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Design and Management of Interfirm Networks

Franchise Networks, Cooperatives and Alliances

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ISSN 1431-1941 ISSN 2197-716X (electronic)
Contributions to Management Science
ISBN 978-3-030-29244-7 ISBN 978-3-030-29245-4 (eBook)
https://doi.org/10.1007/978-3-030-29245-4

This Springer imprint is published by the registered company Springer Nature Switzerland AG.
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

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Horizon and Portfolio Investment Constraints in Agricultural Cooperatives

Jason Franken and Michael Cook

Abstract Though horizon and portfolio problems are commonly thought to limit cooperatives' ability to capitalize on investment opportunities, empirical inquiry into the existence of these constraints is sparse, and recent conceptual arguments suggest that the horizon problem in particular may be less severe than commonly believed. Using surveys of members of three cooperatives, this study investigates the extent to which indicators of potential horizon and portfolio problems influence members' preferences for cooperative investment in value-added processing technology. The evidence points to the existence of three types of horizon problems and two types of portfolio problems influencing cooperative members' investment preferences.

1 Introduction

Scholars suggest that restrictions on transferability of residual claim rights and a lack of a liquid secondary market for them result in a disincentive for user-owners to invest in business growth opportunities (Condon 1990; Iliopoulos 1998; Nilsson 2001; Vitaliano 1985). For these reasons, traditional cooperatives seem particularly susceptible to investment horizon and portfolio problems and, in some cases, adopt

This research received funding from the USDA under Cooperative Research Agreement RBS-09-40. We also acknowledge the detailed and enthusiastic responses of survey participants and the helpful comments of an anonymous reviewer.

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J. Windsperger et al. (eds.), *Design and Management of Interfirm Networks*,
Contributions to Management Science,
https://doi.org/10.1007/978-3-030-29245-4_10

nontraditional cooperative models (Chaddad and Cook 2002; Cook 1995; Cook and Iliopoulos 1998; Hendrikse and Veerman 2001; Nilsson 1999).

Conceptualization of horizon and portfolio investment constraints in agricultural cooperatives was first formalized in the 1980s and has been a subject of increasing concern by academics ever since (Porter and Scully 1987; Staatz 1987; Vitaliano 1985). King et al. (2010) summarize proposed investment constraints in a survey of agribusiness economics and management literature and promising research topics. Plunkett et al. (2010) provide an excellent description of investment constraints in Australian irrigation cooperatives. Bijman et al. (2012) review numerous cases of farmer cooperatives in Europe alluding to or explicitly identifying such investment constraints. Cadot et al. (2015) present a case study of the horizon problem in Bordeaux wine cooperatives. Cook and James (2016) conceptualize these investment constraints from increasingly important ethical and behavior economics viewpoints. Cook and Iliopoulos (2016) introduce measurable indicators for testing these investment constraints and describe increasingly sophisticated solutions being adopted to address the inefficiencies created by these constraints. In his 2012 Agricultural and Applied Economics Association presidential address, Robert King identifies this evolution of institutional and organizational dynamics in response to such investment constraints as a prime example of the innovative work being done on mechanism design (King 2012).

Horizon and portfolio investment constraints are two of the five vaguely defined property rights problems—horizon, portfolio, shirking, control (i.e., agency), and influence cost problems—considered limitations of the cooperative form (Cook 1995; Iliopoulos 1998; Peterson 1992; Porter and Scully 1987; Staatz 1987; Vitaliano 1985). In Cook's (2018) cooperative life cycle piece, he argues that these five problems stem from heterogeneity arising during periods of cooperative growth and identifies examples of cooperatives that he contends have succumbed to and others that have overcome some of these challenges in recent years. For instance, horizon and portfolio problems, respectively, indicate different time and risk preferences, which result in different investment preferences of the members. Höhler and Kühl (2018) review the literature on member heterogeneity in cooperatives and identify 15 dimensions of member heterogeneity and rate investment preferences, at roughly 8% of reviewed studies, as the third most investigated relationship to member heterogeneity after performance (20%) and governance structures (12%). As Höhler and Kühl (2018, p. 704) note, "(M)ost of the reviewed literature on cooperatives does not explicitly examine the impact of member heterogeneity on their dependent variables ... Different dimensions of member heterogeneity are named but only few are included in economic models."

Despite conceptual and anecdotal support, empirical evidence of horizon and portfolio problems, in particular, is scarce and inconclusive. Iliopoulos (1998) finds evidence of both constraints using surveys of US cooperatives' CEOs and CFOs. Alho's (2016) finding that Finnish meat producers' willingness to invest in various hypothetical cooperative forms tends to increase with farm size and decrease with plans to exit may also be consistent with portfolio and horizon problems, respectively. Fahlbeck (2007) finds no evidence of horizon problems using surveys

of Swedish cooperatives' members. Moreover, mathematical models by Olesen (2007) and Fulton and Giannakas (2012) imply that the horizon problem is less severe than typically argued. Olesen (2007, p. 252) concludes from his own findings that "horizon problems cannot explain underinvestment in cooperatives. Instead, underinvestment must be explained by other problems, e.g. free rider problems, portfolio problems, or limited access to capital." Still, Chaddad et al. (2005) find that US cooperatives are capital constrained, implying that one or both of these potential constraints are binding to some degree.

