procedure is likely to lead to model overfit. The procedure operates by 'taking out different subsets of calibration samples from the model estimation, and instead using them as temporary, local sets of secret test samples. If the model parameter estimates are stable against these repeated perturbations,

this indicates that the model is reliable. If the secret test samples are well predicted from the other samples, this indicates that the model will have good predictive ability for new samples of the same general kind' (Martens and Martens, 2002, p.180)

- Martens and Martens (2002, p.187) list the primary purposes of cross validation as:
  - Determining the optimal number of PCs to be used in the final model.
  - Estimating the predictive ability of the final model.
  - Estimating the reliability of estimated model parameters.
  - Detection of the abnormal outliers in the present data set and/or in future data set, i.e. determine what is to be considered normal.

Therefore, whilst the PLS procedure may be conducive to small sample sizes, it is important that samples cover the entire sample space and that sufficient numbers of samples exist.

6. Statistical Power and Sample Size

As indicated immediately above, PLS is designed to accommodate small data sets, but it is important that the entire sample space is covered. Two of the three cooperatives' memberships sampled covered the entire population; the third covered representative quota samples of the entire population (see Chapter 4). For the purposes of binomial regression, a minimum of 20 samples are required for each parameter used in estimation

and this goal was achieved. The remaining issue was to ensure that the sample size was large enough to conduct an MLR.

The power of a statistical test is defined as $1 - \beta$. That is, the odds of failing to reject the null hypothesis (Ho) when it is false, a Type II error. Cohen and Cohen list three factors that determine the power of a test. These are:

1) The α (or probability of Type I error) chosen and whether it is a one tail or two tail test. As α increases, power increases. Power ranges from α to 1; it cannot be less than α.
2) The sample size *n*. As *n* increases, power increases.
3) The magnitude of the parameter (the effect size). If the population parameter is large, then the test will have more power. For instance, if the magnitude of effect is large (say growth over 10 years), then a smaller sample size is required vs. a small magnitude of effect (say growth over one month) then a large sample size is required.

These factors of the power of a test, the region of rejection (α and whether it is a one or two tail test), the sample size and the magnitude of the effect in the population 'are so related that when any of the three of them are fixed, the fourth is completely determined' (Cohen and Cohen, 1983). Therefore, when an α and sample size are chosen, power is determined, if the magnitude of the effect size (ES) in the population is known. There are three strategies for determining the size of the population effect that a researcher is trying to detect. These are

1) The extent to which similar studies indicate an expected ES. Therefore, if a similar group of studies indicate r[14]s ranging from .35 to .45, the population ES in the current study can be expected to be in this range.
2) Theory may indicate an appropriate r value.
3) The ES value may be chosen by using the conventional small, medium and large effects. For instance, the 'conventional medium effect is a population *r* of .30' (Cohen and Cohen, 1983). This study adopts the conventional ES value of .3.

Convention pertaining to choice of power (1 - β) is that it should equate to 0.80.

For this purposes of this study, the α chosen is 0.05 and a two tailed test.

Lastly, Cohen and Cohen's (1983) discussion indicates that power should be set for the level required for statistical significance of the expected unique contribution of the least powerful explanatory variable - *sr* - to the overall R^2. Judging by the work presented by Richards (1996) in an OLS regression of a survey of cooperative members' satisfaction in California, in which he reported R^2 for his explanatory variables of between .036 and .094 for most variables. A conservative estimate would be to set the least powerful explanatory variable's unique contribution to the overall R^2 at 0.04. For instance, in the Fonterra case this variable would most likely be explanatory variable of age, as the co-operative's structure would appear to have corrected for horizon problems.

Accordingly, population ES is defined as *f2*, where:

1) $f2 = sr / (1 - R^2)$, (5.11)

[14] Pearson's product moment correlation coefficient.

where *sr* is the contribution of the least powerful explanatory variable, and the formula for sample size, n^*, is given by:

2) $n^* = L / (f2) + k + 1$ (5.12)

where, L is a function of specified α, specified power for a given number of k.

This implies that 6 independent variables are present in this model. To recap:

2) $n^* = L / (f2) + k + 1$ (5.13)

From 1) and 2) above:

3) $n^* = (p = .8, \alpha = .05$ and $k_B = 1) / ((0.04) / (1 - 0.3)) + 6 + 1$

$n^* = (7.85 / 0.0571) + 6 + 1$

$n^* = 138 + 6 + 1$

$n^* = 145.$

This subsection has been reviewed by the Statistics Department at the University of Missouri.

CHAPTER SIX

EMPIRICAL RESULTS

1. Introduction: Overall Data Description using Projected Growth Models

An underlying assumption of this study is that size is a reasonable proxy for growth, which is supported by empirical evidence presented in chapter two. However, the assumption is necessarily backward looking. Size may also be thought of as a manifestation of growth. High levels of production growth infer a relatively high return to on-farm investment and vice versa. The factors underpinning growth may be more multidimensional than size alone as other variables may interact with it to influence return on capital from growth. These will consist of general factors and factors particular to subsets of farmers. It will also consist of the macro-environment of each industry as this is likely to act as a shift factor on confidence and thus respondent's growth plans.

The three surveys asked respondents to indicate their actual growth over the past five years and their projected growth over the next five years. Growth and size will be the central theme of data description and changes in rates of growth will be the beginning basis of sample segmentation in this chapter.

The purposes of this chapter are: a) to seek confirmatory evidence regarding the hypotheses listed in chapter three; b) to explore the three data sets to draw inferences that can be used to build on the framework presented so far; c) to develop an organizing framework to describe the data sets from which to achieve the first two purposes and d) identify measurement issues that imply a need for survey design improvements.

Sections two to four contain the analysis of each data sample. Each analysis is based on the following template:

- In the first subsection a description is made of a data set's growth variables such as actual and projected growth. Variables that may manifest themselves as a consequence of growth include size and, in Fonterra's case, changes in farm revenue. Variables that may influence growth include age, off-farm income as a proportion of income and the 16 constraints listed in Q20. Growth and its manifestations, particularly size, are the variables against which other variables are compared. In Effingham Equity's case, the emphasis will be on turnover with the cooperative and between members, as the lateral and vertical portfolio problems manifest themselves differently in the multi-purpose cooperative relative to the marketing cooperatives under study.
- In the second subsection models of growth are constructed for the sample to draw inferences as to the possible results from hypothesis testing and survey design. The process of constructing a model in the Fonterra data set provides a template for a common model building process for the rest of the chapter. This process is laid out in detail in the Fonterra subsection, so that only results are subsequently reported in later subsections and sections. This is to streamline the reporting process. The final stage of the process is hypothesis testing.

i) Data Set Descriptions Based on Some Likely Growth Related Variables

Four key factors stand out from the Fonterra survey. Firstly it consists of a total of 1001 responses. This represents around 10% of Fonterra's membership of approximately 11,000. Eighty-eight percent of all respondents were from the North Island.

Secondly, Table 6.1a indicates the average size of respondents' farms, measured in Ms/Kg and number of cows. It is larger than the industry average (see Table 6.1a). Note, Table 6.1b indicates that this sample appears to be somewhat bipolar in its distribution, which also reflects the population distribution presented in the case study. Separate analyses will be carried out on subsections of the size variable.

Table 6.1a: Selected Fonterra Sample and New Zealand Dairy Industry *Averages*

Sample size (MS/Kg)	Industry average size (MS/Kg: 2002)	Sample size (# of cows)	Industry average size (# of cows)
144,000	98,000[a]	415	344[b]

a and b: Complied from NZMAF (2003)

Table 6.1b: Frequency table: Fonterra Size Distribtion (kg/ms '000)

Band and size range	Frequency	Percent	Valid percent	Cumulative percent
1.00: < 55	173	17.3	17.6	17.6
2.00: 56-85	227	22.7	23.1	40.7
3.00: 86-115	195	19.5	19.8	60.5
4.00: 116-145	87	8.7	8.8	69.3
5.00: 146-175	76	7.6	7.7	77.0
6.00: 176-205	56	5.6	5.7	82.7
7.00: > 206	170	17.0	17.3	100.0
Total	**984**	**98.3**	**100.0**	
Missing system	17	1.7		
Total	**1001**	**100.0**		

N: 1001

Thirdly, the rate of growth in milk production is declining. The industry grew around 40% between 1998/99 and 2003/04 (LIC, 2004). The average sample case estimated production growth until 2009 was 1-10%.

The extent of the projected slowdown is illustrated in Table 6.1c. Only 105 (11% - **bold underline**) of respondents indicated that their estimated rate of growth over the next five years would increase relative to their actual growth over the past five years; 598 (56% - ***bold italic***) of respondents indicated a slower rate of growth. This is consistent with the case study discussion on recent falls in milk payouts due to adverse commodity price and exchange rate movements and rising costs, particularly strongly rising land prices.

Table 6.1c: Cross tabulation: Fonterra
Estimated dairy production 2004-09 x Dairy production 1999-04

		Q17 dairy production last 5 years							Total
		Decrease	Stay same	Increase 1-10%	Increase 11-20%	Increase 21-30%	Increase 31-40%	Increase 40%	
Estimated dairy production 2004-09	Decrease	14	*20*	*16*	*21*	*6*	*7*	*9*	93
	Stay same	8	56	*78*	*37*	*25*	*8*	*17*	229
	Increase 1-10%	**9**	**30**	106	*92*	*55*	*21*	*46*	359
	Increase 11-20%	**4**	**8**	**24**	33	*41*	*13*	*52*	175
	Increase 21-30%	**3**	**1**	**3**	**9**	11	*9*	*15*	51
	Increase 31-40%	**1**	**1**	**0**	**1**	**0**	0	*8*	11
	Increase 40%	**1**	**1**	**4**	**3**	2	**1**	17	29
Total		**40**	**117**	**231**	**196**	**140**	**59**	**164**	**947**

N: 1001

This suggests that if the industry's macro conditions are constraining large producers' growth they will be more likely to favor value added investment over ingredients investment. Table 6.1d suggests that while many larger growers are apparently constrained in their growth, a bivariate correlation indicates that size and growth are positively correlated.

Table 6.1d: Cross tabulation: Fonterra
Estimated dairy production 2004-09 x Size (kg/ms: '000)

		Size ('000 kg/ms)							Total
		< 55	55-85	86-115	116-145	146-175	176-205	> 206	
Estimated dairy production 2004-09	**Decrease**	40	24	9	8	2	2	10	95
	Stay same	47	62	40	13	21	14	24	221
	Increase 1-10%	48	86	94	33	23	15	65	364
	Increase 11-20%	14	32	37	17	22	15	45	182
	Increase 21-30%	9	11	6	9	3	4	11	53
	Increase 31-40%	2	1	2	0	1	1	6	13
	Increase 40%	4	3	1	5	3	5	9	30
Total		**164**	**219**	**189**	**75**	**56**	**170**	**958**	

R = 205, p < .001
N: 1001

Fourthly, a large subsection of respondents plan to reduce their percentage of farm revenue from milk, even though they forecast increasing milk production (Table 6.1e). This may be an indication of an emerging lateral portfolio problem; it could indicate farmers' perceptions of relative returns from alternative land uses, such as urban encroachment; or it could indicate farmers' perceptions of relative movements in commodity prices without any plans to change physical production. ***This suggests the need for an additional survey question asking respondents if they intend to change the production mix of their farm as well as the existing question of their sources of farm***

revenue. It may also suggest that gauging the relative effects of alternative commodity returns and alternative land uses will require more exact measurements of constraints upon production than is currently conveyed by the categorical indicators. Lastly, it indicates the need for a survey question to rank respondents' perceptions of the relative attractiveness of alternative commodity production.

Table 6.1e: Cross tabulation: Fonterra
Estimated dairy production 2004-09 x Change in Farm Revenue

		Change in farm revenue %							Total
		-100 to -67	**-66 to -34**	**-33 to -01**	**0**	**01 to 33**	**34 to 66**	**67 to 100**	
Q18 dairy production next 5 years	**Decrease**	47	12	17	12	6	0	0	94
	Stay same	***16***	***3***	***40***	144	17	1	0	221
	Increase 1-10%	***23***	***1***	***62***	222	53	0	2	363
	Increase 11-20%	***6***	***2***	***45***	102	27	0	0	182
	Increase 21-30%	***2***	***0***	***8***	30	13	0	0	53
	Increase 31-40%	0	0	***1***	8	3	0	1	13
	Increase 40%	0	***1***	***7***	16	6	0	0	30
Total		**94**	**19**	**180**	**534**	**125**	**1**	**3**	**956**

N: 1001

Bivariate correlations of standardized age and size (transformed by taking its log, as the raw data is non normally distributed, $r = -.104$, $p < 001$) and standardized age and estimated growth ($r = -.166$, $p < .001$) are negatively correlated, suggesting that horizon dimensions will be considered in hypotheses testing. This is further supported by positive correlations between the number of years until retirement and estimated growth ($r = .222$, $p > .001$) and the number of years until retirement and size ($r = .081$, $p < .05$).

Table 6.1f indicates the production growth constraints that respondents most often identified. 502 identified land costs, 332 identified falling payouts. More than 200 respondents identified the rising price of Fonterra shares, rising input costs, environmental concerns / regulation and the capacity to service more debt.

Table 6.1f: Fonterra
Percentage of Respondents Identification of Severe Constraint on Growth

	Past five years (% of 2307)		Next five years (% of 2700)	
1. Lack of suitable off-farm employment opportunities	3	(< 1%)	7	(< 1%)
2. Cost of supporting family	42	(2%)	36	(1%)
3. Capacity to service more debt	248	(11%)	230	(9%)
4. Management capacity	106	(5%)	82	(3%)
Falling payouts	268	(12%)	332	(12%)
The complexity of fonterra investments	65	(3%)	77	(3%)
Rising fonterra share prices	273	(12%)	287	(11%)
Better rate of return from producing an alternative commodity	61	(3%)	105	(4%)
Environmental concerns/regulation	146	(6%)	244	(9%)
Urban encroachment/subdivision pressures	71	(3%)	88	(3%)
Rising input costs	255	(11%)	269	(10%)
Land cost or availability	502	(22%)	502	(19%)
Herd costs	52	(2%)	46	(2%)
Water costs or availability	50	(2%)	50	(2%)
Labor costs or availability	165	(7%)	181	(7%)
Impending retirement	-	-	164	(6%)
	2307		2700	

N: 1001

Bivariate correlations of the standardized variables of size and land cost ($r = 065$, $p < .05$), and estimated growth and land cost indicate significant positive correlations ($r = 103$, $p < .001$). Bivariate correlations of size and falling payouts and estimated growth, and falling payouts and estimated growth are *not* significant.

ii) Models of Changing Rates of Growth and Hypothesis Testing

The purpose of this subsection is to:

- ascertain how well the survey data accounts for growth within the sample set;
- outline a common analytical process to identify statistically significant and economically relevant growth variables;
- construct *overall* OLS and PLS linear regression models of growth, with attention paid to any interaction effects between variables;
- identify relevant subsections of the sample population using a combination of the inference drawn from the previous section and the economic logic developed by this study's framework to identify variables for subsequent modeling; and
- construct OLS and PLS models of *member segments* with differing rates of projected growth, with particular attention directed towards any interaction effects between variables; and
- draw inferences as to the likely outcomes of hypothesis testing and identify improvements in survey design.

