Design and Management of Interfirm Networks

Franchise Networks, Cooperatives and Alliances
### Contents

**Design and Management of Interfirm Networks: An Introduction**  
Josef Windsperger, Gérard Cliquet, George W. J. Hendriks, and Marijana Srečkoči

**Part I  Franchise Networks**

- **Innovation Climate in Plural Form Franchise Networks: The Mediator Role of Mutual Learning**  
  Nguyen Minh Ngoc and Gérard Cliquet  
  Page 13

- **They Are Jolly Good Fellows! A Framework for Antecedents and Consequences of Peer Trust in Franchise Networks**  
  Evelien P. M. Croonen and Reinder Hamming  
  Page 33

- **Business Model Innovation in Franchising: Rethinking the Franchising Taxonomy**  
  Cary Di Lernia and Andrew Berry  
  Page 57

- **Why Adopt Microfranchising? Evidence from Brazil on an Organizational Innovation Designed to Face New Challenges**  
  Rubens Nunes, Vivian-Lara S. Silva, Muriel Fadairo, and Maria Sylvia M. Saes  
  Page 75

- **Strategic CSR and the Competitive Advantage of Franchise Firms**  
  Maria Jell-Ojebor  
  Page 91

- **Institutional Influences of Professional Associations and Franchise Organizations on Competitiveness of the Healthcare Clinics**  
  Nina Gorovaia, Guillermo Navarro Sanfeliz, and Francisco Puig  
  Page 113

- **Management of Franchising Networks: Seven Principles for Fair Franchise Advisory Councils**  
  Evelien P. M. Croonen and Ivo Bleeker  
  Page 133
Decision Model to Locate a Franchisee Applied to a Fast-Food Restaurant .................................................. 155
José Daniel García-Castro and Josefa Mula

Part II Co-operatives
Horizon and Portfolio Investment Constraints in Agricultural Co-operatives .................................................. 179
Jason Franken and Michael Cook
Member Heterogeneity and Exit ........................................... 197
Julia Höhler
Co-operatives in Modern Food Supply Chains: A Case Study of the Malt Barley Sector in Ethiopia .................. 217
Delelegne A. Tefera and Jos Bijman
Hybrids in the French Apple Industry: Opportunistic and Cognitive Differences Between a Cooperative and an Investor-Owned Group ........ 239
Louis-Antoine Saïset and Jean-Marie Codron

Part III Alliances
Collocation for Supplier–Client Knowledge-Based Coordination: Niche Positioning, Task Complexity, and Comparative Costs ................. 269
Douglas J. Miller and Carmen Weigelt
Dealing with the Post-Honeymoon Blues: Tensions and Governance in Industry–University Alliances ......................... 295
Eveline Corine ten Hoor and Isabel Estrada Vaquero
The Co-evolution of Clusters and the Role of Trans-local Linkages ....... 321
Francesca Mariotti, Muhammad Zafar Yaqub, and Sajjad Haider
The Effects of Cluster Cooperation as a Source of Company Value Creation ..................................................... 337
Joanna Kuczewska, Sylwia Morawska, and Tomasz Tomaszewski
Entering a Foreign Market: Exports, FDI or Strategic Alliance? ........ 353
Karl Morasch
Public-Private Partnerships in Latin America: Evidences from Healthcare Networks ........................................ 373
Nathalie Colasanti, Rocco Frondizi, Marco Meneguzzo, and Noemi Rossi

Contributors

Jos Bijman Business Management & Organisation Group, Wageningen University & Research, Wageningen, The Netherlands
Ivo Bleeker Flynth Adviseurs & Accountants Zwolle, Zwolle, The Netherlands
Gérard Cliquet Institute of Management of Rennes (IAE), Université de Rennes 1, Rennes, France
Jean-Marie Codron INRA, UMR MOISA, INRA, CIRAD, Montpellier SupAgro, Montpellier, France
Nathalie Colasanti University of Rome Tor Vergata, Rome, Italy
Michael L. Cook Department of Agricultural and Applied Economics, University of Missouri, Columbia, MO, USA
Evelien Croonen Faculty of Economics & Business, University of Groningen, Groningen, The Netherlands
Cary Di Lernia The University of Sydney Business School, The University of Sydney, Sydney, Australia
Muriel Fadairo Université Savoie Mont Blanc, IAE Savoie Mont-Blanc (USMB/IAE) Institut de Recherche en Gestion et Economie (IREGE), Mont Blanc, France
Jason R. V. Franken School of Agriculture, Western Illinois University, Macomb, IL, USA
Rocco Frondizi University of Rome Tor Vergata, Rome, Italy
José Daniel García-Castro Escuela Politècnica Superior de Alcoy, Universitat Politècnica de València, Alcoy, Alicante, Spain
Nina Gorovaia School of Business and Law, Frederick University Cyprus, Nicosia, Cyprus
Sajjad Haider Department of Business Administration, Faculty of Economics and Administration, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia

Reinder Hamming Faculty of Economics & Business, Alumni of University of Groningen, Groningen, The Netherlands

George W. J. Hendrikse Rotterdam School of Management, Erasmus University Rotterdam, Rotterdam, The Netherlands

Julia Höhler Institute of Farm and Agribusiness Management, Justus Liebig University Giessen, Giessen, Germany

Maria Jell-Ojobor Department of Business and Management, LUISS Guido Carli University, Rome, Italy

Joanna Kuczewska Faculty of Economics, University of Gdansk, Gdansk, Poland

Francesca Mariotti Department of Business Administration, Faculty of Economics and Administration, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia

Marco Meneguz University of Rome Tor Vergata, Rome, Italy

University della Svizzera Italiana, Lugano, Switzerland

Douglas Miller Rutgers Business School-Newark and New Brunswick, Piscataway, NJ, USA

Karl Morasch Bundeswehr University Munich, Neubiberg, Germany

Sylwia Morawska Collegium of Business Administration, Warsaw School of Economics, Warsaw, Poland

Josefa Mula Research Centre on Production Management and Engineering (CIGIP), Universitat Politècnica de València, Escuela Politècnica Superior de Alcoy, Alcoy, Alicante, Spain

Nguyen Minh Ngoc CREM UMR 6211CNRS, IGR-IAE Université de Rennes 1, Rennes, France

Rubens Nunes School of Animal Sc. and Food Engineering (USP/FZEA), University of São Paulo, Pirassununga, São Paulo, Brazil

Francisco Puig Dpto. Dirección de Empresas "Juan J. Renau", Facultad de Economía, Universidad de Valencia, Valencia, Spain

Noemi Rossi University of Rome Tor Vergata, Rome, Italy

Maria Sylvia Machione Saes School of Economics, Business and Accounting (USP/FEA), Center for Organization Studies (CORS), University of São Paulo, São Paulo, Brazil

Louis-Antoine Sässet Montpellier SupAgro, UMR MOISA, Montpellier SupAgro, INRA, CIRAD, Montpellier University, Montpellier, France

Guillermo Navarro Sanfelix Dpto. Dirección de Empresas "Juan J. Renau", Facultad de Economía, Universidad de Valencia, Valencia, Spain

Vivian Lara Santos-Silva School of Animal Sc. and Food Engineering (USP/FZEA), University of São Paulo, Pirassununga, São Paulo, Brazil

Marijana Srečković Institute for Interdisciplinary Building Process Management, TU Wien, Vienna, Austria

Delegne A. Tefera Department of Agribusiness and Value Chain Management, Hawassa University, Awassa, Ethiopia

Eveline Corine ten Hoor University of Groningen, Groningen, The Netherlands

Andrew Terry The University of Sydney Business School, The University of Sydney, Sydney, Australia

Tomasz Tomaszewski Faculty of Economics, University of Gdansk, Gdansk, Poland

Isabel Estrada Vaquero University of Groningen, Groningen, The Netherlands

Carmen Weigelt A.B. Freeman School of Business, Tulane University, New Orleans, LA, USA

Josef Windsperger Department of Business Decisions and Analytics, University of Vienna, Vienna, Austria

Muhammad Zafar Yaqub Department of Business Administration, Faculty of Economics and Administration, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia
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

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J. Franken (✉)
School of Agriculture, Western Illinois University, Macomb, IL, USA
e-mail: JR-Franken@wiu.edu

M. Cook (✉)
Department of Agricultural and Applied Economics, University of Missouri, Columbia, MO, USA
e-mail: CookML@missouri.edu

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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 horizon and portfolio 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; Furbobtn 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 Wassenhove 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 not transferable (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 Furbottb-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 (Furbottb 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.

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1See 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 Krumpelman-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 (Krumpelman-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 experience 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
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 (Reitka 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). NMG 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 NMG 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 NMG, 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 NMG, 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, Value AddedTech 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>
<thead>
<tr>
<th>Cooperative/variable</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
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<tr>
<td><strong>Fonterra (N = 902)</strong></td>
<td></td>
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<tr>
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<tr>
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<td>Intend to expand</td>
<td>0.67</td>
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<td><strong>NMG (N = 91)</strong></td>
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<td>Lender value &gt;90%</td>
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<td>1.00</td>
</tr>
<tr>
<td>Farm/HH income &gt;50%</td>
<td>0.14</td>
<td>0.34</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Commodities</td>
<td>2.57</td>
<td>0.73</td>
<td>2.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Intend to expand</td>
<td>0.53</td>
<td>0.50</td>
<td>0.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Notes: NMG denotes Northeast Missouri Grain Processors cooperative.

Table 2 Summary statistics
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 Commodity 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 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. Hoelter (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 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 (Wadsorth 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.

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

<table>
<thead>
<tr>
<th></th>
<th>Fonterra</th>
<th>NMGP</th>
<th>WCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relinquish in &gt;5 years (binary)</td>
<td>0.0576</td>
<td>−0.2730***</td>
<td>−0.0898</td>
</tr>
<tr>
<td>Lender value &gt;90% (binary)</td>
<td>0.0571</td>
<td>0.2456</td>
<td>−0.0556</td>
</tr>
<tr>
<td>Farm/HH income &gt;50% (binary)</td>
<td>0.0030</td>
<td>0.0166</td>
<td>−0.2050</td>
</tr>
<tr>
<td>Commodities</td>
<td>−0.0413*** (0.016)</td>
<td>0.0531 (0.043)</td>
<td>−0.0818 (0.057)</td>
</tr>
<tr>
<td>Intend to expand (binary)</td>
<td>0.0613*** (0.036)</td>
<td>0.1878 (0.112)</td>
<td>0.2699*** (0.083)</td>
</tr>
<tr>
<td>$McFadden's R^2$</td>
<td>0.012</td>
<td>0.100</td>
<td>0.071</td>
</tr>
</tbody>
</table>

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.

5 Conclusions

Though horizon and portfolio problems are commonly thought to limit cooperatives’ ability to capitalize on investment opportunities (Cook 1995; Biopoulous 1998; Peterson 1992; Porter and Scully 1987; Statz 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 nearing 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.

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