This study investigates the extent to which variants of the investment horizon and portfolio problems exist in a traditional multipurpose cooperative and a new generation cooperative in the US and a member-investor cooperative in New Zealand using responses to member surveys. The approach shows that members' characteristics impact their perceptions of cooperative investment in value-added processing technology across cooperative type and in both countries. Binary probit analysis of survey data informs whether members' attributes (e.g., nearness to retirement, commodity diversification, intentions to expand production) significantly impact their preferences for cooperative investments in value-added processing technologies.

Literature on the investment horizon problem has focused primarily on the *residual* horizon problem (Ellerman 1986; Gittinger 1972). This issue is also referred to as the *short-term* horizon problem, as active members nearing retirement may oppose investments from which they cannot extract the complete present value of future benefits during their membership horizon. In addition to this horizon problem, this study finds support for a *return of capital* or *wait-to-receive* horizon problem where, upon retirement age, members of traditional cooperatives and nontraditional ones with transferable shares, respectively, prefer accelerated redemption of equities and only those investment opportunities that are believed to lead to a higher share price (Furubotn and Pejovich 1972). Support is also found for a *current obligation* horizon problem, where members with high debt obligations and/or cash constraints may oppose additional investments, particularly if they have limited ability to borrow against their cooperative investment (i.e., lender places little value on cooperative shares as collateral).

The quintessential portfolio problem is believed to occur in cooperatives spanning many commodity divisions with increasingly specialized members (Plunkett 2005). Such lateral portfolio problems arise as members are unable to adjust their cooperative asset portfolios to reflect their degree of commodity specialization. In addition to this version of the portfolio problem, this study also finds evidence of a vertical dimension that arises 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.

The study proceeds with a summary of the relevant literature and resulting hypotheses. Then, the survey data and research context are discussed, followed by the empirical results. The study concludes with implications and direction for further research.

2 Literature and Hypotheses

Difficulties in acquiring and redeeming cooperative patrons' equity capital are considered major constraints to the growth and sustainability of these organizations (Bonin et al. 1993; Caves and Petersen 1986; Furubotn and Pejovich 1972; Murray 1983). Several explanations are offered for the inability of user-owned organizations to acquire sufficient risk capital to finance investment opportunities.

First, property rights allocations in traditional cooperatives do not offer strong incentives to invest (Cook 1995; Cook and Iliopoulos 2000; Knoeber and Baumer 1983; LeVay 1983; Vitaliano 1983). Residual claims in these organizations are non-appreciable, since they are nontransferable and are redeemable only at book value (Van Wassenaer 1989). As patrons therefore benefit mainly through usage via favorable prices and patronage refunds, their incentive to invest risk capital is limited. Furthermore, patrons may share in the cooperative's return on equity without investing, thereby giving rise to free riding and underfinancing of the cooperative (Knoeber and Baumer 1983).

Second, cooperatives traditionally have restricted residual claims since only active members provide equity capital. That is, traditional cooperatives can only source equity from active members. Thus, the acquisition of risk capital is limited by the number, wealth, and risk-bearing capacity of current members. The aforementioned inability to transfer residual claims prevents the functioning of secondary markets for cooperative stock and leads to portfolio and horizon problems. That is, members of traditional cooperatives tend to influence investment decisions since they cannot capture the future payoffs of the cooperatives' risky investments due to the horizon problem nor adjust their individual investment portfolios to match their risk preferences due to the portfolio problem (Jensen and Meckling 1979; Porter and Scully 1987).

Other arguments supporting the presence of capital constraints in cooperatives include that equity capital is tied to patronage, cooperative equity is not permanent, and cooperatives have limited access to external funding. Cooperatives depend mainly on internally generated capital or patronage to acquire risk capital. Internally generated capital is redeemable at the discretion of the board of directors. Since redeeming equity is a cash outlay, lenders may not consider allocated patronage refunds sufficiently permanent equity capital to support loans, thus limiting cooperatives' access to debt capital (Parliament and Lerman 1993).

Each of these explanations for potential investment constraints in cooperatives stems from heterogeneity in cooperative membership. While cooperative memberships have always included farmers of all ages and at all points in the life of their farm businesses, most farms in the Midwest USA (and likely elsewhere) were typically diversified family operations with grain, hogs, cattle, or perhaps dairy and similar production technologies up until the 1970s (Ginder 1999). However, over time, membership became more heterogeneous, placing greater emphasis on the time horizon issue. The degree of membership heterogeneity can be measured by variation in size, degree of specialization, financial position, and geographic

dispersion of farm operations, farmers' age or time horizon, education level, and percentage of non-farm income (Ginder 1999; Iliopoulos and Cook 1999). Hence, the general hypothesis advanced here is that heterogeneity in cooperative members' characteristics leads to varying perceptions of the cooperative's proposed investments; or in other words, members' characteristics have a nonzero effect on their perceptions of these investments.

The literature on cooperative investment horizon problems has largely focused on the return on capital in the *residual* or *short-term* horizon problem, in which members who are near retirement prefer only short-term investments that may be recouped quickly.[1] This horizon problem occurs when a member's residual claim on the net income generated by a growth opportunity is shorter than the asset's productive life and ownership rights to the firm's assets are nontransferable (Ellerman 1986; Porter and Scully 1987). Traditional cooperatives tie formal claims on residual income to patronage (Staatz 1987). Thus, members benefit from investments until they cease to patronize the cooperative and surrender any future residual claims (Staatz 1987; Vitaliano 1983). That is, members do not directly realize the capitalized value of the cooperatives' future income streams beyond their expected membership horizons. Thus, active members nearing retirement might have time preferences skewed slightly toward the present. Since they have shorter membership horizons, these members discount associated income streams beyond their membership horizon to zero. These members prefer short-term investments with a quick payback since they cannot capture the future value of long-term investments during their membership horizon.