Linear Models of Growth

The following variables were regressed in a linear OLS model on the variable for projected growth over the next five years:

1. Existing size (Q15) for reasons outlined in earlier chapters.

2. Age (Q7) as this may be related to lifecycle factors, such as an ability to manage increasing complexity or generational differences in calculating an acceptable on-farm ROI.
3. Succession planning as those planning to pass the farm to family may have differing growth plans than those who plan to completely exit the industry.
4. Years to relinquishing control of the farm, as those planning to retire soon may have differing growth plans than others (horizon issues).
5. Ownership structure differences as these may imply different liquidity levels and different levels of risk. This was briefly discussed in chapter three.
6. The proportion of off-farm household income (Q24). Higher proportions of off-farm income may relieve on-farm capital constraint to production growth as more farm revenue can be retained for growth.
7. Share collateralization (Q8) as borrowing against FVS may enable greater on-farm investment. Included in this consideration may also be the variables of cooperative investment preferences (Q10) and share value ranking (Q6A), as high values preferences for these variables implies a preference for an increase the value of existing shares that may be subsequently borrowed against.
8. Region, as South Island farms tend to be much larger than North Island farms.
9. All constraints listed in Q20.

Age, the proportion of off-farm household income, share collateralization, share value preference and investment preference variables are represented on a seven-point ordinal scale. Size is a scalar variable and non normally distributed and therefore was transformed to a log. The succession planning variable is coded to a seven-point category variable and recoded as seven dummy variables. The ownership structure variable is coded to a four-point category variable, reclassified as seven categories and recoded as seven dummy variables. All Q20 constraints are represented as 1,0 dummy variables. All variables are standardized to account for measurement problems due to different scale. OLS modeling is conducted in SPSS, and PLS modeling is conducted in Unscrambler.

A linear regression of variables in an *overall growth* model on the dependent variable Estimated Production Growth over 2004-09 (survey question 18) is presented in Table 6.1g. The adjusted r square value was .132 which indicates reasonable explanatory power given data is from a survey. Note that the size variable has the largest t value of the significant explanatory variables, indicating that it is the most important indicator of growth. This is consistent with the theoretical framework developed earlier in this study.

The surprising result is the absence of the rising land cost constraint variable. An explanation is that there may be a positive association between land cost and expansion as farmers seek to 'farm capital gains' from rising land prices. Another explanation is ***measurement error arising from the present categorical form of the constraint question, suggesting the need for a better survey indicator.***

Other interesting results are the non significance of age as a predictor and the negative correlation of impending retirement and estimated growth. This implies that impending retirement is correlated with low / decreasing growth. The complexity of investing in Fonterra as a production constraint was significantly related to lower levels of estimated growth.

Table 6.1g: Coefficient Summary of Linear Regression Model of Growth within Fonterra Sample Standardized Variables Dependent Variable: Estimated dairy production 2004-09

	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. error	Beta		
(Constant)	.037	.036		1.017	.310
Size (log))	.161	.039	.162	4.097	.000
Years until relinquishing control of the farm	.122	.039	.117	3.164	.002
Proportion of off-farm household income	.081	.036	.081	2.234	.026
Value placed shares by lenders	.072	.037	.072	1.954	.051
Importance of Understanding Fonterra Investment	-.073	.037	-.071	-1.940	.053
Share Value Preference	-.085	.038	-.083	-2.234	.026
Impending Retirement	-.110	.036	-.113	-3.019	.003
Labor Cost/Availability	.075	.036	.075	2.093	.037
Rising Share Prices	.077	.040	.076	1.947	.052
Complexity of Fonterra Investment	-.107	.041	-.101	-2.638	.009
North Island	-.081	.038	-.082	-2.117	.035

Adjusted r square: .132
N: 1001

The tolerance and Variance Inflation Factors (VIF) scores indicate that there is no evidence of significant multi-collinearity. Examination of residuals and case summaries variables, such as Cook's Distance, indicates no evidence of outliers unduly influencing the results.

Blocking the independent variables into those that are relatively fixed from the co-operative's point of view (i.e. the factors that the farmers have control over: size, years until relinquishing control of the farm, the proportion of off-farm household income, impending retirement, labor costs / availability and location), into those that the cooperative may have some influence over by communication with members (share value preferences, the value placed on shares by lenders, the importance of understanding of Fonterra investments) and those that the co-operative has direct influence over (rising share prices and the complexity of investing in the co-operative) results in an adjusted r square for the first block of .102, the second block of .120. The cooperative therefore has direct influence over, at a maximum, 1.2% of the factors effecting the industry's growth over the next five years.

The significant independent variables were combined as interaction terms in a second model of estimated growth over the next five years. Variables that exhibited significant collinearity (VIF above 10) and were not significant at a 5% level were dropped from the model. The interaction term for the labor cost constraint and the value placed upon shares by lenders increased the adjusted r to .144. All other variables remained significant. This interaction term may suggest that the impact of increasing labor costs is mitigated by the ability of higher growth members to borrow against the value of these shares.

Although the diagnostic tests did not detect problem levels of multi-collinearity in the OLS model, a PLS regression was run to check these results, to ascertain if the small amount of collinearity may result in a different outcome, and to check the score plot to gain insight into any distinct clustering of samples. Note, as discussed in the previous

chapter, PLS is a structural equation modeling technique that can over fit models, as it is designed not to leave any significant explanatory variables which may be dropped in an OLS model due to collinearity. Therefore, all PLS regressions conducted in this study use the Unscrambler's 'uncertainty test', which is a form of 'jack-knifing'. That is, one sample is removed from the model in each iteration to test its impact when returned to the model. Variables are tested at the 5% significance level. All variables are standardized to eliminate distortion from unequal units of measurement.

The significant PLS regression coefficients are presented in Table 6.1h. The plots are not presented because no pattern was obvious in the score (sample) loadings. The explained variance is 13%, which is very similar to the OLS regression adjusted r square and all signs are consistent with the OLS regression. However, the age variable and the constraint variables of capacity to manage more debt and rising land costs were also found to be significant. Unlike the OLS model, household income was not found to be significant. The inclusion of the land constraint variable as significant may indicate that low levels of multi-collinearity are sufficient to remove this important variable from the OLS results. An interpretation of these results is that the PLS model, by incorporating collinearity into the technique, removes some measurement error and thus includes significant variables without inflating its version of the r square. ***This measurement problem may be ameliorated with constraint variables that are scalar/ordinal rather than nominal.***

Table 6.1h: Significant Coefficient (+ Interactions) Summary of PLS Regression Model of Growth within Fonterra Sample Standardized Variables Dependent Variable: Estimated dairy production 2004-09

Variable	Co-efficients
Importance of understanding Fonterra Investment	-6.161e-02
Share value preference	-5.912e-02
Age	-9.317e-02
Value placed shares by lenders	8.669e-02
North Island	-8.418e-02
Size (Log Kg/Ms)	0.135
Capacity to service more debt	5.027e-02
The complexity of Fonterra investments	-4.470e-02
Rising Fonterra share prices	4.636e-02
Land cost or availability	5.266e-02
Impending retirement	-9.310e-02
Years before relinquishing control over the farm	6.533e-02

Explained Variance: 13%
N: 1001

Conclusion

The framework developed by this study appears to be supported thus far. Size, portfolio and horizon factors appear to be important determinants of estimated growth over the next five years.

The above models suggest that some of Fonterra's members may still face a constraint on growth from its rising share prices as there is not a significant interaction effect between value placed by lenders upon shares and the constraint of rising share prices. A cross tabulation between the two variables illustrates this point (see Table 6.1i). It appears that around half of those indicating that rising share prices were not a constraint were aware of the value of those shares as collateral. However, about half of

those who indicated that rising share prices were a constraint on growth indicated that they were aware of the value of the shares as collateral.

Table 6.1i: Fonterra
Value placed on shares by lenders x rising share prices

Percent of value place on shares by lenders	Constraint of rising share prices		Total
	0	1	
Don't know	388	139	527
0- 15%	7	8	15
16- 30%	4	6	10
31- 45%	3	3	6
46- 60%	15	16	31
61- 75%	27	13	40
76- 90%	55	23	78
91-100%	176	62	238
Total	**675**	**270**	**945**

N: 1001

Tests of Vertical Portfolio Constraint Hypothesis

Two survey questions pertained to the respondent's cooperative investment preferences. Q10 is a LIKERT variable with high scores indicating a preference for ingredients and low score a preference for value added investment.

Table 6.1j indicates that if 6 and 7 indicate a preference for ingredients and 1 and 2 indicate a preference for value added, then 32% of respondents favored value added investment and 14% favored ingredients investment. The largest single group was indifferent / don't know with the value of 4.

Table 6.1j: Variable Frequency Table: Fonterra Survey (Q10)

Prefer Fonterra invest in ingredients rather than value added		Frequency	Percent	Valid percent	Cumulative percent
Strongly disagee	1	122	12.2	12.6	12.6
	2	191	19.1	19.8	32.4
	3	155	15.5	16.0	48.4
	4	275	27.5	28.5	76.9
	5	88	8.8	9.1	86.0
	6	101	10.1	10.5	96.5
	7	34	3.4	3.5	100.0
Strongly agree	Total	966	96.5	100.0	
Missing	System	35	3.5		
Total		**1001**	**100.0**		

N: 1001

The categorical question asking investment preferences apparently resulted in different outcomes compared to Table 6.1j. In Table 6.1k, A is the categorical variable for the investment option of ingredients. Only 7% of respondents preferred this option. Sixty three percent opted for B, the value added option, while 16% indicated no further investment was required or don't know.

Table 6.1k:
Variable Frequency Table: Fonterra (Q4)

Categorical investment preferences		Frequency	Percent	Valid percent	Cumulative percent
		77	7.7	7.7	7.7
Ingredients	A	65	6.5	6.5	14.2
Value added	B	705	70.4	70.4	84.6
No further investment required	C	83	8.3	8.3	92.9
Don't Know	D	71	7.1	7.1	100.00
Total		**966**	**96.5**	**100.0**	

N: 1001

In Table 6.1l the LIKERT investment variable was recoded as 1 and 2 to represent a preference for value added investment, 5 and 6 to represent a preference for ingredients and 3 to 5 to represent don't know / require no additional investment at this time. The cross tabulation between these variables and the categorical variables suggests that 65 respondents chose not to answer the categorical question but answered the continuous form of the question. This indicates that the LIKERT form appears to have greater acceptance than the 'forcing' type of categorical question, as only half the number of respondents chose not to answer this question. ***Modifications to the questions on these grounds will be discussed in the final chapter***.

Table 6.1l: Cross-tabulation: Fonterra
Categorical Investment Variable x LIKERT Variable Recoded as Categorical

		LIKERT recoded as categorical			**Total**
		1 and 2: Value added	**3 To 5: No further investment/ don't know**	**6 And 7: Ingredients**	
Categorical investment preferences		16	39	10	65
Ingredients	A	12	26	26	64
Value added	B	266	342	80	688
No further investment required	C	15	50	16	81
Don't know	D	4	61	3	68
Total		**313**	**518**	**135**	**966**

N: 1001

Of greater concern are the 12 respondents that chose A, ingredients, in Q4 and chose 1 or 2, value added, in Q10. Of equal concern are the 80 respondents that chose B, value added, in Q4 and chose 6 or 7, in Q10. ***This may indicate measurement error. The***

study will presume that the continuous variable is the more accurate of the two because of respondent's higher propensity to answer the question relative to the categorical option question.

The LIKERT variable was tested first with a stepwise linear regression on the variables listed on page 8 using all standardized variables. The variables for estimated growth over the next five years and changing farm revenue from milk over the next five years were also added to the model. Table 6.1m indicates that four variables were significant, but the adjusted r square was only .041. Two of the significant relationships involved horizon variables; interestingly the constraint variable of obtaining a better rate of return from producing an alternative commodity was also significant. ***This may suggest a lateral portfolio constraint within a subsection of the sample population.***

Table 6.1m: Coefficient Summary of Continuous Investment Preference Regression Model within Fonterra Sample: Standardized Variables Dependent Variable: LIKERT Investment Preference

	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. error	Beta		
(Constant)	-.023	.034		-.690	.490
Importance of understanding Fonterra investment	.168	.034	.168	4.971	.000
Better rate of return from producing an alternative commodity	.099	.032	.105	3.102	.002
Bequeath farm to family and Will farm	.070	.034	.070	2.041	.042
Southland	-.069	.033	-.071	-2.087	.037

Adjusted r square: .041
N: 1001

The negative sign on the Southland dummy variable was interesting given the large number of conversions to dairy farms on the South Island and its rapid growth in the past few years. Bivariate correlations between the Southland variable and estimated growth over the next years and the Southland variable and the change in the rate of growth over the next five years indicate a positive significant correlation with estimate growth, but a negative significant correlation with the change in growth. That is, the respondents from this region expect a slowing rate of growth.

Table 6.1n indicates that that the PLS regression also indicated little variation in the dependent variable (Q10) by the X data set (4% explained variation). The PLS model identified two additional significant variables of the succession option to sell the farm (negatively related to the ingredients option) and age (positively related).

Table 6.1n: Significant Coefficient (+ Interactions) Summary of PLS Continuous Regression Model within Fonterra Sample: Standardized Variables Dependent Variable: LIKERT Investment Preferences

Importance of understanding Fonterra investment	0.118
Age	5.896e-02
Better rate of return from producing an alternative commodity	6.935e-02
Sell farm	-5.960e-02
Bequeath farm to family and Will farm	6.807e-02
Southland	-6.196e-02

Explained Variance: 4%
N: 1001

Neither the OLS or PLS models indicated that size was significant.

No easily identifiable patterns could be observed comparing the PLS score and loading plots, so these were not presented.

Table 6.1o presents the results of a binomial regression those who indicated a preference for categorical investment preferences Q4A, the option of ingredients investment. Sixty five respondents chose this option. In SPSS, the log likelihood statistic is not reported; the value is multiplied by -2 (-2LL), as it has an approximate chi-square distribution (Field, 2002). It is the basis of the r square measure (the Nagelkerke), which may be interpreted as comparable to the r square in multiple regression. It is also the basis of the Hosmer and Lemeshow test, which is calculated by dividing the model chi-square by the original -2LL. Thus it measures the correspondence of actual and predicted values of the dependent variable; a good overall model fit is indicated by a non-significant chi-square value.

Table 6.1o: Binomial Regression: Standardized Variables
Dependent variable: Categorical Indicator of Preference for Cooperative Investment into Ingredients (Q4A) within Fonterra Sample

	B	S.E.	Wald	df	Sig.	Exp(B)	Change in -2 log likelihood
Estimated production growth over the next five years	.702	.166	17.912	1	.000	2.017	17.453
Capacity to service debt constraint	-.882	.457	3.722	1	.041	.414	3.538
Constant	-2.484	.406	37.460	1	.000	.083	

Nagelkerke r square: .168
Hosmer and Lemeshow Test: .787
Percent correct: 92%
Sample size: 1001

These respondents have ***comparatively*** high levels of projected growth, which is in keeping with the theoretical framework developed in this study and they are unconstrained by their capacity to service debt.

