



International Food and Agribusiness Management Review

Official Journal of the International Food and Agribusiness Management Association

Volume 17: Issue 1 2014



International Food and Agribusiness Management Review

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The IFAMR (ISSN #: 1559-2448) is published quarterly and is available at http://www.ifama.org. For copyright and publishing information, please contact: Kathryn White, Administrative Editor. IFAMA Business Office • 1511 15th Street, NW Suite 500 Washington, DC 20005 • USA • Tel: 1 (202) 429-1610 • Fax: 1 (202) 530-0659 • E-mail: ifamr@ifama.org • Web: http://www.ifama.org



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EDITOR'S NOTE

Dear Readers,

As we begin 2014 with our first issue of the year, I want to draw readers' attention to a very simple mission we initiated six years ago: to elevate the impact of the sub discipline of food and agribusiness management.

First a disclaimer, we have much more to do. But let me review the actions we have put in place to give our authors voice and translate that voice into impact. First, we now publish double the number of articles while simultaneously halving our acceptance rate.

Second, we have in the last few years worked with scholars and now publish about two special issues a year. Special issues provide a platform for scholar editors to advance an important theme. In 2014, we will see editors from the USDA's Economic Research Service (ERS) publish a vitally important issue on the role of management on the obesity epidemic. Editors, Mary Shelman from the Harvard Business School, Aidan Connolly, Vice President of Alltech, and Mandla Nkomo, from TechnoServe will publish a fascinating issue on African food and agribusiness case studies. This issue is unique in its focus on African private sector entrepreneurs. Two new special issues are in the works for 2015.

Third, our downloaded articles have been rising at a 40% per year clip, and now top 22,000 articles a month. When we began, the number was in the hundreds. This resulted from going open access and by making a concerted effort to have numerous organizations catalogue our journal.

Fourth, we now have impact factors from Thompson Reuters (U.S.), Scopus (Europe), and are highly ranked in Brazil.

Fifth, we now welcome sponsorship and advertising. These steps allow organizations to directly buy in to the journal, link us to their efforts, and provide the IFAMR with capital for growth.

Sixth, we have dramatically increased our global email list to over 10,000 food and agribusiness scholars, managers, and policymakers who now receive E-reader copies of every issue in their mailbox.

Finally, we offer the opportunity for authors to produce executive videos that we place on our YouTube channel. Not only is there often interest by our readership to watch a video on a subject matter, but YouTube is owned by Google which provides synergy in terms of search. We have a library of 50+ videos. A video by Fritz Roka, Associate Professor in the Food and Resource Economics Department at the University of Florida has been downloaded over 19,000 times in the last year. Now that is impact!

What can you do to help us on our mission? Keep sending us articles. Instead of producing one article on a topic, edit a special issue and advance an idea with ten. Cite IFAMR articles in your publications. Link the IFAMR to your web page. Produce a two-minute video to accompany your article. Promote your program to our global mail list by advertising. Together we can build the sub discipline of Food and Agribusiness Management.

Enjoy the issue,

Peter Goldsmith, Executive Editor, IFAMR





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Big Data and the Ag Sector: More than Lots of Numbers

Steve Sonka

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Abstract

It seems that one can't go through a work day without seeing some mention of Big Data, its application and its potential to have unprecedented impact. The potential for Big Data application in the agricultural sector is examined. The role of analytics and the variety and velocity characteristics of Big Data as they can apply to the sector are stressed. Integration of data and analysis across business and government entities will be needed for successful implementation. The eventual impact of Big Data within the agricultural sector likely will require both organizational and technological innovation.

Keywords: Big Data, agricultural supply chain integration, information and communication technology

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Over the last three decades, the application of information and communication technologies (ICT) has had marked impact across society and the economy. Changes fueled by ICT adoption are apparent to us today and the processes by which those changes occurred are a tacit part of our experience base. As we moved through that adoption process, however, the extent of adoption and its eventual effects were not nearly so clear. We asked questions such as:

In the 1980s,

- What is a microcomputer?
- If my office has a Selectric typewriter, why would I need to do word processing?
- o Isn't 32K RAM (Random Access Memory) plenty?

In the 1990s,

- I have voice mail for my phone, why would I use e-mail?
- What is this Internet thing?
- Would farmers actually pay for GPS-based yield monitors?

In the 2000s,

- Why would I buy a book on-line when the bookstore is just down the road?
- o I get calls on my current cell phone, why buy something called a Smartphone?
- Google it?

Today, ICT-based advances continue to offer opportunities and challenges. One of the most talked about, for business, government, and society, is called "*Big Data*". (A term often followed by either the phrase –"whatever that is" or by a measure expressed as "****bytes", which then is explained as equivalent to some multiple of the information stored in the Library of Congress.)

Big Data is perceived to be as relevant for agriculture as it is for the rest of the economy. Indeed, Padmasree Warrior, Chief Technology and Strategy Officer for Cisco Systems (Kirkland 2013), notes:

In the next three to five years, as users we'll actually lean forward to use technology more versus what we had done in the past, where technology was coming to us. That will change everything, right? It will change health care; <u>it could even change</u> <u>farming</u>. There are new companies thinking about how you can farm differently using technology; sensors connected that use water more efficiently, use light, sunlight, more efficiently.

The purpose of this article is to examine the Big Data phenomenon and to explore its implications for agriculture. From a managerial perspective it is important to stress that Big Data encompasses much more than just lots of numbers. It provides the potential for managers to have access to explicit information and decision making capabilities that have not been available previously. For some, the resulting innovations likely offer opportunity but, for others, they represent threats.

The Big Data phenomenon is driven by stunning and exciting advances in technology. Taking advantage of these advances in the ag sector could require new organizational linkages to be formed – between suppliers and customers and among competitors. The effective evolution of such linkages will materially affect the manner and extent of Big Data's effect on the sector.