Hypothesis 1a (H1a) The number of years until retirement is positively associated with the preference for further investments in the cooperative.

The *return of capital* or Furubotn-Pejovich (1972) horizon problem is also known as the *wait-to-receive* horizon problem, because members wait to receive the book value of their residual claims until the board of directors chooses to redeem the equities (Cobia 1989). Inactive or retired members of traditional cooperatives might pressure the board to accelerate redemption of older equities, because they no longer benefit through patronage (Furubotn and Pejovich 1972, Ellerman 1986). Members of nontraditional cooperatives with transferable shares may, as they approach retirement, wish for a higher share value price. These members may pressure the board of directors to set the share price at a higher value, and while they may oppose certain investments, they may support those that they anticipate will be capitalized in a higher share price. Thus, we hypothesize:

Hypothesis 1b (H1b) The number of years until retirement is negatively associated with the preference for higher share value price.

[1] See Vitaliano (1985) for a conceptual framework depicting the residual horizon problem using a graphical analysis of a two-period investment and Ellerman (1986) for a framework covering the residual horizon problems while comparing ownership rights in investor-owned and labor-managed firms.

Following Krumpleman-Farmer (2005), other variants of the horizon problem may exist. Under the *current obligation* horizon problem, members with current cash flow constraints have time preferences skewed toward the present (Krumpleman-Farmer 2005). While such members benefit from residual claims, taxes on residual claims in combination with current obligations to service debt may outweigh those benefits. Therefore, these members pressure the cooperative to not retain all of the equity allocated as they generally prefer to receive higher cash in the year earned but may accept slightly lower amounts if they can borrow against the cooperative investment. However, if members are unable to secure such loans, then they will likely oppose any further investments. Thus, we hypothesize:

Hypothesis 2 (H2) The ability to borrow against the cooperative investment is positively associated with support of investment opportunities.

The *portfolio problem* constitutes another investment constraint in traditional cooperatives. The lack of transferability, liquidity, and appreciation mechanisms for residual claims prevents members from adjusting their cooperative asset portfolios to match personal risk preferences (Cook 1995). Since investment and patronage decisions are linked, some members find they hold suboptimal investment portfolios and pressure the cooperative to rearrange the portfolio to be more consistent with their preferences, even if it means lower expected returns. As noted earlier, most farms were historically diversified family operations producing several commodities with similar technologies (Ginder 1999); but more recently many operations have become more specialized, and traditional multipurpose cooperatives now serve the input procurement and marketing needs of a more heterogeneous mix of diversified and specialized patrons. Heterogeneity of membership, particularly in large, diversified cooperatives, presents difficulties in achieving consensus and establishing viable coalitions (Feng and Hendrikse 2012). Variation in diversification/specialization among cooperative memberships leads to the *classical (lateral) portfolio problem*. Accordingly, we hypothesize:

Hypothesis 3 (H3) Diversification in commodity production is negatively associated with support of investment into specialized value-added technology.

Plunkett (2005) introduces the possibility of a *vertical portfolio problem*, where support for cooperative investments that entail vertical integration, for instance, into value-added processing, may also vary with the size of members' farm operations. As opposed to the classical (lateral) portfolio problem that is common in cooperatives dealing with multiple commodities, the vertical portfolio problem may arise in single-commodity cooperatives that process the commodity into branded products. For example, some dairy cooperatives become more involved in the production of capital-intensive consumer-ready, branded products. Essentially, differences in farm size may underlie differences in cooperative members' support for such investments. However, as outlined below, sound arguments can be made for both positive and negative effects of farm size, and hence, empirical analysis may provide insights as to the overriding effect. For instance, research indicates that larger farmers tend to participate more in cooperatives (Wadsworth 1991) and, in general, larger farmers are more likely to adopt new technology (Barham et al. 2014; Just et al. 1980; Khanna 2001). Furthermore, smaller, diversified members may prefer less investment in cooperative assets that underpin further specialization in value-added processes relative to larger, expanding, specialized farmers. Hence, larger farmers may be relatively more supportive of cooperative investments and those in value-added processing technologies in particular.

Hypothesis 4a (H4a) Intentions to expand the farm operation are positively associated with support of investment into specialized value-added technology.

However, Plunkett (2005) also argues that patron-members with larger and expanding operations may be more interested in investment opportunities that support farm profitability and expansion, whereas members with smaller operations that face constraints in expansion will more likely support investment opportunities that add value to existing production. This conclusion is drawn based on the logic that large farmers should enjoy a greater on-farm return on investment (ROI) than smaller farmers due to economies of scale. Conceivably, the prospective ROI in cooperative processing technology, for instance, may be less than the on-farm ROI for large farmers and greater than that of small farmers. Hence, any prospective cooperative investment in investor assets (e.g., value-added processing technology) with an anticipated ROI between that of small and large farmers will be more likely to be supported by small farmers than by large farmers. Large and expanding farmers rather support investments in user assets (e.g., collection stations, warehousing, and agronomy services, like spraying) that further facilitate on-farm ROI. Hence, we may also hypothesize:

Hypothesis 4b (H4b) Intentions to expand the farm operation are negatively associated with support of investment into specialized value-added technology.