The discrepancy between the variables for the variable measuring ingredient's investment preference highlights the need for survey design improvement.

However, the binomial regression indicates that the cooperative may face a vertical portfolio problem among its highest growth suppliers. This finding is consistent with the opportunity cost framework proposed in this study.

Segmented Models

The focus of this subsection is membership segmentation to ascertain whether sub groups may face a vertical portfolio constraint. The descriptive statistics presented in subsection one suggest that segmentation along size and estimated growth over the next five years are unlikely to yield significant results. Using the LIKERT dependent variable for investment preferences, Linear (OLS), PLS, binomial modeling based on these segments confirmed this supposition.

Further the binomial regression on the Categorical Investment Option, Ingredients suggests that examining growth rates may provide greater insights and examination of the Cross-tabulation in Table 6.1d suggests that the *change in the rate of growth* may provide the best insight to the investment preferences of member sub groups. This would be consistent with the opportunity cost framework proposed in this study.

One hundred seventeen respondents indicated that they intended to increase their rate of growth over the next five years relative to the rate of growth they had achieved over the past five years. A new variable was created by subtracting respondent's last rate five years rate of production growth (Q17) from their next five years rate of production growth (Q18). A PLS regression was chosen as the first means of analyzing this sub

group, as the technique makes it easy to inspect sample plots (see Plot 6.1a). The plot overview is presented because of the interesting pattern between the score and loading plots, suggesting that further analysis could be undertaken on the composition of these apparent score (sample) clusterings.

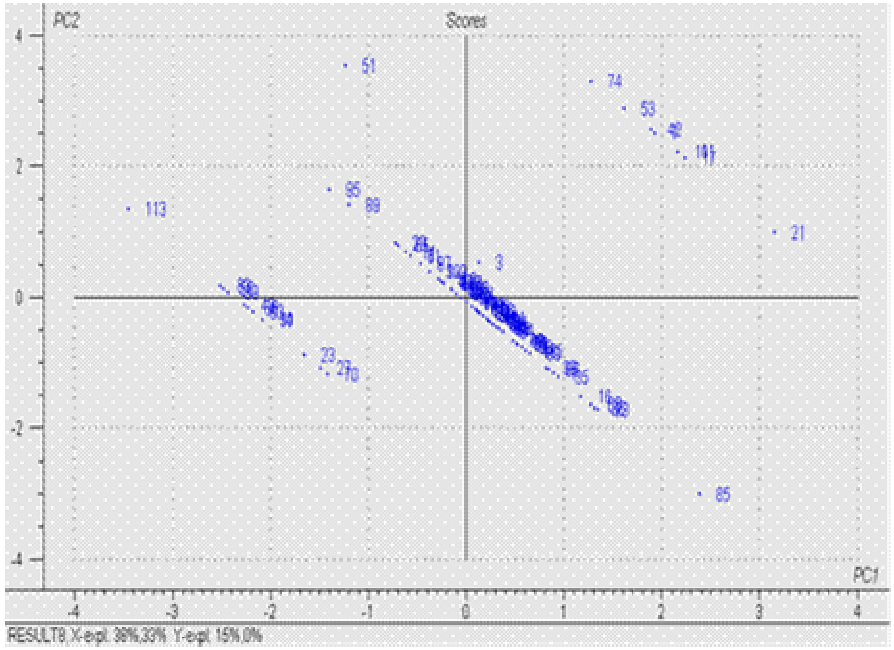
Three significant independent variables were identified in the PLS model and the explained variance is 15%, supporting the proposition that a vertical portfolio problem is evident within this subset of the membership (Table 6.1p)

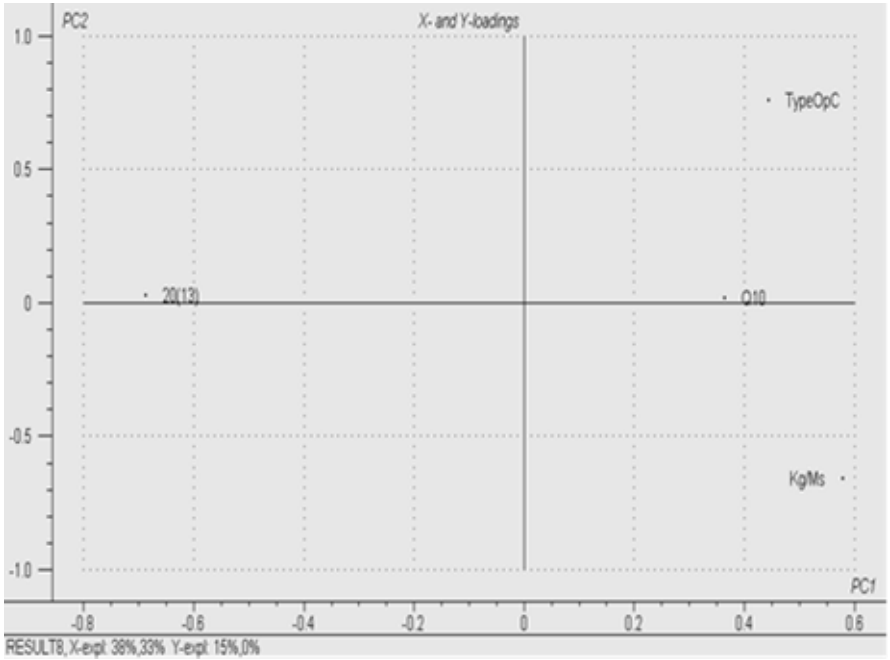
Table 6.1p: Significant Coefficient (+ Interactions) Summary of PLS Regression Model within Fonterra Sub Sample: Standardized Variables Dependent Variable: Positive Change in the Rate of Estimated Growth relative to Last Five Years Actual Rate of Growth

Size (log - kg/ms)	0.195
Herd costs	-0.250
Manager with equity	0.179

Explained variance: 15%

Plot 6.1a: Comparison of Scores and Loading Plots Fonterra:
Sub Sample of Positive Change in the Rate of Estimated Growth relative to Last Five Years Actual Rate of Growth





A comparison between Table 6.1b and Table 6.1q (below) indicates that the sub group planning to increase their rate of growth is comparatively smaller than the overall sample.

Table 6.1q: Frequency Table: Fonterra
Size within the Positive Changing Rate of Growth Sub Group

Kg/Ms: Ranges	Frequency:	Percent	Valid percent	Cumulative percent
1.00: < 55	31	26.5	26.5	26.5
2.00: 56-85	36	30.8	30.8	57.3
3.00: 86-115	24	20.5	20.5	77.8
4.00: 116-145	7	6.0	6.0	83.8
5.00: 146-175	6	5.1	5.1	88.9
6.00: 176-205	3	2.6	2.6	91.5
7.00: > 206	10	8.5	8.5	100.0
Total	**117**	**100.0**	**100.0**	

N: 117

The rising herd cost constraint's negative co-efficient may infer that this is the least binding of these respondents' constraints. The positive relationship between the Manager Equity type of operator and the dependent variable was an unexpected but interesting result. Binomial regression of this variable on the coded variable for ingredients, and a linear regression of this variable on the continuous investment preference variable over the entire sample did not indicate significance. This suggests that other interaction effects are occurring within the subset. Over the entire sample, 'contract milkers' was the only ownership variable to significantly prefer ingredients investment over value added. Further information is required as to why this may be.

An OLS linear regression (Table 6.1r) confirmed the PLS results, with the addition of a significant variable for the constraint of falling payouts.

Table 6.1r: Co-efficient Summary of LIKERT Investment Preference Regression Model within Fonterra Sample: Standardized Variables Dependent Variable: LIKERT Cooperative Investment Preferences

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. error	Beta		
(Constant)	.162	.087		1.853	.067
Ownership type: Manager with equity	.172	.066	.238	2.583	.011
Size (Log of)	.158	.076	.191	2.061	.042
Herd costs	-.121	.056	-.200	-2.159	.033
Falling payouts	.151	.077	.181	1.952	.054

Adjusted r square: .126

The significant finding for the constraint variable for falling payouts is interesting, as the industry has experienced sharp declines in payouts in the past two years. Presumably, a lift in payouts will result in a further increase in the rate of growth within this group and may also draw others into it.

The results provide evidence supporting the first hypothesis that unconstrained members will prefer commodity investment over value added investment. That the result pertains to 10% of Fonterra's membership is unsurprising given the industry's macro environment and Fonterra's property rights structure.

In the short term, the finding probably signals little of practical short run significance to the cooperative as the number of affected members and their relative size is small. This is not to underestimate the ability of these producers to apply political pressure. However, the finding does suggest that in the medium term Fonterra may have a much larger scale problem if the conditions within the industry were to improve and the change in the rate of growth begins to increase among a wider section of the membership.

Testing for the Lateral Portfolio Problem

The case evidence from chapter four, the cross tabulation on page five and the models on pages 11 and 14 indicated that the cooperative may face a lateral portfolio problem within a sub section of its membership. Hypothesis 5 states that 'Members altering their on-farm production portfolio, so as to reduce the volume marketed by the cooperative, will prefer not to invest any further capital in the cooperative'. However, this hypothesis relates to a traditionally structured marketing cooperative; Fonterra's linking of shares to production volumes infers that members with reducing volumes will automatically have their share capital redeemed. Consequently, Fonterra's unlocking of its market value infers that it may be in the interest of members reducing their percentage of farm revenue from milk to prefer higher levels of value adding investment, to lift the range of the share price, and to prefer the Board set share prices at the higher end of the range. This may be particularly the case if members are able to borrow against their shares and finance their on-farm portfolio diversification.

To test this proposition a new dependent variable, to represent change in projected percentage farm revenue from milk, was constructed by subtracting respondents projected percentage of revenue from milk in 2009 from respondents' current percentage of revenue from milk. Values range from + 100 percent to -100 percent. The section of this variable that is of interest is the decline in farm revenue from milk. The pertinent independent variables are:

- cooperative investment preference (q10). This sub group may prefer value added investment relative to ingredients in order to lift the share price range;

- share value ranking (Q6). This sub group may prefer a higher share price;
- the value placed upon shares by lenders. This variable is entered as a categorical / dummy indicating a positive value (1) or don't know (0) due to the approximate 50% of respondents who indicated don't know;
- the 'better rate of return from an alternative commodity' production constraint. This sub group may indicate that their declining projected percentage of farm revenue from milk is positively related to better returns from alternative commodities; and
- the impending retirement production constraint and the variable years to relinquishing control over the farm. These will indicate which respondents are retiring and therefore are decreasing their percentage of farm revenue from milk due to horizon, rather than portfolio concerns.

A linear OLS model was constructed using these variables and is presented in model 6.1s. Two hundred twenty three respondents indicated that they projected a decline in farm revenue from milk over the next five years. Each of these variables was significant and with the appropriate signs, with the exception of the lender value variable. The adjusted r square was .221.

Table 6.1s: Co-efficient Summary of Respondents within Fonterra Sub Sample (Estimated Decreasing returns from Milk Production, 2004-09): Standardized Variables
Dependent Variable: Decreasing Percentage of Farm Revenue from Milk 2004-09

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.	Collinearity statistics	
	B	Std. error	Beta			Tolerance	VIF
(Constant)	-.083	.061		-1.349	.179		
Size (Log Kg/Ms)	-.306	.057	-.320	-5.355	.000	.976	1.024
Impending retirement	.216	.057	.224	3.765	.000	.985	1.015
Share value preference	.119	.057	.124	2.074	.039	.972	1.029
Better rate of return from producing an alternative commodity	.091	.043	.126	2.118	.035	.978	1.022
Size (Log Kg/Ms) x share value preference	-.206	.059	-.208	-3.489	.001	.980	1.020

Adjusted r square: 221
N: 233

While two of the leverage values for Mahalanobis distance were above 15, which could be cause for concern (Field, 2002, p.125), an examination of the Cook's distance statistics indicated that they were both < 1 so 'there is no real need to delete that point since it does not have a large effect on the regression analysis' (Stevens, in Field, 2002, p. 127).

A PLS regression was also run to check these results, although the collinearity diagnostics for the OLS model did not indicate any significant collinearity problems. The same variables were found to be significant, the signs were as expected and the explained variance was a similar 21%. Plot overview 61.b indicates clear segmentation of samples, which may be the subject of further research.

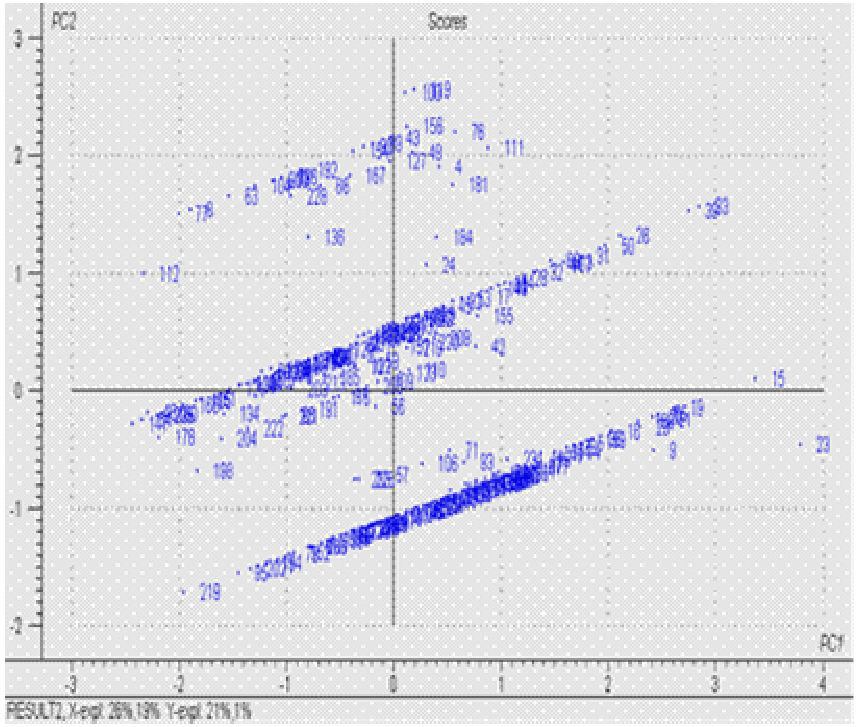
These models may provide support for the existence of a lateral portfolio problem. However, to reduce the likelihood of a confounding effect with a horizon problem, all samples indicating a production constraint from impending retirement were removed from the sample (192 cases remaining). Table 6.1t presents the OLS model; two variables, and an interaction effect between them, were significant in this reduced sample. The adjusted r square was .101.

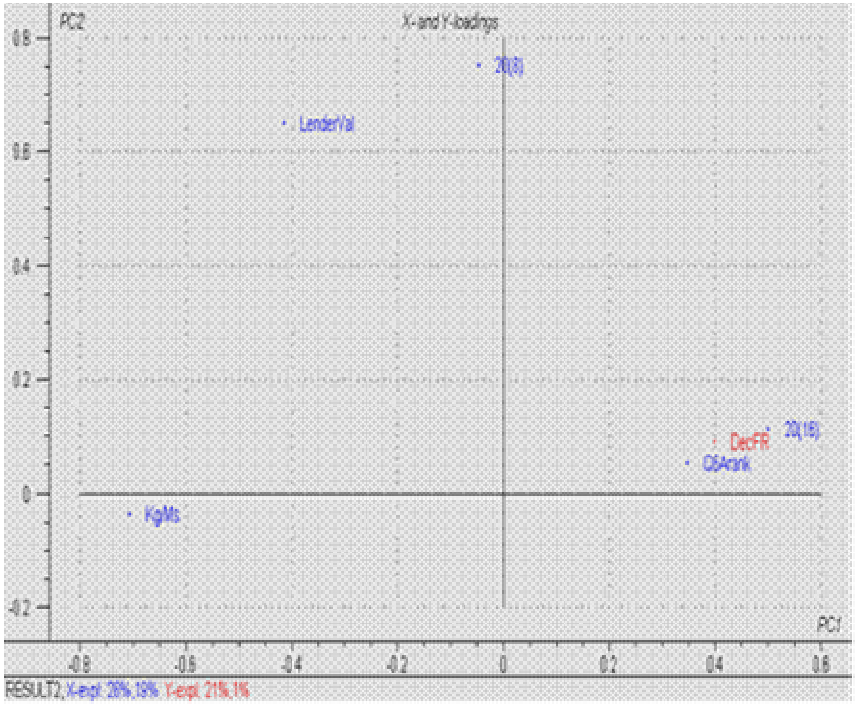
Table 6.1t:
Co-Efficient Summary of Respondents within Fonterra Sub Sample
(Respondents Indicating An Impending Retirement Constraint Removed):
Standardized Variables
Dependent Variable: Decreasing Percentage of Farm Revenue from Milk 2004-09

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. error	Beta		
(Constant)	.197	.066		2.983	.003
Better rate of return from producing an alternative commodity	.085	.045	.132	1.898	.059
Size (Log Kg/Ms)	-.297	.064	-.337	-4.637	.000
Better rate of return from producing an alternative commodity x size (Log Kg/Ms)	-.091	.044	-.151	-2.084	.039

Adjusted r square: .101
N: 192

Plot 6.1b: Comparison of Scores and Loading Plots Fonterra:
Sub Sample of Positive Change in the Rate of Estimated Growth relative to Last Five Years Actual Rate of Growth





A PLS regression of the same sample subset resulted in significant size, lender value and share preference ranking variables, but found the better rate of return to be insignificant. The explained variance was 9 percent. The same interesting pattern of score clusters was apparent.

Respondents indicating that they planned to relinquish control over the farm within the next five years were next removed from the sample set (148 cases remaining). The Linear OLS model, presented in Table 6.1u, indicated that two variables remained significant and the adjusted r square fell to .068. A PLS regression confirmed these results.

Table 6.1u: Co-Efficient Summary of Respondents within Fonterra Sub Sample (Respondents Impending Retirement Constraint and Relinquishing Control of the Farm within Five Years - Removed): Standardized Variables Dependent Variable: Decreasing Percentage of Farm Revenue from Milk 2004-09

	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. error	Beta		
(Constant)	-.203	.073		-2.771	.006
Size (Log Kg/Ms)	-.211	.068	-.250	-3.099	.002
Better rate of return from producing an alternative commodity	.108	.051	.171	2.122	.036

Adjusted r square: 0.68
N: 148

These models suggest no support for the existence of a lateral portfolio problem with this subset of Fonterra's membership because once the horizon variables were removed from the samples, the share value preference variable became insignificant. Any gaming of the cooperative may be explained as a horizon problem. While Table 6.1u could be explained as simply an explanation of diversification, adding the constraint for urban encroachment in the last sub sample set renders both the production constraint 'better rate

of return from producing an alternative commodity' and size as insignificant. This suggests that the 'lateral diversification' may be into alternative land uses, rather than alternative forms of agricultural production. If this is correct, then the macro environment suggests that a more serious threat to Fonterra's production base is likely to come from non agricultural factors. This speculation again highlights the need for better metrics for the constraint variables.

2. Effingham Equity

i) Data Set Descriptions and Simple Analysis Based on Some Likely Growth and Specialization Related Variables

A total of 267 responses were received from this survey, which is an overall response rate of 15%. Table 6.2a indicates that the respondents' average age is reflective of the surrounding eleven counties close to the cooperative[15]. However, the sample appears to consist of farmers that are larger than those of the surrounding counties. Table 6.1b indicates that 96% of respondents produce grain and 65% had crop operations of 1,000 acres or less.

Table 6.2a: Selected Effingham Equity Sample and Surrounding Counties *Averages*

Sample age range	Surrounding counties age (2002)[a]	Sample Size: Crop acres	Surrounding counties crop acres (2002)[a]
46-50	**45-54**	500 - 1000	**520**

Source: a) USDA, 1992 and 2002 Census of Agriculture; b) Effingham Equity survey (2004).

[15] The average age for farmers, nationally, is 55 years (USDA, 2005 http://www.usda.gov/nass/).

Table 6.2b: Frequency Table: Effingham Size Distribution (Crop Operation) Effingham

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Less than 100 acres	15	5.6	5.8	5.8
	100-500 acres	76	28.5	29.6	35.4
	501-1,000 acres	74	27.7	28.8	64.2
	1,001-1,500 acres	44	16.5	17.1	81.3
	1,501-2,000 acres	20	7.5	7.8	89.1
	2,001-2,500 acres	13	4.9	5.1	94.2
	More than 2,500 acres	15	5.6	5.8	100.0
	Total	257	96.3	100.0	
Missing	System	10	3.7		
Total		267	100.0		

Table 6.2c: Selected Effingham Equity Sample and Surrounding Counties *Averages*

Sample size: Hog numbers	Surrounding counties hog number per farm	Sample size: Cattle numbers	Surrounding counties beef cattle number per farm	Surrounding counties dairy cattle number per farm
500 - 1000	**920**	1-50	**20**	**62**

Source: USDA, 2002 Census of Agriculture, Effingham Equity survey (2004).

Table 6.2c indicates that livestock numbers appear to be reflective of the surrounding counties. Thirty-five percent of respondents have cattle. Nearly half have fewer than 50 cattle (Table 6.2d). These small herds are presumably part of a pasture rotation system; the larger herds are presumably dairy operations requiring purchased animal feed. ***This may suggest that very small herd owners, if they are predominantly grain producers, may not use the cooperative's animal feed facilities and may prefer specialized grain related cooperative investment, rather than generalized cooperative investment into grain and livestock related activities. This suggests a possible lateral portfolio problem.***

Table 6.2d: Frequency Table: Effingham
Size (Cattle Operation)

		Frequency	Percent	Valid percent	Cumulative percent
Valid	1-50 cows	41	15.4	44.1	44.1
	51-125 cows	32	12.0	34.4	78.5
	126-200 cows	13	4.9	14.0	92.5
	201-275 cows	3	1.1	3.2	95.7
	276-350 cows	3	1.1	3.2	98.9
	More than 350 cows	1	.4	1.1	100.0
	Total	93	34.8	100.0	
Missing	None	35	13.1		
	System	139	52.1		
	Total	174	65.2		
Total		**267**	**100.0**		

Table 6.1e indicates that 17% of respondents have hogs. The distribution is characterized by very small producers, presumably requiring a minimum of purchased inputs and very large producers, presumably requiring extensive feed inputs, which could be purchased from the cooperative. ***Again, smaller hog producers, if they are predominately grain producers, may prefer specialized cooperative investment into grain related activities rather than generalized investment into grain and livestock activities.***

Table 6.2e: Frequency Table: Effingham Size (Hog Operation)

		Frequency	Percent	Valid percent	Cumulative percent
Valid	1-500 hogs	11	4.1	24.4	24.4
	501-1,000 hogs	6	2.2	13.3	37.8
	1,001-2000 hogs	5	1.9	11.1	48.9
	2,001-3,000 hogs	3	1.1	6.7	55.6
	3,001-4000 hogs	2	.7	4.4	60.0
	More than 4,000 hogs	18	6.7	40.0	100.0
	Total	45	16.9	100.0	
Missing	None	75	28.1		
	System	147	55.1		
	Total	222	83.1		
Total		**267**	**100.0**		

Tables 6.2f-g indicate that small farmers are likely to be diversified between livestock and grain, i.e. the larger the farmer's production, the more likely the farmer is increasingly specialized relative to cattle production. However, some of the largest hog producers are also major grain producers, presumably to feed their own livestock. Bivariate correlations do not indicate any significant relationships between the size of livestock operations and crop operations. Therefore, it may be inferred that size will not be a major explanatory variable when testing for the lateral portfolio hypothesis that more specialized producers will prefer more specialized cooperative investment reflective of their farm portfolio.

Table 6.2f: Cross-tabulation: Effingham Size Cattle Operation x Size of Crop Operation

		Q20 size crop operation							Total
		Less than 100 acres	100-500 acres	501-1,000 acres	1,001-1,500 acres	1,501-2,000 acres	2,001-2,500 acres	More than 2,500 acres	
Size of cattle operation	1-50 cows	3	12	13	6	2	2	3	41
	51-125 cows	1	10	10	7	3	0	1	32
	126-200 cows	0	4	7	2	0	0	0	13
	201-275 cows	0	2	1	0	0	0	0	3
	276-350 cows	1	1	1	0	0	0	0	3
	More than 350 cows	0	0	0	0	1	0	0	1
Total		**5**	**29**	**32**	**15**	**6**	**2**	**4**	**93**

Table 6.2g: Cross-tabulation: Effingham Size Hog Operation x Size of Crop Operation

		Q20 size crop operation						Total
		100-500 acres	501-1,000 acres	1,001-1,500 acres	1,501-2,000 acres	2,001-2,500 acres	More than 2,500 acres	
Size of hog operation	1-500 hogs	1	8	1	0	0	1	11
	501-1,000 hogs	3	1	1	1	0	0	6
	1,001-2,000 hogs	3	2	0	0	0	0	5
	2,001-3,000 hogs	1	2	0	0	0	0	3
	3,001-4,000 hogs	0	1	1	0	0	0	2
	More than 4,000 hogs	3	5	2	3	2	1	16
Total		**11**	**19**	**5**	**4**	**2**	**2**	**43**

In order to test the lateral portfolio hypothesis, a new variable will be created to measure specialization as a financial ratio of the percent of farm revenue gained from livestock production relative to grain production. This is discussed in the next subsection.

Bivariate correlations indicate that the percentage of household income from non farm sources is negatively correlated with the size of grain and hog operations at the .01 level (two tailed test). The percentage of income from non farm sources and the size of cattle operations are weakly correlated at the .1 level (two tailed test).

Figures for production growth in the eleven counties over the last five years are not available, but Tables 6.2h-i indicate that the cooperative's members have probably attained comparatively higher rates of production growth in crops and livestock.

Table 6.2h: Selected Effingham Equity Sample and Surrounding Counties *Averages*

Sample production growth – acres 1999-04	**Surrounding counties production growth (acres 1987-2002)[A]**	**Sample estimated production growth – acres 2004-09**
1-10%	**7.5%**	1-10%

Table 6.2i: Selected Effingham Equity Sample and Surrounding Counties *Averages*

Sample production growth – livestock (hog and cattle) numbers 1999-04	**Surrounding counties production growth – livestock (hog and cattle) numbers 1987-2002**	**Sample estimated production growth – livestock (hog and dairy) numbers 2004-09**
1-10%	**-13%**	1-10%

Source: USDA, 1992 and 2002 Census of Agriculture, Effingham Equity survey (2004).

Table 6.2j indicates that the majority of the respondents' growth in grain production is negative or static. There is an apparent clear relationship between an intention to increase production (***bold italics***) and scale. A bivariate correlation indicates that there is a significant positive relationship between size and intention to grow at the .001 level (two tailed test). Note the discrete jumps in apparent intention to grow at the 100-500, 501-1000, 1500-2000 and more than 2500 acre levels.

Table 6.2j: Cross-tabulation: Effingham
Estimated Crop Production 2004-09x Size of Crop Operation

		Q20 size crop operation							Total
		Less than 100 acres	**100-500 acres**	**501-1,000 acres**	**1,001-1,500 acres**	**1,501-2,000 acres**	**2,001-2,500 acres**	**More than 2,500 acres**	
Estimated crop production 2004-09	Decrease	2	7	6	4	0	1	0	20
	Stay same	11	48	23	12	6	3	3	106
	Increase 1-10%	***0***	***9***	***17***	***8***	***6***	***3***	***4***	47
	Increase 11-20%	***1***	***4***	***15***	***9***	***3***	***5***	***4***	41
	Increase 21-30%	***0***	***3***	***5***	***3***	***3***	***1***	***2***	17
	Increase 31-40%	***1***	***2***	***3***	***0***	***1***	***0***	***2***	9
	Increase > 40%	***0***	***0***	***4***	***3***	***0***	***0***	***0***	7
Total		***15***	***73***	***73***	***39***	***19***	***13***	***15***	**247**
Percent that intend to grow over the next five years		0.7%	20%	60%	59%	68%	69%	80%	

Table 6.2 k indicates that the rate of growth in the next five years is likely to be similar to the rate of growth over the past five years.

Table 6.2k: Cross-tabulation: Effingham
Estimated Crop Production 2004-09 x Crop Production 1999-04

		Crop production 1999-04s							Total (%)
		Decrease	**Stayed same**	**Incr. 1-10%**	**Incr. 11-20%**	**Incr. 21-30%**	**Incr. 31-40%**	**Inc. > 40%**	
Estimated crop production 2004-09	Decrease	6	6	3	3	0	0	2	20 (8%)
	Stay same	14	59	22	6	3	2	1	107 (43%)
	Increase 1-10%	***0***	***14***	13	11	6	1	2	47 (19%)
	Increase 11-20%	***0***	***7***	***5***	18	5	1	5	41 (17%)
	Increase 21-30%	***0***	***5***	***1***	***0***	6	2	3	17 (7%)
	Increase 31-40%	***0***	***1***	***0***	***1***	***4***	0	3	(4%)
	Increase > 40%	***0***	***1***	***1***	***1***	***0***	***1***	3	7 (3%)
Total (%)		**20 (8%)**	**93 (38%)**	**45 (18%)**	**40 (16%)**	**24 (10%)**	**7 (3%)**	**19 (8%)**	**248**

Table 6.2l: Cross-tabulation: Effingham
Size of Crop Operation x Ownership Type

		Type of grain farmer							Total
		Owner	**Owner / crop share**	**Owner / crop share / cash rent**	**Owner / cash rent**	**Crop share**	**Crop share / cash rent**	**Cash rent**	
Size of crop operation	Less than 100 acres	4	0	0	0	6	1	4	15
	100-500 acres	39	3	2	5	11	0	16	76
	501-1,000 acres	30	6	4	2	22	3	7	74
	1,001-1,500 acres	16	3	4	1	14	0	6	44
	1,501-2,000 acres	4	3	3	1	8	0	1	20
	2,001-2,500 acres	4	2	0	1	1	0	5	13
	More than 2,500 acres	4	2	0	1	6	0	2	15
Total		**101**	**19**	**13**	**11**	**68**	**4**	**41**	**257**

Table 6.2m: Cross-tabulation: Effingham
Size of Hog Operation x Ownership Type

		Q27 type livestock farmer			Total
		Owner	**Contract feeder**	**Other**	
Q29 size of hog operation	1-500 hogs	11	0	0	11
	501-1,000 hogs	4	1	1	6
	1,001-2000 hogs	4	1	0	5
	2,001-3,000 hogs	3	0	0	3
	3,001-4000 hogs	1	1	0	2
	More than 4,000 hogs	17	1	0	18
Total		**40**	**4**	**1**	**45**

Table 6.2n: Cross-tabulation: Effingham
Size of Cattle Operation x Ownership Type

		Q27 type livestock farmer				Total
		Missing	**Owner**	**Contract feeder**	**Other**	
Size of cattle operation	1-50 cows	1	35	1	4	41
	51-125 cows	0	32	0	0	32
	> 125 cows	1	15	1	3	20
Total		**2**	**82**	**2**	**7**	**93**

Tables 6.2l-n indicates that owner is the dominate type of ownership structure with livestock respondents, whereas grain farmer respondents are more likely to use a mix of ownership structures. Presumably, this is a strategy to avoid the impact of rising land prices. *This implies that a useful additional survey question would be to ask what strategy the farmer perceives as best in dealing with identified constraints.*

Table 6.2m indicates that that *on average* respondents tend to purchase a large percentage of their inputs from the cooperative and market considerably less of their hogs and grain through the cooperative.