3 Methodology

3.1 Research Design and Data

This study analyzes data from mail surveys of three agricultural cooperatives conducted between December 2004 and May 2005. The data, though dated, provide insights into investment constraints faced by one cooperative still in operation, a second that serves its members through a merger to form a new cooperative, and a third that has transitioned to a limited-liability company. Fonterra Co-operative Group (Fonterra) is a member-investor cooperative that is a leading multinational dairy company accounting for the majority of New Zealand's milk. West Central Cooperative (WCC) was a grain marketing multipurpose cooperative that formed the Landus Cooperative through a "merger of equals" with Farmers Cooperative Company in 2016 to ensure local ownership in Iowa for generations to come (Landus Cooperative 2015). Northeast Missouri Grain Processors (NMGP) was a

Table 1 Ownership rights and response rates for surveyed cooperatives

Ownership rights	West Central	Northeast Missouri Grain Processors	Fonterra
Restricted to members	Yes	Yes	Yes
Redeemable from cooperative	C stock, 10–12-year revolving period; B stock, retire	Non-redeemable	Immediate
Benefits: user or investor	User	Investor/user	Investor
Proportional to member investment	No	Yes	Recently yes
Survey response rate	17.6% (160 of 910 sent)	31% (96 of 311 sent)	8.2% (997 of 12,144 sent)

new generation cooperative that provided the majority of equity for a corn ethanol plant in Macon, Missouri, and has since transitioned to a limited-liability company to facilitate further non-farmer investment but remains held largely by corn farmers (Retka Schill 2013).

Table 1 summarizes the ownership rights and survey response rates for each of the three cooperatives at the time of the survey. WCC is a multipurpose cooperative with passive investment where the cooperative allocates a portion of its net income to members in proportion to levels of patronage (i.e., user benefits). NMGP and Fonterra, as new generation and member-investor cooperatives, respectively, have proactive investment where members directly invest cash in the organizations and returns are distributed in proportion to investment (i.e., investor-oriented benefits). Considering different types of cooperatives with different characteristics allows examination of whether these differences affect the kinds of investment constraints faced.

Personal interviews with cooperative top management, the board of directors, and research from various branches of new institutional economics (Coase 1998) informed the general survey design. This draft was sent back to key individuals (e.g., general manager, chief financial officer, board chairperson) at each cooperative, and meetings were arranged to modify the survey to better fit the circumstances of each cooperative in order to enhance comprehension of the questions. Once approved by the respective cooperatives, finalized surveys were sent to the entire memberships of NMGP and Fonterra and subsamples of WCC's membership based on size and specialization. For the WCC, this choice was made to facilitate sufficient variety in size of farmer members in the sample to observe effects of heterogeneity in farm size. Specifically, all 122 of the large-grain members (over 1000 acres of grain), all 303 of the medium-grain members (500 and 1000 acres of grain), and a random sample of 500 small-grain members (less than 500 acres of grain) were surveyed. Surveys were sent to 910 members of WCC, and 160 completed surveys were returned for a 17.6% response rate or about 5% of the membership (Table 1). Surveys were sent to all 311 members of NMGP, and 96 completed surveys were returned for a 31% response rate. Surveys were sent to the entire Fonterra membership of 12,144 shareholders at that time, and 997 completed surveys were returned for an 8.2% response rate. Accounting for omitted responses yields slightly smaller samples for analysis with 155 observations for WCC, 91 for NMGP, and 902 for Fonterra.

3.2 Measures

Summary statistics are given in Table 2. The dependent variable is based on a seven-point scale item ranging from one indicating a strong preference for investment in "new" or "value-added" processing technology to seven indicating a strong preference for traditional investments likely to increase volumes marketed and another item indicating a desire for no further investments. Thus, *ValueAddedTech* is coded as a binary variable equal to one if the responding member reports a preference for cooperative investment in value-added processing technology (i.e.,

Table 2 Summary statistics

Cooperative/variable	Mean	Standard deviation	Min	Max
Fonterra (N = 902)				
ValueAddedTech	0.49	0.50	0.00	1.00
Relinquish in >5 years	0.65	0.48	0.00	1.00
Lender value >90%	0.77	0.42	0.00	1.00
Farm/HH income >50%	0.09	0.29	0.00	1.00
Commodities	2.15	1.07	1.00	6.00
Intend to expand	0.67	0.47	0.00	1.00
NMGP (N = 91)				
ValueAddedTech	0.59	0.49	0.00	1.00
Relinquish in >5 years	0.73	0.45	0.00	1.00
Lender value >90%	0.77	0.42	0.00	1.00
Farm/HH income >50%	0.22	0.42	0.00	1.00
Commodities	3.51	1.28	1.00	6.00
Intend to expand	0.58	0.50	0.00	1.00
West Central (N = 155)				
ValueAddedTech	0.57	0.50	0.00	1.00
Relinquish in >5 years	0.83	0.38	0.00	1.00
Lender value >90%	0.67	0.47	0.00	1.00
Farm/HH income >50%	0.14	0.34	0.00	1.00
Commodities	2.57	0.73	2.00	5.00
Intend to expand	0.53	0.50	0.00	1.00

Notes: NMGP denotes Northeast Missouri Grain Processors cooperative

less than four on the seven-point scale) and zero otherwise (i.e., if traditional investments or no further investment is preferred). The mean statistic indicates that the percentage of respondents who support (i.e., prefer) such investments in value-added processing technology varies between 49% for Fonterra and 59% for NMGP.