Table 6.2m: Selected Effingham Equity Sample *Averages*

Percentage of grain marketed through Effingham equity	Percentage of grain inputs purchased from Effingham equity	Percentage of hogs marketed through Effingham equity	Percentage of livestock (hogs and dairy) feed purchased from Effingham equity
0-15%	61-75%	61-75% *16-30%*	46-60%

Source: Effingham Equity survey (2004)

Table 6.2n indicates that grain marketing is more likely to be used by Effingham's relatively smaller producers; a bivariate correlation indicates a negative relationship at the .01 level (two tailed). This is reflective of the case study which indicated Effingham's decision to specialize in crop production services, as is indicated by Table 6.2o.

Table 6.2n: Cross-tabulation: Effingham
Size of Crop Operation x Percent Marketing Grain Through the Cooperative

		Q20 size crop operation							Total
		Less than 100 acres	100-500 acres	501-1,000 acres	1,001-1,500 acres	1,501-2,000 acres	2,001-2,500 acres	More than 2,500 acres	
Percent marketing grain through the cooperative	NA	4	12	11	5	1	4	5	42
	0-15%	6	38	37	30	18	9	10	148
	16-30%	1	4	7	2	0	0	0	14
	31-45%	1	3	6	1	1	0	0	12
	46-60%	0	2	2	0	0	0	0	4
	61-75%	1	3	1	2	0	0	0	7
	76-90%	1	5	1	2	0	0	0	9
	91-100%	1	7	9	0	0	0	0	17
Total		**15**	**74**	**74**	**42**	**20**	**13**	**15**	**253**
Percent of respondents marketing more than 15% of grain through Effingham equity		33%	32%	35%	16%	5%	0%	0%	

There is apparently a non linear relationship between the above average percentage of crop inputs purchased and size (Table 6.2o). It appears that the cooperative's most loyal customers are middle size grain producers and that larger producers may shop between competitors to source the best price / service.

Table 6.2o: Cross-tabulation: Effingham
Size Crop Operation x Percent Grain Inputs Purchased from the Cooperative

		Size of crop operation							Total
		Less than 100 acres	100-500 acres	501-1,000 acres	1,001-1,500 acres	1,501-2,000 acres	2,001-2,500 acres	More than 2,500 acres	
Percent of input purchase	NA	1	1	3	0	0	0	0	5
	0- 15%	1	6	5	4	1	0	3	20
	16- 30%	2	5	2	3	2	1	1	16
	31- 45%	2	5	4	2	3	2	3	21
	46- 60%	1	5	7	4	2	1	2	22
	61- 75%	1	6	5	4	3	2	0	21
	76- 90%	2	16	19	11	2	3	1	54
	91-100%	5	31	29	14	7	4	5	95
Total		**15**	**75**	**74**	**42**	**20**	**13**	**15**	**254**
Percent of respondents purchasing more than 75% of inputs from Effingham equity		47%	61%	65%	60%	45%	54%	40%	

Table 6.2p indicates the color coding given to member surveys to delineate their level of business with the cooperative.

Table 6.2p: Selected Effingham Equity Sample: Respondent Turnover with the Cooperative

More than $75,000 (Blue Survey)	$25,000 to $75,000 (Gold Survey)	Less than $25,000 patronage (Yellow Survey)
11%	39%	50%

Tables 6.2q – t are Cross-tabulations of the volume of business done with the cooperative and the respondents' percentages of input and marketing done through the cooperative. These indicate that the:

- small turnover members are the main users of grain marketing services (29%). All classes of turnover are unlikely to market the majority of their grain through Effingham;
- larger turnover members purchase proportionally more of their crop inputs / crop services from the cooperative relative to than lower turnover members. A bivariate correlation indicates that a positive, significant relationship exists between increasing turnover and percentage of inputs purchased from the cooperative (.01 level, two tailed test). All color survey classes are likely to purchase most of their crop inputs / services from the cooperative;
- larger turnover members sell proportionally more of their hogs through the cooperative relative to lower turnover members; and
- large turnover members are more likely to purchase a majority of their animal feed from the cooperative relative to lower turnover members (gold and yellow).

Table 6.2q: Cross-tabulation: Effingham
Survey Color x Percent Grain Marketed Through the Cooperative

		Percent grain marketed through the cooperative								Total
		NA	0-15%	16-30%	31-45%	46-60%	61-75%	76-90%	91-100%	
Survey color	Blue (> $75,000)	6	20	1	0	0	0	1	1	29
	Gold ($25,000 to $75,000)	15	56	8	7	1	3	3	8	101
	Yellow (< $25,000)	22	74 (***29%***)	5	5	3	4	5	8	126
Total		**43**	**150**	**14**	**12**	**4**	**7**	**9**	**17**	**256**

Table 6.2r: Cross-tabulation: Effingham
Survey Color x Percent of Crop Inputs Purchased from the Cooperative

		Percent of crop inputs purchased from the cooperative								Total
		NA	0-15%	16-30%	31-45%	46-60%	61-75%	76-90%	91-100%	
Survey color	Blue (> $75,000)	0	0	0	3	2	3	3	18 (***62%***)	29
	Gold ($25,000 to $75,000)	0	4	2	6	11	11	28	40 (***40%***)	102
	Yellow (< $25,000)	6	16	15	12	10	7	23	37 (***30%***)	126
Total		**6**	**20**	**17**	**21**	**23**	**21**	**54**	**95**	**257**

Table 6.s: Cross-tabulation: Effingham
Survey Color x Percent of Hogs Marketed through the Cooperative

		Percent of hogs marketed through the cooperative				Total
		0-15%	46-60%	61-75%	91-100%	
Survey color	Blue (> $75,000)	1	0	0	3 (***75%***)	4
	Gold ($25,000 to $75,000)	22	0	1	5 (***18%***)	28
	Yellow (< $25,000)	24	1	0	6 (***19%***)	31
Total		**47**	**1**	**1**	**14**	**63**

Table 6.2t: Cross-tabulation: Effingham
Survey Color x Percent of Animal Feed Purchased from the Cooperative

		Percent of animal feed purchased from the cooperative							Total
		0-15%	16-30%	31-45%	46-60%	61-75%	76-90%	91-100%	
Survey color	Blue (> $75,000)	2	1	0	0	0	1	4 (***50%)***	8
	Gold ($25,000 to $75,000)	22	2	2	1	1	2	16 (***35%***)	46
	Yellow (< $25,000)	19	3	7	5	2	3	25 (***39%***)	64
Total		**43**	**6**	**9**	**6**	**3**	**6**	**45**	**118**

Lastly, Tables 62.u – v apparently indicate that the cooperative's stronger volume of growth opportunities lies with its grain customers over the next five years. A bivariate correlation indicates a positive, significant relationship at the .001 level (two tailed) between increasing turnover and estimated growth in grain production over the next five years. There is no such significant relationship between increasing turnover and estimated growth in livestock production. Whilst further focus on the grain inputs side of the cooperative would appear to be the natural business focus for the cooperative, ultimately its direction and effectiveness of the business will be heavily influenced by the investment preferences of its members. Conflict over this direction infers a loss of efficiency.

Table 6.2u: Cross-tabulation: Effingham
Blue and Gold Surveys x Estimated Livestock Production over the next Five Years

		Estimated livestock production over the next five years							Total
		Decrease	**Stay same**	**Incr. 1-10%**	**Incr. 11-20%**	**Incr. 21-30%**	**Incr. 31-40%**	**Incr. > 40%**	
Survey color	Blue (> $75,000)	0	5	2	1	1	0	0	9
	Gold ($25,000 to $75,000)	5	25	7	4	1	0	2	44
	Yellow (< $25,000)	17	29	13	4	0	2	6	71
Total		**22 (*18%*)**	**59 (*43%*)**	**22 (*18%*)**	**9 (*7%*)**	**2 (*2%*)**	**2 (*2%*)**	**8 (*6%*)**	**124**

Table 6.2v: Cross-tabulation: Effingham
Blue and Gold Surveys x Estimated Crop Production over the next Five Years

		Estimated crop production over the next five years							Total
		Dec.	**Stay same**	**Incr. 1-10%**	**Incr. 11-20%**	**Incr. 21-30%**	**Incr. 31-40%**	**Incr. > 40%**	
Survey color	Blue (> $75,000)	3	9	6	6	3	1	1	29
	Gold ($25,000 to $75,000)	5	36	23	20	10	3	2	99
	Yellow (< $25,000)	12	63	18	15	4	5	4	121
Total		**20 (*8%*)**	**108 (*43%*)**	**47 (*19%*)**	**41 (*16%*)**	**17 (*7%*)**	**9 (*4%*)**	**7 (*3%*)**	**249**

Conclusions

Size is unlikely to be a reasonable indicator of specialization. A new variable will be created from the percentage of farm revenue derived from grains or livestock feed. The estimated rate of growth for the next five years appears to be much the same as the last five years; therefore this variable is unlikely to provide much explanatory power with respect to testing the portfolio hypotheses. A more likely indicator may be the expected

change in farm revenue over the next years, as this may indicate changes in the degree of specialization.

Tests of the Lateral Portfolio Problem

Two survey questions pertain to the respondents' cooperative lateral investment preferences. Question four was a categorical question outlining four options. Option 4 A indicated a preference for provision of all services by the cooperative; option B indicated a preference for only services related to the respondent's farm production portfolio; Option C indicated a preference for no further required investment, and Option D indicated the respondent did not know how to answer the question. A LIKERT question was used to check the responses and gave respondents a seven-point scale to choose between A and B.

Table 6.2w indicates a very high valid response rate, so it appears that respondents were comfortable with the question as asked. There were nearly an even division between those favoring A and B, which combined accounted for 87% of responses.

Table 6.2w: Frequency Table: Effingham
Choice of Categorical Option Preference

		Frequency	Percent	Valid percent	Cumulative percent
Valid		6	2.2	2.2	2.2
	A: Generalized services	115	43.1	43.1	45.3
	B: Specialized services	118	44.2	44.2	89.5
	C: No further investment required	18	6.7	6.7	96.3
	D: Don't know	10	3.7	3.7	100.0
Total		**267**	**100.0**	**100.0**	

Table 6.2x also indicates a very high response rate for the LIKERT question. If Option A is represented by categories 1 and 2, then the response rate for this option is 30%; and if categories 6 and 7 represent Option B, then the response rate for this option is 25%. If a more liberal interpretation is used of categories 1 to 3 representing Option A and categories 5 to 7 representing Option B, then this variable's score may closely reflect question four's responses.

Table 6.2x: Frequency Table: Effingham
Choice of LIKERT Investment Option Preference

		Frequency	Percent	Valid percent	Cumulative percent
Valid	1: Generalized investment	35	13.1	13.4	13.4
	2	46	17.2	17.6	30.9
	3	24	9.0	9.2	40.1
	4	60	22.5	22.9	63.0
	5	31	11.6	11.8	74.8
	6	42	15.7	16.0	90.8
	7: Specialized investment	24	9.0	9.2	100.0
	Total	262	98.1	100.0	
Missing	System	5	1.9		
Total		**267**	**100.0**		

Table 6.2y indicates a fairly low degree of inconsistency, in that less than 10% of respondents choosing A in question four chose B in question 9 and visa versa. ***An improvement to the design of these questions to reduce the level of inconsistency will be discussed in the final chapter of this study.***

Table 6.2y: Cross-tabulation: Effingham
Choice of Categorical Option Preference x Choice of LIKERT Option Preference

		LIKERT Option preferences							Total
		1 and 2: Generalized option		3	4	5	6 and 7: Specialized option		
Categorical option preferences		1	1	0	1	0	0	0	3
	A: Generalized option	27	27	13	26	8	9	5	115
	B: Specialized option	4	11	10	26	20	28	18	117
	C: No further investment required	3	5	1	2	2	4	1	18
	D: Don't know	0	2	0	5	1	1	0	9
Total		**35**	**46**	**24**	**60**	**31**	**42**	**24**	**262**

Table 6.2z indicates that 89% of valid sample respondents' total farm revenue consists of a combination of livestock or grain production. Only 3% of valid sample respondents' farm revenue consisted of less than 85% of a combination of grain and livestock production. Therefore, it may be inferred that declining percentage of farm revenue from livestock production is offset by an increasing percentage of grain production.

Table 6.2z: Percent of Farm Revenue from a Combination of Grain and Livestock Production Effingham

	Missing	0 – 50%	51-89%	89-99%	100%	Total
Number	26	2	4	21	214	267
Percent valid samples	-	< 1%	2%	9%	88%	241

N: 241 valid samples

A new variable was created to measure grain and livestock producers' *degree* of specialization (Table 6.2aa).

Table 6.2aa: Percent of Farm Revenue from Livestock Production, 2004 (Valid Samples)
Effingham

	100% (Specialized livestock)	99-80%	79-60%	59-40%	39-20%	19-1%	0% (Specialized grain)	Total valid
Number	5	14	22	20	22	21	138	241
Percent	2%	6%	9%	8%	9%	9%	57%	

A linear OLS regression of this variable on the LIKERT variable indicates that this variable is significant, but the adjusted r square is .032, indicating that the model has little explanatory power.

Binomial regressions were carried out on the categorical variables 4A (generalized cooperative investment), 4B (specialized cooperative investment) and 4C (no further investment required). The results are presented in Tables 6.2ab-ac.

The results for the regression on 4A, indicate that respondents with high percentages of farm revenue from livestock production are more likely to prefer this investment option relative to other respondents. As the Hosmer and Lemshow test result is greater than .05, it can be inferred that the model adequately fits the data. Other variables, such as the Change in the Percentage of Farm Revenue from Livestock Production, Estimated Production Growth in Grain and the Change in the Rate of Growth and an interaction term for the degree of specialization and turnover were not significant.

Table 6.2ab: Binomial Regression: Standardized Variables
Dependent Variable: Categorical Option Preference A, Generalized Investment
Effingham

	B	S.E.	Wald	df	Sig.	Exp(B)	-Change in 2 Log likelihood
Percent of farm revenue from livestock production, 2004	.716	.149	22.982	1	.000	2.046	28.487
Constant	-.228	.139	2.680	1	.102	.796	

Nagelkerke r square: .146
Hosmer and Lemeshow test: .565
Overall percent correct: 56%
N: 267

The expected, opposite results were found for option 4B and these are presented in Table 6.2ac.