The only continuous explanatory variable is the number of *Commodities* that respondents produce, which ranges from one to six, as farmers may produce multiple commodities even if they are members of cooperatives that specialize in processing one commodity (e.g., corn-ethanol or milk). The average respondent produces about two or three commodities, depending on the cooperative sample.

The remaining explanatory variables are binary, with values of one and zero indicating affirmative and negative responses, respectively. Some underlying survey items allow selection of ranges in years or percentages and also an option for "I don't know" or "Not applicable." In order to retain the observations for which respondents are unsure or consider the issue not applicable, the following binary coding is adopted. *Relinquish in >5 years* equals one if the respondent is sure it will be more than 5 years before relinquishing control of the farm and zero if it will be sooner or the respondent is unsure. *Lender value >90%* equals one if the lender accepts cooperative equity (i.e., shares) as collateral at more than 90% of its market value and if the respondent doesn't know or doesn't have debt (i.e., it is not an issue) and zero otherwise. *Farm/HH income 50%* reflects whether the respondent relies primarily on the farm for income and equals one if over 50% of the household income is from the farm and zero otherwise. *Intend to expand* equals one if the respondent indicated intention to expand the farm operation over the next 5 years and zero if no expansion is planned.

Mean statistics (Table 2) indicate that, depending on the cooperative sample, about half or a little more of the respondents plan to wait at least 5 years before relinquishing control of the farm (*Relinquish in >5 years*). Between 67 and 77% have lenders who value cooperative equity as collateral at 90% or more of its market value or don't have debt and/or don't know what value a lender would place on cooperative equity (*Lender value >90%*). Between 9 and 22% have over half of their household income coming from the farm (*Farm/HH income >50%*). Over half of respondents intend to expand (*Intend to expand*).

4 Results

4.1 Correlations

Most of the correlations are fairly small (Table 3). The strongest correlations are 0.32 and 0.25 between *Intend to expand* and *Relinquish in >5 years* and *ValueAddedTech*, respectively, for WCC reflecting that at least some members of this cooperative who plan to hold onto the farm for a while also plan to expand

Table 3 Correlations

	(1)	(2)	(3)	(4)	(5)	(6)
Fonterra (N = 902)						
(1) ValueAddedTech	1.000					
(2) Relinquish in >5 years	0.058	1.000				
(3) Lender value >90%	0.043	0.006	1.000			
(4) Farm/HH income >50%	0.006	0.013	−0.016	1.000		
(5) Commodities	−0.083	0.030	0.039	−0.005	1.000	
(6) Intend to expand	0.062	0.105	−0.029	0.059	−0.001	1.000
NMGP (N = 91)						
(1) ValueAddedTech	1.000					
(2) Relinquish in >5 years	−0.209	1.000				
(3) Lender value >90%	0.184	0.014	1.000			
(4) Farm/HH income >50%	−0.047	−0.030	−0.024	1.000		
(5) Commodities	0.118	0.051	−0.028	−0.107	1.000	
(6) Intend to expand	0.161	0.078	0.012	−0.304	0.074	1.000
WCC (N = 155)						
(1) ValueAddedTech	1.000					
(2) Relinquish in >5 years	0.011	1.000				
(3) Lender value >90%	−0.084	−0.104	1.000			
(4) Farm/HH income >50%	−0.149	0.033	0.077	1.000		
(5) Commodities	−0.071	0.008	−0.133	−0.102	1.000	
(6) Intend to expand	0.246	0.316	−0.193	−0.080	0.079	1.000

Notes: NMGP denotes Northeast Missouri Grain Processors cooperative

and some who plan to expand have positive views of the cooperative investing in value-added processing technology. Some members who rely predominately on farm income prefer WCC not make such investments, as indicated by the −0.15 correlation between *ValueAddedTech* and *Farm/HH income >50%*.

The −0.19 correlation between *Intend to expand* and *Lender value >90%* for WCC means that some members who plan to expand have lenders who do not place full market value on their cooperative equity and these members may prefer accelerated redemption of equities if they otherwise had to borrow money to finance the expansion. Notable correlations with *ValueAddedTech* for the NMGP sample include −0.21 with *Relinquish in >5 years*, 0.18 with *Lender value >90%*, and 0.16 with *Intend to expand*. These correlations are consistent with some hypothesized relationships and also appear in regression results, as discussed in the next section. In the Fonterra sample, most correlations are around 0.10 or less, foreshadowing a relatively lower ability of the independent variables to explain the variability in members' investment preferences for this sample.