Table 6.2ac: Binomial Regression: Standardized Variables
Dependent Variable: Categorical Option Preference B, Specialized Investment
Effingham

	B	S.E.	Wald	df	Sig.	Exp(B)	-Change in 2 Log likelihood
Percent of farm revenue from livestock production, 2004	-.735	.164	20.066		.000	.480	25.190
Constant	-.214	.140	2.345	1	.126	.807	

Nagelkerke r square: .137
Hosmer and Lemeshow test: .679
Overall Percent correct: 63.2%
N: 267

Significant results could not be found for Option 4C, which is expected.

A further binomial regression of the Percentage of Farm Revenue from Livestock Production on the Dependent Variable Option B3, in which a person who chose Specialized Investment could indicate a preference for animal feeds, indicates that a person who chose Option B3 is no more statistically likely to choose animal feeds than a

person who chose Option A. This further supports the contention that predominately grain farmers were more likely to have chosen Option B.

Conclusion

Evidence of a binding lateral portfolio problem is not expected as Effingham has maintained separate patronage pools since the early 1990s. These unbundled price signals have presumably contributed to the cooperative investing in services that are more highly valued by members, relative to the common cooperative practice of operating bundled patronage pools. Whilst the cooperative has become focused on its grain inputs services over the past 15 years, its maintenance of an animal feed division does not appear to generate much dissention among respondents. Presumably, the animal feed section's turnover reflects the comparatively small number of respondents using the service.

Furthermore, reducing the sample to gold and blue survey respondents did not alter the results.

This infers that relatively little conflict is evident between predominantly specialized grain growers and livestock operators over the current direction of cooperative investment, which is presumably weighted towards grain services.

Tests of the Vertical Portfolio Problems

Hypothesis 2 states that 'Smaller, diversified, constrained commercial farmer members will prefer less investment in cooperative assets that underpin further specialization relative to larger, unconstrained specialized farmers'.

Hypothesis 3 states that 'Very small, specialized farmers will prefer investment in services that reduce the opportunity cost in pursuing off-farm returns**.'**

The response variables to test theses hypothesis are a LIKERT variable (Q26) which presents a continuum between competitively priced crop inputs (1) and a full range of crop input services (7) and categorical options (Q21) of a full range of timely input services (A), competitively priced inputs (B) and don't know (C). Frequency Tables for these options are presented in Tables 6.2ad-ae.

Table 6.2ad: Frequency Table: Effingham
Choice of LIKERT Option Investment Preference

		Frequency	**Percent**	**Valid percent**	**Cumulative percent**
Valid	1: Competitively priced inputs	53	19.9	21.0	21.0
	2	66	24.7	26.2	47.2
	3	29	10.9	11.5	58.7
	4	42	15.7	16.7	75.4
	5	23	8.6	9.1	84.5
	6	25	9.4	9.9	94.4
	7: Full range of crop input services	14	5.2	5.6	100.0
	Total	252	94.4	100.0	
Missing	System	15	5.6		
Total		**267**	**100.0**		

Table 6.2ae: Frequency Table: Effingham
Choice of LIKERT Option Investment Preference

		Frequency	Percent	Valid percent	Cumulative percent
Valid		12	4.5	4.5	4.5
	A: Full range of timely delivered crop input services	69	25.8	25.8	30.3
	B: Competitively priced inputs	171	64.0	64.0	94.4
	C: Don't know	15	5.6	5.6	100.0
Total		**267**	**100.0**	**100.0**	

Table 6.2af presents a Cross-tabulation of the two investment preference questions. If it is considered that the LIKERT choice 6 and 7 corresponds to categorical Option A and LIKERT choices of 1 and 2 correspond to categorical option B, then there appears to be a consistent response between those who opted for the investment option B. Greater inconsistency occurs between those who opted for A.

Table 6.2af: Cross-tabulation: Effingham
Choice of Categorical Option Preference x Choice of LIKERT Option Preference

		Choice of categorical option preference				
			A: Full range of timely delivered crop input services	B: Competitively priced inputs	C: Don't know	Total
Choice of LIKERT option preference	1: Competitively priced inputs	1	6	45	1	53
	2	0	7	57	2	66
	3	1	4	24	0	29
	4	2	12	21	7	42
	5	0	15	7	1	23
	6	0	16	8	1	25
	7: Full range of crop input services	0	8	6	0	14
Total		**4**	**68**	**168**	**12**	**252**

A binomial model was constructed for the category option B, the option for competitively priced inputs. A variable denoting respondents with 100% of farm income from grain was included as an independent variable. The results are presented in Table 6.2ag. The model suggests that those who prefer option B are significantly more likely to be larger size, specialized and not constrained by falling commodity prices. Further, there is weaker statistical evidence that they have relatively large patronage with the cooperative. The model fits well, and there is a reasonable degree of explanatory power.

Table 6.2ag: Binomial Regression: Standardized Variables
Dependent Variable: Categorical Option Preference B,
Competitively Price Crop Inputs
Effingham

	B	S.E.	Wald	df	Sig.	Exp(B)	Change in -2 Log likelihood
Specialized grain farmers	.609	.315	3.739	1	.053	1.838	3.836
Size of crop operation	.841	.196	18.373	1	.000	2.319	21.506
Falling commodity prices constraint on production	-.757	.337	5.054	1	.025	.469	5.313
Blue surveys (> $75,000 turnover)	.922	.553	2.777	1	.096	2.515	2.703
Constant	.279	.563	.246	1	.620	1.322	

Nagelkerke r square: .162
Hosmer and Lemeshow test: .643
Percentage correct: 71%
N: 267

Table 6.2ah: Binomial Regression: Standardized Variables
Dependent Variable: Categorical Option Preference A, Full Range of Crop Services
Effingham

	B	S.E.	Wald	df	Sig.	Exp(B)	Change in -2 Log likelihood
Size of crop operation	-.792	.210	14.182	1	.000	.453	14.182
Falling commodity prices constraint on production	.646	.354	3.319	1	.068	1.907	3.319
Change in the rate of grain production in 2004-09 compared to 1999-04	.306	.162	3.594	1	.058	1.358	3.594
Blue surveys (> $75,000 turnover)	-1.199	.577	4.324	1	.038	.301	4.324
Limited time availability constraint on production	-.941	.387	5.898	1	.015	.390	5.898
Constant	.337	.645	.273	1	.601	1.401	

Nagelkerke r square: .182
Hosmer and Lemeshow test: .905
Percentage correct: 75%
N: 267

A binomial model was constructed for categorical option A. The results are presented in Table 6.2ah. The model suggests that those who prefer option A are significantly more likely to be smaller size farmers, not the largest turnover category for whom time is not a constraint on production. There is weaker statistical evidence that they are seeking to increase their rate of growth over the next five years, compared to the last five years and they perceive their production growth is likely to be constrained by falling commodity prices.

This is an interesting model as it would be expected that these farmers would be more likely to be constrained by time rather than falling commodity prices. It would seem that these farmers find it more cost effective to use the cooperative to apply crop applicants as

they presumably do not have the equipment for themselves. If they are successful in their growth strategy, then in time they may become less reliant on the cooperative for services as presumably they will be able to justify the costs of application equipment for their own operations.

A linear OLS model was constructed for the LIKERT variable. Size was also significant in this model. The sign on the Falling Commodity prices constraint is contradictory to the above model, but as the adjusted r square is very low, it would appear the inconsistent answers noted in the Cross-tabulation (Table 6.2ai) has introduced a deal of statistical noise to the dependent variable.

Table 6.2ai: Linear Regression: Standardized Variables
Dependent Variable: LIKERT Vertical Investment Preference Options
Effingham

	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. error	Beta		
(Constant)	-.004	.061		-.066	.948
Size of crop operation	-.196	.062	-.197	-3.174	.002
Falling commodity prices constraint on production	-.126	.061	-.127	-2.049	.042

Adjusted r square: .045

Conclusion

The above tests do not support the hypotheses as they currently stand. It is not possible to test hypothesis 2 because of the very small sub group pertaining to this hypothesis. It appears that Hypothesis 3 should be restated to take account of the larger than average size respondents. This would be consistent with the framework developed by this study.

The final chapter will discuss improvements that could be to the hypotheses, such as modified conditional statements. Further the methodological issue will be addressed as to how to better select a more appropriate cooperative to test the hypotheses and how to improve the survey design to do it.

3. North East Missouri Grain Processors (NMGP/NEMO)

i) Data Set Descriptions and Simple Analysis Based On Some Likely Growth Related Variables

A total of 96 responses were received from this survey, which represents around 30% of NEMO's membership of approximately 310. Tables 6.1a-c outline some key average statistics from the sample and Missouri comparisons. It indicates that the sample average age range is reflective of the industry; that although the sample average size is larger than the industry average, nearly half of the respondents were in the 100-500 acre range; and that respondents have experienced approximately the same average production growth as the industry average over the past five years.

Table 6.3a: Selected NEMO Sample and Missouri *Averages*

Sample age range	Industry average age (2003)[A]	Sample size acres	Industry average size acres[B]	Sample size Bu
50-51	54.7	509	279	89,000

a and b: Missouri Agricultural Statistics Service (2003/05)[16]

Table 6.3b: Selected NEMO Sample and Missouri *Averages*

Sample production growth – last five years	Industry average production growth – last five years	Sample estimated production growth – next five years
1-10%	8%[c]	1-10%

c: Missouri Agricultural Statistics Service (2003/05)

[16] http://agebb.missouri.edu/mass/agrifact/state/

Table 6.3c: Frequency of Size of Corn Operation in Acres: NEMO

		Frequency	Percent	Valid percent	Cumulative percent
Valid	< 100	12	12.5	13.2	13.2
	100 - 499	43	44.8	47.3	60.4
	500 - 999	24	25.0	26.4	86.8
	1000 - 1499	7	7.3	7.7	94.5
	1500 - 1999	1	1.0	1.1	95.6
	2000+	4	4.2	4.4	100.0
	Total	91	94.8	100.0	
Missing	System	5	5.2		
Total		**96**	**100.0**		

Table 6.3d indicates that the largest group of members is between 41 and 70 miles from the plant. Roughly one quarter of the respondents are members of the 'between 20 and 40 miles' and 'more than 70 miles from the plant' groups.

Table 6.3d: Frequency Table
Distance of Farm from NEMO Plant (Q6)

		Frequency	Percent	Valid percent	Cumulative percent
Valid	< 20 miles	6	6.3	6.4	6.4
	20-40 miles	23	24.0	24.5	30.9
	41-70 miles	40	41.7	42.6	73.4
	> 70 miles	25	26.0	26.6	100.0
	Total	94	97.9	100.0	
Missing	System	2	2.1		
Total		**96**	**100.0**		

Bivariate correlations indicate that there is not a significant relationship between distance from plant and the amount of share corn delivered. However, there is a strong negative correlation between distance from plant and overall delivery of corn to the NEMO plant ($r = -.392$, $p < .001$).

Table 6.3e indicates that a small sub section of smaller growers estimate relatively high growth over the next five years.

Table 6.3e: Cross-tabulation: NEMO
Size of Corn Operation (Acres) x Estimated Crop Production Growth 2004-09

		Estimated crop production growth 2004-09							Total
		Decrease	**Stay same**	**Incr. 1-10%**	**Incr. 11-20%**	**Incr. 21-30%**	**Incr. 31-40%**	**Incr. > 40%**	
Size of corn operation (acres)	< 100	4	3	4	1	0	0	0	12
	100-499	4	18	13	6	1	1	0	43
	500-999	1	3	10	5	4	0	1	24
	1000-1499	0	3	2	1	0	1	0	7
	1500-1999	0	1	0	0	0	0	0	1
	2000+	0	1	2	1	0	0	0	4
Total		**9**	**29**	**31**	**14**	**5**	**2**	**1**	**91**

$r = .220$, $p < .05$ level

Table 6.3f indicates that 14 respondents (14.5%) estimate that their comparative growth will increase over the next five years (***italics and bold).*** Forty-four respondents indicated that their comparative growth will decline over the next five years **(underline and bold)**.

Table 6.3f: Cross-tabulation: NEMO
Estimated Crop Production Growth 2004-09x Crop Production Growth 1999-2004

		Crop production growth 1999-2004							Total
		Decrease	**Stayed same**	**Incr. 1-10%**	**Incr. 11-20%**	**Incr. 21-30%**	**Incr. 31-40%**	**Incr. > 40%**	
Estimated crop production growth 2004-09	Decrease	2	**4**	**1**	**1**	**0**	**0**	**1**	9
	Stay same	3	13	**5**	**1**	**5**	**1**	**2**	30
	Increase 1-10%	***0***	***6***	9	**9**	**4**	**1**	**2**	31
	Increase 11-20%	***0***	***2***	***3***	4	**2**	**0**	**3**	14
	Increase 21-30%	***0***	***0***	***2***	***0***	0	**2**	**1**	5
	Increase 31-40%	***1***	***0***	***0***	***1***	***0***	0	**0**	2
	Increase > 40%	***0***	***1***	***0***	***0***	***0***	***0***	0	1
Total		**6**	**26**	**20**	**16**	**11**	**4**	**9**	**92**

Bivariate correlations indicate a negative association between the percentage of household income derived from non farm sources and size ($r = -.316$, $p < .01$), and productivity ($r = .224$, $p < .05$). The percentage of household income is also negatively associated with estimated growth over the next five years ($r = -.213$, $p < .05$).

Table 6.3k indicates that the most binding constraints upon growth appear to be rising land costs and rising input costs. Rising land costs and limited time appear to be the factors that most respondents indicate are likely to increase as constraints. Water cost / availability is the constraint most likely to ease over the next five years.

Table 6.3g: Percentage of NEMO Respondents Identification of Severe Constraint on Production Growth

	Past five years (% of 193)	Next five years (% of 226)
1. Lack of suitable off-farm employment opportunities	1 (< 1%)	1 (< 1%)
2. Cost of supporting family	1 (< 1%)	4 (2%)
3. Capacity to service more debt	11 (5%)	4 (2%)
4. Management capacity	9 (4%)	6 (3%)
Falling corn prices	21 (11%)	23 (10%)
Rising share corn prices	3 (2%)	1 (< 1%)
The complexity of nemo investments	- (0)	1 (< 1%)
Better rate of return from producing an alternative commodity	18 (10%)	13 (6%)
Environmental concerns/ regulation	1 (< 1%)	7 (3%)
Urban encroachment / subdivision pressures	3 (2%)	3 (1%)
Rising input costs	42 (22%)	48 (21%)
Land cost or availability	57 (30%)	58 (26%)
Limited time	4 (2%)	14 (6%)
Water costs or availability	17 (9%)	5 (2%)
Labor costs or availability	15 (8%)	21 (9%)
Impending retirement		18 (8%)
Total	**193**	**226**

Bivariate correlations indicate that size and the production constraint of land cost are not correlated; that size and rising input costs are negatively correlated ($r = -.231$, $p < .05$) possibly reflecting scale economies; that size and productivity are positively related indicating gains from better management ($r = .338$, $p < .01$); and that size and expected growth are positively correlated ($r = .220$, $P < .05$).

ii) Models of Growth

Using the framework developed earlier in section 1 (Fonterra sample) of this chapter, the following linear models of growth were constructed. They consist of the dependent variable of expected production growth over the next five years and the

independent variables of size, age, succession planning, years to relinquishing control over the farm, ownership structure, the proportion of household income from off farm sources, share collateralization, cooperative investment preferences and distance from the plant and constraints. All variables are standardized.