4.2 Regression Results

Results for probit regressions of the binary dependent variable, *ValueAddedTech*, are reported for each cooperative sample in Table 4. McFadden's (1974) R^2 is low for each sample, particularly for Fonterra. Hoetker (2007) emphasizes that no pseudo-R^2 has the same meaning as R^2 in ordinary least squares regressions (i.e., proportion of variance explained) and, hence, recommends considering the proportion of correct predictions. The model correctly classifies 57, 64, and 64% of the observations on *ValueAddedTech* for the Fonterra, NMGP, and WCC samples, respectively, which exceeds the power of naïve models (e.g., predicting a value of one for every observation) that, as indicated by means of *ValueAddedTech* (Table 1), predict 49, 59, and 57% of observations correctly. Even though the model identifies some significant relationships and outperforms naïve models, relatively low proportions of correct predictions likely reflect that other factors, which may be identified in the future, help to better explain cooperative member investment preferences.

As just noted, several statistically significant marginal effects are detected (Table 4). The marginal effect of 0.058 for *Relinquish in >5 years* indicates that Fonterra members who plan to retain control of their farms for at least the next 5 years are almost 6% more likely to support investment in value-added technology on average, which supports Hypothesis 1a (i.e., *residual* or *short-term* horizon problem). A stronger effect of the opposite sign (−0.27) is observed for NMGP, which is

Table 4 Results for binary probit regression of preference for cooperative investment in value-added technology

	Fonterra	NMGP	WCC
Relinquish in	0.0576_{*}	-0.2730_{***}	−0.0898
>5 years (binary)	(0.035)	(0.105)	(0.107)
Lender value	0.0571	0.2456_{*}	−0.0556
>90% (binary)	(0.040)	(0.127)	(0.089)
Farm/HH income	0.0030	0.0166	-0.2050_{*}
>50% (binary)	(0.058)	(0.136)	(0.118)
Commodities	-0.0413_{***}(0.016)	0.0531(0.043)	−0.0818(0.057)
Intend to expand (binary)	0.0613_{*}(0.036)	0.1878_{*}(0.112)	0.2609_{***}(0.083)
N	902	91	155
McFadden's R^2	0.012	0.100	0.071
Percentage correctly classified:			
$Y = 1$	50%	74%	73%
$Y = 0$	63%	49%	52%
Overall	57%	64%	64%

Notes: $_{***}$, $_{**}$, and $_{*}$ denote statistical significance at 1, 5, and 10% levels, respectively. Standard errors are in parentheses. NMGP denotes Northeast Missouri Grain Processors cooperative

consistent with Hypothesis 1b (i.e., the *return of capital or wait-to-receive* horizon problem).

Support for Hypothesis 2 (i.e., the *current obligation* horizon problem) is also obtained, as evidenced by the significant effect of *Lender value >90%* in the NMGP sample. Specifically, if a lender values cooperative equity at 90% of market value or more, then that member is 25% more likely to support the investment on average. In other words, a cooperative member is more likely to support further investment in the cooperative if the member can use that equity as collateral against a loan.

Evidence of portfolio problems is also apparent (Table 4). Hypothesis 3 (i.e., the *classical lateral* portfolio problem) is supported by the statistically significant effect of *Commodities* in the Fonterra sample, which indicates that producing an additional commodity decreases the probability of support for investments in value-added technology by 4% on average. That is, producers specializing in milk production are more likely than diversified farmers to support such investments by Fonterra, given that it would enhance the value of only milk production.

Hypothesis 4a (i.e., *vertical* portfolio problem) is supported by the significant effect of *Intend to expand* in all three samples, which indicates that anticipated expansion of production in the next 5 years increases the probability of supporting such investments by 6, 19, and 26% in Fonterra, NMGP, and WCC samples, respectively. This result is also consistent with the generally greater membership and patronage of cooperatives by larger producers (Wadsworth 1991). Though the vertical portfolio problem seems particularly likely to occur in specialized cooperatives, the effect is surprisingly strongest for the multipurpose WCC. Given these results, no support is found for the negative relationship proposed in Hypothesis 4b (i.e., the argument that divergent investment preferences could arise if cooperative-level ROI exceeds that of small but not large farmers). Perhaps the vertical portfolio problem overwhelms any differences in on-farm ROI stemming from scale economies, or the anticipated ROI of the proposed investments by these cooperatives exceeds ROI on both large and small farms. Of course, intentions to expand do not necessarily imply that the farm is currently small or large either, so this variable may be an imperfect indicator of the validity of Hypothesis 4b. *Farm/HH income >50%* is included to control for whether the household relies primarily on farm income, and its marginal effect indicates that households with primarily non-farm income are 21% more likely to support cooperative investments. This effect could be interpreted as support for Hypothesis 4b if small farms also have primarily non-farm income, or it may simply reflect that the farm is a small enough portion of household income that the cooperatives' investments are of little concern to the household.

5 Conclusions

Though horizon and portfolio problems are commonly thought to limit cooperatives' ability to capitalize on investment opportunities (Cook 1995; Iliopoulos 1998; Peterson 1992; Porter and Scully 1987; Staatz 1987; Vitaliano 1985), empirical

inquiry into the existence of these constraints is sparse (Fahlbeck 2007; Iliopoulos 1998), and conceptual arguments suggest that the horizon problem in particular may be less severe than commonly believed (Olesen 2007). Using surveys of members of three cooperatives, this study investigates the extent to which indicators of potential horizon and portfolio problems influence member preferences for investment in value-added processing technology.

The evidence points to the existence of two types of portfolio problems and three types of horizon problems influencing cooperative members' investment preferences. All three cooperatives show evidence of the *vertical portfolio problem*, as members' support of investments in commodity-specific, value-added processing technology tends to increase if members plan to increase production of that commodity. Fonterra Co-op Group, a member-investor dairy cooperative in New Zealand, also shows strong evidence of the *classical (lateral) portfolio problem*, as its members' opposition to such investments increases with the number of commodities the member produces.

Some evidence of the *current obligation* horizon problem is found for Northeast Missouri Grain Processors, as members who have lenders who take cooperative equity at or near its market value as collateral against loans (i.e., current debt obligations) are more likely to support cooperative investments. There is also some evidence of the classic *residual* or *short-term* horizon problem for Fonterra Co-op Group, as members further from retirement are more likely than those nearing retirement to support cooperative investments in processing technology, since it may not be recovered before impending retirements. Strong support exists for the *return of capital* or *wait-to-receive* horizon problem for Northeast Missouri Grain Processors, a corn-ethanol new generation cooperative, as members near retirement are significantly more likely to support cooperative investments in processing technology, since it likely will increase the value of their tradable shares.

The divergent results regarding impacts of members' nearness to retirement may reflect differences in equity redemption policies for the two cooperatives at the time of our survey. Fonterra would buy back delivery right shares at book value from members scaling back production or ceasing to patronize the cooperative, and equity was redeemable from the cooperative immediately upon a member's exit. In contrast, since Northeast Missouri Grain Processors redeemed equities on a traditional revolving basis, the only way its members could extract the value of their tradable delivery right shares was through use (i.e., patronage) or sale to another corn producer. That is, the return of capital seems to have been higher for Fonterra than Northeast Missouri Grain Processors, even if the return on capital for these two cooperatives may have been similar. The nonzero effect of members' nearness to retirement in each cooperative is consistent with the general hypothesis that heterogeneity of members' characteristics influences their investment preferences. Changes at both businesses (e.g., Fonterra capping redemption at 5% of total equity and later adopting tradable shares and Northeast Missouri Grain Processors transitioning to a limited-liability company to facilitate outside investment) were responses to the frictions created by these horizon problems (Cook 2018).

Lastly, although the reported regression models provide statistically significant evidence of the above-described effects, they account for only small amounts of the variation in investment preferences, suggesting opportunities for future work to delve deeper into determinants of cooperative members' investment preferences.

References

Alho E (2016) Survey evidence of members' willingness to invest in agricultural hybrid cooperatives. J Chain Net Sci 16(1):41–58

Barham BL, Chavas J-P, Fitz D, Salas VR, Schechter L (2014) The roles of risk and ambiguity in technology adoption. J Econ Behav Organ 97:204–218

Bijman J, Pope KJ, Cook ML, Iliopoulos C (2012) Support for farmers' cooperatives; case study report Cebeco. Wageningen UR, Wageningen

Bonin JP, Jones DC, Putterman L (1993) Theoretical and empirical studies of producer cooperatives: will ever the twain meet? J Econ Lit 31:1290–1290

Cadot J, Ugaglia AA, Bonnefous B, Del'homme B (2015) The horizon problem in Bordeaux wine cooperatives. Int J Entrep Small Bus 29(4):651–668

Caves RE, Petersen BC (1986) Cooperatives' tax "advantages": Growth, retained earnings, and equity rotation. Am J Agric Econ 68:207–213

Chaddad FR, Cook ML (2002) An ownership rights typology of cooperative models. Department of Agricultural Economics working paper: 2002–2006

Chaddad FR, Cook ML, Heckelei T (2005) Testing for the presence of financial constraints in US agricultural cooperatives: an investment behaviour approach. J Agric Econ 56:385–397

Coase R (1998) The new institutional economics. Am Econ Rev 88(2):72–74

Cobia DW (1989) Cooperatives in agriculture. Prentice Hall, New Jersey

Condon AM (1990) Property rights and the investment behavior of US agricultural cooperatives. Virginia Polytechnic Institute and State University, Virginia

Cook ML (1995) The future of US agricultural cooperatives: a neo-institutional approach. Am J Agric Econ 77:1153–1159

Cook ML (2018) A life cycle explanation of cooperative longevity. Sustainability 10(5):1586

Cook ML, Iliopoulos C (1998) Solutions to property rights constraints in producer-owned and controlled organizations: prerequisite for agri-chain leadership? In: Ziggers G, Trienekens J, Zuurbier P (eds) Proceedings of the third international conference on chain management in agribusiness and the food industry held in Ede, The Netherlands, 28–29 May 1998, pp 541–553

Cook ML, Iliopoulos C (2000) Ill-defined property rights in collective action: the case of US agricultural cooperatives. In: Menard C (ed) Institutions, contracts and organizations. Edward Elgar, London, pp 335–348

Cook ML, Iliopoulos C (2016) Generic solutions to coordination and organizational costs: informing cooperative longevity. J Chain Net Sci 16(1):19–27

Cook ML, James H (2016) Cooperatives. In: Kolb RW (ed) Encyclopedia of business ethics and society, 2/e. Sage, Thousand Oaks, CA

Ellerman DP (1986) Horizon problems and property rights in labor-managed firms. J Comp Econ 10:62–78

Fahlbeck E (2007) The horizon problem in agricultural cooperatives–only in theory? In: Karantininis K, Nilsson J (eds) Vertical markets and cooperative hierarchies. Springer, Dordrecht, pp 255–274