A PLS regression model (Table 6.3h) indicates that growth is significantly correlated with decreasing proportions of household income from off farm sources, an increase in the estimated percentage of farm revenue from corn production over the next five years, cash renting and size.

Table 6.3h: Co-efficient Summary (including interaction effects) of PLS Regression Model of Growth within NEMO Sample: Standardized Variables Dependent Variable: Estimated Growth Over the next five years

Proportion of household income from off farm sources	-0.153
Percentage change in expected farm revenue from corn over the next five years	0.218
Cash renter	0.194
Size (Bu)	0.148

Explained variance: .21
N: 96

This result was checked with an OLS model, which identified fewer significant variables and a lower adjusted r square.

Table 6.3i: Co-efficient Summary of Initial OLS Regression Model of Growth of NEMO Sample: Standardized Variables Dependent Variable: Estimated Crop Production over the Next Five Years

	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. error	Beta		
(Constant)	.183	.104		1.753	.084
Cash rent	.245	.100	.263	2.448	.017
Change in farm revenue from corn 2004-09	.335	.107	.339	3.126	.003
Cash rent x change in farm revenue from corn 2004-099	-.176	.102	-.186	-1.716	.091

Adjusted r square: .146
N: 96

It would appear that larger respondents and those cash renting may be swapping production into corn from other production, as farm revenue from corn is expected to rise over the next five years. The plant's very high ROI and its lifting of the local basis may be plausible explanations for this. This would indicate that the cooperative does not face a lateral portfolio constraint.

However, it may indicate a vertical portfolio problem if those unable to expand production relatively quickly would prefer cooperative investment to increase returns on existing corn volumes put through the plant. However, the survey did not ask whether respondents intended to increase the volume of their corn that they deliver to NEMO over the next five years.

PLS models of the percentage of corn production delivered to NEMO to fulfill *share corn requirements* and the percentage of overall *corn production delivered* to NEMO are presented below (Tables 6.3j-k). Table 6.3j suggests that members who supply NEMO with larger proportions of their grain are those with high proportions of income from off

farm sources, those indicating a binding constraint on production from rising input costs, those of small size and unlikely to cash rent. OLS modeling confirmed these results.

Table 6.3j: Co-efficient Summary (including interaction effects) of PLS Regression of NEMO Sample: Standardized Variables Dependent Variable: Percent of Corn Production Delivered to Fulfill Share Corn Requirements

Proportion of household income from off farm sources	0.293
Cash renter	-0.123
Rising input costs	0.101
Size of corn operation	0.-929

Explained variance: .38
N: 96

Note that both Tables j and k indicate that those with a higher proportion of household income from off farm sources are significantly positive variable and, therefore as expected, negatively correlated with size of corn operation. Interestingly, there appears to be a geographical difference between the tables, which may be explained by the lower opportunity costs that those closest to the plant face when supplying it with corn that is in addition to their share corn requirements. This may suggest a portfolio problem with a geographical dimension.

Table 6.3k: Co-efficient Summary (including interaction effects) of PLS Regression of NEMO Sample: Standardized Variables Dependent Variable: Percent of Corn Production Delivered to NEMO from all Sources

Proportion of household income from off farm sources	0.249
21-40 miles from the plant	0.197
More than 70 miles from the plant	-0.177
Size of corn operation	-0.224

Explained variance: .33
N: 96

Tests of Portfolio Constraint Hypothesis

Three questions were originally asked to test for the vertical portfolio constraint. These were changed as cooperative decision makers felt the questions may have been divisive; consequently the questions asked whether the membership would prefer further investment into new technology to increase returns on existing share corn, unspecified further investment or no further investment. Thus it is not possible to directly test for the vertical portfolio problem.

Table 6.3m, is a frequency table on question 7 in which respondents were asked to indicate whether they prefer no further, or further cooperative investment in NEMO. *This question did not indicate the type of investment the cooperative may make; it merely asked whether respondents would be in favor of investment.* A high LIKERT score indicated the respondent preferred further cooperative investment in NEMO. It indicates that a majority of respondents preferred further cooperative investment.

Table 6.3m: Frequency Table: NEMO LIKERT Investment Option (Q7)

		Frequency	Percent	Valid percent	Cumulative percent
Valid	1: No further investment	5	5.2	5.4	5.4
	2	6	6.3	6.5	11.8
	3	3	3.1	3.2	15.1
	4	11	11.5	11.8	26.9
	5	16	16.7	17.2	44.1
	6	28	29.2	30.1	74.2
	7: Further investment	24	25.0	25.8	100.0
	Total	93	96.9	100.0	
Missing	System	3	3.1		
Total		**96**	**100.0**		

Table 6.3n presents the results of a PLS regression on this LIKERT question. It indicates that younger members, those with a slowing rate of growth over the next five years compared to the last five years, and those facing a labor constraint to their production growth significantly preferred further investment.

Table 6.3n: Co-efficient Summary (including interaction effects) of PLS Regression: Standardized Variables Dependent Variable: Further Investment in NEMO (Q7)

Change in the rate of growth	-0.193
Age	-0.165
Labor constraint	0.130

Explained variance: .12
N: 96

Table 6.3o presents the frequency table of responses to Q26 in which respondents were offered three categorical options. A is the option for investment into new technology, B is the option for no further investment and C is don't know. Seventy-nine percent of respondents indicated that they preferred new technology investment to the other options.

Table 6.3o: Frequency Table: NEMO Categorical Investment Option (Q26)

		Frequency	Percent	Valid percent	Cumulative percent
Valid		2	2.1	2.1	2.1
	A: Investment in new technology to lift returns on existing share corn	76	79.2	79.2	81.3
	B: No further investment required	3	3.1	3.1	84.4
	C: Don't know	15	15.6	15.6	100.0
Total		**96**	**100.0**	**100.0**	

Table 6.3p is a frequency table on the LIKERT question in which respondents were asked to agree or disagree with the statement "I prefer the cooperative's investment in NEMO be in New Technology which could increase my existing share corn returns."

Table 6.3p: Frequency Table: NEMO
LIKERT Scale: Investment in New Technology to Lift Returns on Existing Share Corn

		Frequency	Percent	Valid percent	Cumulative percent
Valid	1: Strongly agree	24	25.0	26.1	26.1
	2	25	26.0	27.2	53.3
	3	8	8.3	8.7	62.0
	4	12	12.5	13.0	75.0
	5	8	8.3	8.7	83.7
	6	9	9.4	9.8	93.5
	7: Strongly disagree	6	6.3	6.5	100.0
	Total	92	95.8	100.0	
Missing	System	4	4.2		
Total		**96**	**100.0**		

These questions are slightly different, which may explain the apparent difference in answers received for categorical responses in Table 6.3o and the LIKERT responses in Table 6.3p. Both indicate, however, that a large majority of respondents preferred that the cooperative's investment in NEMO be in new technology that would increase the returns on existing share corn. This analysis will utilize the LIKERT scales as there is little variability in the categorical answers.

Table 6.3q presents the results of a PLS regression on the LIKERT question on whether to invest in new technology to lift returns on existing share corn; a high LIKERT score indicates that the respondent did *not* prefer investment in new technology.

Table 6.3q: Co-efficient Summary (including interaction effects) of PLS Regression: Standardized Variables Dependent Variable: Cooperative Investment in NEMO Should be in New Technology

Estimated farm revenue from corn production 1999 - 2004	-0.250
More than 70 miles from the plant	-0.244

Explained variance: .15
N: 96

The model suggests that those respondents with a high estimated percentage of their farm revenue from corn in 2009 and those more than 70 miles from the plant preferred the cooperative's investment in NEMO to be in new investment that lifted the return on existing share corn. Those 70 miles or more from the plant presumably face higher transport / logistical costs in supplying NEMO relative to those closer to the plant.

Conclusion

That cooperative decision leaders did not want a question to test for the existence of a vertical portfolio problem suggests that one exists. The finding that those 70 miles or more from the plant are negatively correlated with delivering corn to it as well as significantly preferring investment in new technology could suggest that conflict may be centered on distance, as those further from the plant have larger transaction costs in supplying corn. Conversely, those respondents within the 20-40 mile distance from the plant are significantly more likely to deliver more of their corn for the plant's overall corn requirement. Investment into new technology to lift the return on their existing share corn would appear to be a less attractive proposition for those members closer to the plant that presumably are better able to put more of their existing corn through the plant as non share corn. Both groups constituted large proportions of the sample and are similar in size, inferring fairly equal political strength within the organization.

Table 6.3n may also indicate that a vertical portfolio problem may also exist in relation to estimated growth. However, this cannot be assessed due to the absence of a direct question better differentiating vertical investment preferences.

CHAPTER SEVEN

Summary and Possible Implications

1. Introduction

This chapter summarizes and contextualizes the study's empirical results and considers their implications, methodological issues to do with sample selection and survey design and recommendations for further study.

2. Contextualized Empirical Results and Consequent Implications for Sample Selection and Hypotheses

This subsection examines generic property rights ameliorations suggested by Cook and Iliopoulos (1998) and specific property rights ameliorations pertinent to each of the samples. It also considers pertinent wider industry conditions that may also ameliorate, or exacerbate the traditional cooperative structure's portfolio problems hypothesized by this study's framework. This contextualization will assist in drawing conclusions as to the importance of the empirical results.

North East Missouri Grain Processors (NMGP/NEMO)

NEMO has adopted a New Generation cooperative (NGC) structure. The NGC is generally characterized by:

- transferable equity shares tied to input supply volume. This implies a liquid secondary market for shares;

- appreciable equity shares tied to supply volume. That is, the discounted flow of future profits can be priced into the value of the share in the secondary market;
- a defined membership. This implies the cooperative can control supply. It also implies that rent dissipation from free riding new entrants arising in an open member cooperative does not occur;
- legally binding delivery contracts. That is, the cooperative assures continuity of supply and quality and discourages opportunistic behavior by members;
- and minimum up-front equity investment. This implies the members with similar risk profiles self select into the cooperative and that a hostage asset is created with discourages opportunistic behavior by members.

Tong (1996) found that these characteristics establish a cooperative property rights structure that provides members with investment incentives relative to the traditional cooperative property rights structure.

Cook and Iliopoulos (1998) list the NGC characteristics of single commodity focus, hedging, transferable delivery rights and appreciable delivery rights as innovations designed to ameliorate the Portfolio problem.

Single commodity focus, common to many marketing cooperatives, removes the need for internal reallocation of members' cooperative investment to better reflect members' on-farm portfolios. That is, a single commodity focus avoids the type of lateral portfolio problem hypothesized to exist within the traditionally structured multi purpose cooperative. It also lowers the risk from cooperative failure if members are diversified

farmers. Hedging lowers the risk borne by member investors and thus lower differences in risk assessment by members when considering new cooperative investment. Appreciable delivery rights infer members are able to better judge the risk and return payoff when assessing potential cooperative investment. Transferable delivery rights infer members have a mechanism to adjust their cooperative investment to reflect their risk preferences. Furthermore, the high relative ROI from the NEMO ethanol plant suggests that the cooperative should be unconstrained in sourcing additional member investment.

These generic solutions and industry conditions suggest that a portfolio problem *should not* pertain to NEMO. However, this study's framework suggests that portfolio problem has at *least* lateral and vertical dimensions. Consequently the generic solutions proposed by Cook and Iliopoulos (1998) may not address the vertical portfolio problem. Using the framework developed in chapter three, it was hypothesized in chapter four that two potential variants of the portfolio problem may pertain to marketing cooperatives such as NEMO. These are:

- Operational Hypothesis 1: The Vertical Portfolio Problem in Marketing Cooperative (H1). It states that smaller members who are relatively more constrained in expanding their farm operation will prefer investment in cooperative investor assets (for offensive purposes) that provide higher cooperative returns relative to larger members who are relatively less constrained from expanding on-farm who will prefer investment into cooperative user assets (for defensive purposes) that provide higher on-farm returns.

- Operational Hypothesis 5: Members altering their on-farm production portfolio, so as to reduce the volume marketed by the cooperative, will prefer not to invest any further capital in the cooperative.

Results

Vertical Portfolio Problem In Marketing Cooperatives: H1

Empirical evidence suggests the existence of a vertical portfolio problem within the NEMO's cooperative's membership, as the cooperative's decision makers decided to eliminate the question testing for the problem.

The statistical modeling of the available data suggests that those further from the plant are more likely to prefer higher value added investment relative to those closer to the plant. This infers that a vertical portfolio problem in NEMO has manifested itself in a geographical dimension. Those members who are more than 70 miles from the plant are comparatively constrained in supplying the cooperative with corn above that required to fulfill their share corn requirements. *The key cause remains the bundling of investment* so that investment decisions are 'locked in' and so that members consequently cannot adjust their level of investment in a manner that maximizes their returns. The NGC structure does not solve for vertical bundling of investment.

Therefore H1 is supported within the NEMO sample set. However, this finding implies that the hypothesis constructed for the traditional cooperative structure should be modified to encompass a wider range of cooperative structures, such as an NGC, by removing its reference to scale as the key insight is the relative degree of constraint experienced by sub groups of members. In this case, the relative constraint is geography.

Modifying the hypothesis by removing the reference to size is consistent with the Opportunity Cost of Capital framework developed in this study.

A appropriate modification to H1 is: members who are relatively more constrained in expanding their farm operation will prefer investment in cooperative investor assets (for offensive purposes) that provide higher cooperative returns relative to members who are relatively less constrained from expanding on-farm who will prefer investment into cooperative user assets (for defensive purposes) that provide higher on-farm returns. That is, reference to size is excluded from the modified hypothesis.

Lateral Portfolio Problem in Marketing Cooperatives: H5

The very high ROI from ethanol production has resulted in a strong overall member preference for further cooperative investment in NEMO. Therefore, no evidence is found for the existence of a lateral portfolio problem within NEMO's membership, which is also consistent with the Opportunity Cost of Capital framework developed in this study.

Fonterra

Fonterra retains the traditional marketing cooperative structures of:

- Open membership. This implies that it has little control over supply volumes;
- Non transferable shares. All shares are redeemed by the cooperative implying that its capital base may be largely non permanent. More importantly, from the member's perspective, members are unable to allocate their exposure to risk from further *vertical* investment according to their preferences. This problem stems from the bundling of all investment into a single class of share.

Like NEMO, Fonterra is a single commodity marketing cooperative, and as such avoids the type of lateral portfolio problem hypothesized to exist within the traditionally structured multi purpose cooperative. Cook and Iliopoulos (1998) list two generic set of solutions to property rights constraints in traditionally structured marketing cooperatives. These are Innovative Equity Capital Acquisition Techniques which refer to financial strategies to provide the cooperative with risk capital and Risk/Measurement Transparency which are organizational innovations that permit members to better assess and adjust their risk exposure.