Feng L, Hendrikse GWJ (2012) Chain interdependencies, measurement problems and efficient governance structure: cooperatives versus publicly listed firms. Eur Rev Agric Econ 39:241–255

Fulton M, Giannakas K (2012) The value of a norm: open membership and the horizon problem in cooperatives. Special issue: cooperative values in internationalized operations. J Rural Coop 40:145–161
Furubotn EG, Pejovich S (1972) Property rights and economic theory: a survey of recent literature. J Econ Lit 10:1137–1162
Ginder RG (1999) Who will retire member's equity? Working paper, Department of Economics. Iowa State University, Ames, IA
Gittinger JP (1972) Economic analysis of agricultural projects. John Hopkins University Press for the World Bank, Baltimore
Hendrikse GW, Veerman CP (2001) Marketing cooperatives and financial structure: a transaction costs economics analysis. Agric Econ 26:205–216
Hoetker G (2007) The use of logit and probit models in strategic management research: critical issues. Strateg Manag J 28:331–343
Höhler J, Kühl R (2018) Dimensions of member heterogeneity in cooperatives and their impact on organization – a literature review. Ann Publ Cooper Econ 89(4):697–712
Iliopoulos C (1998) A study of the property rights constraints in US agricultural cooperatives: theory and evidence. Dissertation, University of Missouri-Columbia
Iliopoulos C, Cook ML (1999) The efficiency of internal resource allocation decisions in customer-owned firms: the influence costs problem. In: 3rd annual conference of the International Society for New Institutional Economics. Citeseer, Washington, DC, pp 16–18
Jensen M, Meckling W (1979) Rights and production functions: an application to labor managed firms and codetermination. J Bus (4):496–506
Just RE, Zilberman D, Rausser GC, Yaron D, Tapiero C (1980) A putty-clay approach to the distributional effects of new technology under risk. In: Yaron D, Tapiero C (eds) Operations research in agriculture and water resources. North-Holland, Amsterdam, pp 97–121
Khanna M (2001) Sequential adoption of site-specific technologies and its implications for nitrogen productivity: a double selectivity model. Am J Agric Econ 83:35–51
King R (2012) The science of design. Am J Agric Econ 94(2):275–284
King R, Boehlje M, Cook ML, Sonka ST (2010) Agribusiness economics and management. Am J Agric Econ 92(2):554–570
Knoeber CR, Baumer DL (1983) Understanding retained patronage refunds in agricultural cooperatives. Am J Agric Econ 65:30–37
Krumpleman-Farmer EL (2005) The investment horizon issue in user-owned organizations. Dissertation, University of Missouri
Landus Cooperative (2015) Members approve merger of farmers cooperative company and west central cooperative. http://www.landuscooperative.com/news_release/members-approve-merger-of-farmers-cooperative-company-and-west-central-cooperative/. Accessed 29 May 2019
LeVay C (1983) Agricultural Co-operative theory: a review. J Agric Econ 34:1–44
McFadden D (1974) Conditional logit analysis of qualitative choice behavior. In: Zarembka P (ed) Frontiers in econometrics. Academic, New York, pp 105–142
Murray G (1983) Management strategies for corporate control in British agricultural co-operatives—Part 1. Agric Adm 14:51–63
Nilsson J (1999) Cooperative organizational models as reflections of the business environments. Finnish J Bus Econ 4:449–470
Nilsson J (2001) Organisational principles for co-operative firms. Scand J Manag 17:329–356
Olesen HB (2007) The horizon problem reconsidered. In: Karantininis K, Nilsson J (eds) Vertical markets and cooperative hierarchies. Springer, Dordrecht, The Netherlands, pp 245–253
Parliament C, Lerman Z (1993) Risk and equity in agricultural cooperatives. J Agric Coop 8:1–14
Peterson HC (1992) The economic role and limitations of cooperatives: an investment cash flow derivation. J Agric Coop 7:61–78
Plunkett B (2005) The portfolio problem in agricultural cooperatives: an integrated framework. Dissertation, University of Missouri

Plunkett B, Chaddad FR, Cook ML (2010) Ownership structure and incentives to invest: dual structured irrigation cooperatives in Australia. J Inst Econ 6(2):261–280
Porter PK, Scully GW (1987) Economic efficiency in cooperatives. J Law Econ 30:489–512
Retka Schill S (2013) Missouri's first ethanol plant has a rich history. Ethanol Producer Magazine July. www.ethanolproducer.com/issues. Accessed June 18, 2019.
Staatz JM (1987) The structural characteristics of farmer cooperatives and their behavioral consequences. In: Royer JS (ed) Cooperative theory: new approaches. USDA. Agricultural Cooperative Services, Washington, DC, pp 33–60
Van Wassenaer APW (1989) An optimal ownership structure for cooperatives. Thesis, Harvard University
Vitaliano P (1983) Cooperative enterprise: an alternative conceptual basis for analyzing a complex institution. Am J Agric Econ 65:1078–1083
Vitaliano PW (1985) Potential benefits and costs to agricultural cooperatives from assuring access to input and product markets. In: Farmer cooperatives for the future, proceedings of the workshop farmer cooperatives for the future, Saint Louis, Missouri, pp 64–74
Wadsworth JJ (1991) An analysis of major farm characteristics and farmers' use of cooperatives. J Agric Coop 6:45–53