Fonterra's innovative equity capital acquisition techniques centers on the Fair Value Share system. Shares are *fully* redeemable upon exit, which solves for the lack of transferability and a system of 'market' valuation of shares which solves for the lack of appreciablity. Additionally, it has negotiated collateralization of shares with the financial community. The cooperative also engages in extensive commodity and currency hedging and has formed numerous joint ventures with overseas partners in order to create distribution networks and spread risk.

The NZ dairy industry's current production slowdown, associated with decreased margins as a result of rapidly rising land prices and recent falling payouts also suggest that members will tend to prefer value added investment over commodity investment as a means to lift returns.

Fonterra has not implemented extensive Risk/Measurement Transparency innovations, such as establishing separate capital pools for value added and ingredients investments and issuing stock attached to each of these. Indeed, Fonterra's balance

sheets are currently consolidated across value added and ingredients divisions and the divisions are central managed. This issue will be returned to shortly.

Fonterra's FVS system and its current industry conditions suggest an amelioration of the vertical portfolio problem, at least in the short term. On the other hand, its lack of extensive Risk/Measurement Transperency innovations suggests that a vertical portfolio problem may be binding on the cooperative, particularly in the medium term.

Furthermore, the ability of members to fully redeem their appreciating FVS infers that the cooperative may face a binding lateral portfolio problem if returns from other commodities become relatively attractive.

Results

Vertical Portfolio Problem in Marketing Cooperatives: H1

A binomial regression of the 6.5% of respondents preferring the categorical ingredients investment option (Chapter 6, Table 6.1 p) indicates that, relative to the 93.5% of respondents who did not prefer ingredients investment, they have relatively high growth expectations over the next five years (Nagelkerke r square: .168). This indicates a binding vertical portfolio constraint exists, at least within this small group.

Within the sub group identifying themselves as increasing their *rate* of estimated rate of production growth over the next five years, compared to their rate of production growth over the past five years, a PLS linear regression on the LIKERT dependent variable for investment preferences indicate a positive relationship between ingredients investment preference and size (Plot 6.1a and Table 61.s), although the ownership

variable of manager equity (+) and herd costs (-) also contributed to the explained variance of 15%. These results were confirmed by an OLS regression.

These results lend support to the proposition that a binding vertical portfolio constraint exists, at least within this small group. ***These results strongly infer that the problem may be far more binding in a traditionally structured cooperative with extensive value adding activities.*** These statistical findings also imply that the hypothesis constructed for the traditional cooperative structure should be modified to encompass a wider range of cooperative structures, such as Fonterra, by removing its reference to scale, as the key insight is the relative degree of production constraint experienced by sub groups of members. Modifying the hypothesis by removing the reference to size is consistent with the Opportunity Cost of Capital framework developed in this study.

An appropriate modification to H1 is: members who are relatively more constrained in expanding their farm operation will prefer investment in cooperative investor assets (for offensive purposes) that provide higher cooperative returns relative to members who are relatively less constrained from expanding on-farm who will prefer investment into cooperative user assets (for defensive purposes) that provide higher on-farm returns. That is, reference to size is excluded.

The case study also indicates that Fonterra provides evidence of the existence of a (potential) vertical portfolio problem as it actively supported the financial community's collateralization of its FVS.

Further, it recently announced Risk/Measurement Transparency structural innovations. Firstly, the cooperative announced in February, 2005 that in the coming year *(check)* it would separate its operational divisions into ingredients and value added, with further contemplation to be given at a later date of possible separate capital pools for these divisions. It has also announced the introduction of milk contracts that do not require members to hold FVS in proportion to the volume of milk under contract, thus lowering the opportunity cost for members preferring a high growth strategy.

H1 is therefore supported within the Fonterra sample set.

Although the vertical portfolio problem pertains to a small subset of respondents its practical effect may be much larger in the medium term. Although Fonterra appears to have solved for the vertical portfolio problem for most of those hypothesized to be effected in the short term, it may have exacerbated the problem in the medium term. Unlocking the 'market' value of the cooperative, and fully and immediately redeeming its shares upon exit creates an incentive for members to exit the cooperative and join/establish other low cost, commodity focused cooperatives. This is evidenced by the recent case of several members cashing in their Fonterra shares to expand on-farm and joining the rival Westland cooperative. In April, 2005, Fonterra's largest dairy farm announced that it would leave Fonterra in 2006 and use the proceeds from redeeming its shares to establish its own milk processor.

That is, Fonterra's short run solution to the vertical portfolio problem may have lowered the opportunity cost of dairy farming for farmers able to collateralize their shares, but it has increased the opportunity cost of remaining part of Fonterra.

Lateral Portfolio Problem in Marketing Cooperatives: H5

Fonterra's unlocking of its 'market' value and its full redeemability of shares upon exit implies that the lateral portfolio hypothesis, constructed for a traditional cooperative structure, should be modified for the Fonterra case. This is it can be inferred that it would be rational for members diversifying their on-farm production to prefer higher share values to underpin their diversification. However, statistical evidence to analyze the hypothesis could not be found.

H5 is not supported within the Fonterra sample. Better measurement of the relevant constraint variables may provide insight into whether this hypothesis pertains to Fonterra. Non agricultural land uses may provide a greater challenge to milk production than alternative commodity production. A survey question to ascertain whether respondents plan to change the production mix of their farms as well as their revenue mix would also assist in measuring any potential lateral problem.

Effingham Equity

Lateral portfolio Problem in Multi-Purpose Cooperatives: H4

Effingham Equity is a traditionally structured cooperative. However, it is far less 'multi-purpose' than most comparable input cooperatives as it has increasingly focused on the provision of crop inputs since the early 1990's. This may be loosely thought of falling within the Risk/Measurement Transparency generic solution proposed by Cook and Iliopoulos (1998) as an increasingly single focus progressively reduces the scope for a lateral type problem hypothesized to exist for traditionally structured cooperatives. That is, this cooperative has become increasingly similar to the single commodity marketing cooperative in that the development of a more focused business progressively

reduces the need for internal reallocation of members' cooperative investment to better reflect members' on-farm portfolios by default.

As would be expected, therefore, strong statistical evidence of a binding lateral portfolio problem does not exist. However, the binomial regressions on the Q4 categorical investment options, in which respondents were ask whether they preferred generalized or specialized cooperative investment indicated that the problem does exist in (see Tables 6ab-ac). The Nagelkerke r square for these models were .137 and .146 respectively.

Therefore, Operational Hypothesis 4, that 'less diversified members will prefer cooperative investment into assets that reflect their specialization, while more diversified members will prefer a wider range of cooperative investment that reflects their enterprise diversification' is supported.

Vertical Portfolio Problem in Multi-Purpose Cooperatives: H2 and H3

Hypothesis 2 states that 'smaller, diversified, constrained commercial farmer members will prefer less investment in cooperative assets that underpin further specialization relative to larger, unconstrained specialized farmers.'

This hypothesis was constructed for a multi-purpose, traditional cooperative. Although Effingham is traditionally structured, its focus on crop inputs infers that it will attract larger than average farmers relative to larger and medium size farmers, relative to the counties surrounding Effingham. Smaller, constrained diversified farmers are most likely under represented in this sample. The medium size farmers appear to be somewhat diversified but are apparently unconstrained as the empirical evidence indicates that they

plan to grow over the next five years and therefore are likely to attain *further specialization and prefer cooperative investment to underpin this strategy.* The very largest farmers are already highly specialized, are able to justify the cost of equipment that underpins their existing specialization and therefore *are likely to have no need of further cooperative investment in specialized equipment.*

The statistical evidence from Tables 6.3ag-ah imply that the hypothesis constructed for the traditional cooperative structure / strategy should be modified to encompass a wider range of cooperative strategies, such as Effingham's focused strategy on crop inputs, by changing the conditional statement to reflect the ability of members to internalize the costs of their growth / specialization strategy. This hypothesis would also be more robust with respect to different production regimes within varying locations within an industry and across industries. That is, the expected cost of a lack of timely crop input services to members may be different in Illinois relative to the Dakotas, implying a different scale of operation to justify internalizing the cost of farmer owned crop applicators. Modifying the hypothesis in this manner is consistent with the Opportunity Cost of Capital framework developed in this study.

An appropriate modification to H2 is: 'smaller unconstrained commercial farmer members, who are probably relatively diversified, and seeking further growth and specialization will prefer more investment in cooperative assets compared to unconstrained, larger, probably relatively specialized farmers able to internalize the costs of specialized equipment.'

Hypothesis 3 states that ‘very small, specialized farmers will prefer investment in services that reduce the opportunity cost in pursuing off-farm returns**.**’ This hypothesis is unable to be tested because of the very small numbers of respondents fitting this category.

Table 7.1a summarizes the empirical evidence, the implications for the sample and Hypotheses and appropriate modifications to the hypotheses proposed in Chapter 3.

Table 7.1: A Summary of Hypotheses Related to the Portfolio Investment Constraint, Implications and Suggested Modifications

Hypothesis	Description	Empirical results	Sample and hypothesis implications	Hypothesis modification
General hypothesis	Pooling of cooperative returns across market segments creates an incentive for members to over produce as the average value of returns exceeds the marginal value from the least returning market.	Not tested for in this study.		
Operational Hypothesis 1: The Vertical Portfolio Problem in Marketing Cooperatives H1	Smaller members who are relatively more constrained in expanding their farm operation will prefer investment in cooperative investor assets (for offensive purposes) that provide higher cooperative returns relative to larger members who are relatively less constrained from expanding on-farm who will prefer investment into cooperative user assets (for defensive purposes) that provide higher on-farm returns.	Statistical evidence supports the existence of H1 within a subgroup of Fonterra members with accelerating growth and NEMO members of differing distance from the plant. Heavily supported by Fonterra and NEMO case study evidence. The results are consistent with overall framework.	Hypothesis should be modified to de-emphasis scale and emphasis members changing rate of growth as this is a better indicator of respondents' opportunity cost of capital. Evidence of a vertical portfolio problem on a wider member segment is expected within a cooperative with a traditional property rights structure and higher industry growth.	Members who are relatively more constrained in expanding their farm operation will prefer investment in cooperative investor assets (for offensive purposes) that provide higher cooperative returns relative to members who are relatively less constrained from expanding on-farm who will prefer investment into cooperative user assets (for defensive purposes) that provide higher on-farm returns.

Hypothesis	Description	Empirical results	Sample and hypothesis implications	Hypothesis modification
Operational Hypothesis 2: The Vertical Portfolio Problem in Input Supply Cooperatives H2	Smaller, diversified, constrained commercial farmer members will prefer less investment in cooperative assets that underpin further specialization relative to larger, unconstrained specialized farmers.	Statistical supports the existence of H2. The results are consistent with the overall framework.	Hypothesis should be modified to emphasize smaller, probably more diversified, farmers pursuing growth will prefer cooperative investment in assets that underpin that strategy, relative to larger, probably already highly specialized farmers whom are able to internalize the cost of assets that underpin their growth strategy. Evidence of a vertical portfolio problem on a wider member segment is expected within a cooperative with a traditional property rights structure with less of a specialized business focus.	Smaller unconstrained commercial farmer members, who are probably relatively diversified, seeking further growth and specialization will prefer more investment in cooperative assets this strategy relative to unconstrained, larger probably relatively specialized farmers able to internalize the costs of specialized equipment.
Operational Hypothesis 3: The Vertical Portfolio Problem in Input Supply Cooperatives	Very small, specialized farmers will prefer investment in services that reduce the opportunity cost in pursuing off-farm returns.	Unable to be tested because of very small sub group.	Implies the need for selection of a traditional cooperative with a large number of very small, specialized members in order to test the hypothesis.	

Hypothesis	Description	Empirical results	Sample and hypothesis implications	Hypothesis modification
Operational Hypothesis 4: The Lateral Portfolio Problem in Multi-Purpose Cooperatives	Less diversified members will prefer cooperative investment into assets that reflect their specialization, whilst more diversified members will prefer a wider range of cooperative investment that reflects their enterprise diversification.	Statistical evidence supports the existence of H4.	More conclusive results are expected from a traditionally structured cooperative with a greater diversify in business focus.	-
Operational Hypothesis 5: The Lateral Portfolio Problem in Marketing Cooperatives	Members altering their on-farm production portfolio, so as to reduce the volume marketed by the cooperative, will prefer not to invest any further capital in the cooperative.	Statistical evidence does not support the hypothesis. This appears to be largely a horizon effect within the sample Fonterra. explanatory power and the practical importance of the findings.	Better measurement of production constraints is required to gauge their relative importance and consequently reduce statistical noise. Survey questions are also required to measure planned shifts in physical on-farm production and the relative attractiveness of alternative commodities.	-

3. Further Methodological Issue: Survey Design of Dependent Variable

Consistency of Responses

The Fonterra results indicate a need for improvement in the design of response variables to measure cooperative investment preferences. The response rate for the categorical questions was much higher in the Effingham and NEMO surveys, indicating that respondents did not appreciate being forced into a categorical answer. The response rate for the Fonterra investment preference LIKERT question was also higher than for the categorical question. Further, a degree of inconsistency was evident between the two sets of answers. This may have been influenced by the lack of information immediately before the LIKERT question, inferring that the information presented to respondents before the categorical question may have influenced the outcome. However, it should be noted that an inconsistent response rate of less than 10% is not high for a survey *(ref).*

Consequently, two modifications are suggested. First, it is suggested that the background information to the investment question be shifted to the front of the survey, along with other explanatory material. This will give respondents time to process the material before answering questions related to the material. Second, it is suggested that the categorical and LIKERT questions be blended into a question similar to question six in which the LIKERT question becomes part of a categorical set of options. Respondents could who do not want further investment or don't know, will not be required to circle the middle of the LIKERT scale, inferring a 4 on the LIKERT scale would represent an indifference between the two further investment options. Less middle of the LIKERT scale responses may result in greater explanatory power from the variable.

Interaction with other VDPR

The most obvious interaction between the portfolio problem and another VDPR in this study is the horizon problem. In the Fonterra sample, horizon considerations were analyzed prior to analyzing a possible lateral portfolio problem. This is important because dealing with a horizon problem may require different structural innovations relative to dealing with a portfolio problem and therefore it is important not to confuse the VDPR. Understanding the dimensions of the investment constraints will inform decision makers as to how the control VDPR may manifest itself. For instance, in Fonterra's case it would appear that over attention to horizon issues (and regulatory constraints imposed by government) – FVS to reward long term investment – has resulted in an over emphasis on horizon solutions, which may seriously exacerbate a medium term portfolio problem.

Recommendations for Further Study

A systematic expansion of sample cooperatives should be tested, beginning with a traditionally structured multi purpose cooperative without a dominant business focus and a traditionally structured marketing cooperative with significant value adding assets. These samples properly screened so as to have a minimum of structural innovations and market conditions that may ameliorate or exacerbate portfolio problems, should further confirm the existence of the lateral and vertical portfolio problems. A subsequent round of study should examine sub samples of variants of multi purpose cooperatives and marketing cooperatives within discrete jurisdictions to ascertain the effects of institutional environments. Further rounds of study should systematically vary property rights structures and market conditions to ascertain their effects on the portfolio problem.

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