The remainder of this report is comprised of the following three sections:

- Exploring Big Data and characteristics of its business application to date
- Big Data and agriculture: vision and/or hallucination?
- Wrapping it up

Exploring Big Data and Characteristics of its Business Application to Date

Although of great potential importance, the Big Data phrase is only the latest buzz word to capture media attention. Interestingly, there seems to be a continual pattern in society's response to such phenomenon; we tend to overestimate the initial impact and underestimate the long run effect. Both perceptions can lead to difficulties for agricultural managers as they fashion the most effective response to innovation possibilities.

The Big Data concept seems to be clearly in the initial overemphasis stage, where media hype and advertising are capturing significant attention. In this section, we'll attempt to present available information without being overwhelmed by the enthusiasm of the moment. The examples noted in this section will not be limited to applications in production agriculture or the food chain. Linking the concepts noted here to potential application in agriculture will be the focus of the paper's following section.

In this section, we'll focus on the following three components of Big Data:

- What is Big Data and why is it different?
- Example applications
- What are the managerial lessons so far?

What is Big Data and Why is it Different?

The reference source of choice for today's college student (Wikipedia 2013) highlights six examples of Big Data use:

- Amazon.com handles millions of back-end operations every day, as well as queries from more than half a million third-party sellers.
- Walmart handles more than 1 million customer transactions every hour, which is imported into databases estimated to contain more than 2.5 petabytes (2560 terabytes) of data – the equivalent of 167 times the information contained in all the books in the US Library of Congress.
- Facebook handles 50 billion photos from its user base.

- FICO Falcon Credit Card Fraud Detection System protects 2.1 billion active accounts world-wide.
- The volume of business data worldwide, across all companies, doubles every 1.2 years, according to estimates.
- Windermere Real Estate uses anonymous GPS signals from nearly 100 million drivers to help new home buyers determine their typical drive times to and from work throughout various times of the day.

These examples illustrate, but don't completely capture, the diversity of Big Data applications. Looking behind such examples, three dimensions are typically used to describe the Big Data phenomenon; **Volume**, **Velocity**, and **Variety**. Each dimension present challenges for data management and for exploiting opportunities to advance business decision making. These three dimensions focus on the nature of data, however, as we'll see just having data isn't sufficient. Therefore an overview of **Analytics** also will be presented in this section.

We'll employ the concepts of a recent paper of the McKinsey Global Institute to describe the dimension of Big Data (Manyika et al. 2011). Interestingly, the **volume** dimension of Big Data is not delineated in quantitative terms. Rather, Big Data refers to datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyze. This definition is intentionally subjective and incorporates a moving definition of how big a dataset needs to be in order to be considered big. As technology advances over time, the size of datasets that qualify as Big Data will also increase. Also the definition can vary by sector, depending on what kinds of software tools are commonly available and what sizes of datasets are common in a particular industry. With those caveats, Big Data in many sectors today will range from a few dozen terabytes to multiple petabytes (thousands of terabytes).

The **velocity** dimension refers to the capability to acquire, understand, and interpret events **AS** they occur. For analysts interested in retailing, anticipating the level of sales is critically important. McAfee and Brynjolfsson (2012) report on an effort to monitor mobile phone traffic to infer how many people were in the parking lots of a key retailer on Black Friday – the start of the holiday shopping season -- as a means to estimate retail sales.

Variety, as a dimension of Big Data, may be the most novel and intriguing of these three characteristics. For many senior managers, the personal computer freed us from the tyranny of the IT department's chokehold on data. In our experience, however, data refers to numbers meaningfully arranged in rows and columns that can then be summarized in appropriate standardized reports. Usually these numbers summarized operating and financial performance.

For Big Data, the concept of "what is data" is wildly expanded. We now refer to the "Internet of Things"—acquisition of data from activities in the physical world, where sensors embedded in physical objects continually report on their status. In the Internet of Things, processes continually monitor and report their own activities and products are themselves source of information – of what they are, where they are and where they're headed. The potential role of nanotechnology-based sensors will be critical to low-cost, widespread availability of sensor capabilities (Lu and Bowles 2013).

Of equal importance is the capability for Big Data efforts to extract value from analysis of unstructured, qualitative data. Searching text files is not new. Previously, however, such efforts had to be carefully structured, with precise search terms and limitations on the amount of text examined. Big Data tools enable analysts to explore massive quantities of text and allow for the analysis itself to identify the relevant descriptors within the information.

ICT advances have materially affected what is data and the ability of businesses to capture, transmit and store data. But, we still have to make sense of the information inherent in these massive amounts of diverse data to learn how to make better decisions and implement new opportunities. **Analytics** (often with information, business, or social as an adjective) is the term now used to describe this process.

A comparison of shopping for a book in a physical store versus shopping on-line illustrates the change of perspective. Tracking, of which books sold and which didn't, could be done effectively in a physical bookstore. Combined with a loyalty program, that information could be linked to characteristics of the individual purchaser. This information needs to be captured by the on-line bookseller as well. However, the on-line bookseller can track and influence the shopping experience of each customer. The on-line bookseller can track what books were examined but not purchased and how the customer navigated through the site. The customer, while shopping, can be offered promotions and suggestions – linked to that customer's characteristics. Further the effectiveness of the suggestions and promotions can be assessed. Learning from and influencing the shopping experience is driven by development and implementation of algorithms in the process referred to as information analytics.

Of course, brick and mortar retailers have the potential to employ ICT applications in novel ways to develop improved insight regarding their in-person customers (Clifford and Hardy 2013). Tracking cell phone signals as customers move through the store can give an indication of what is of most interest. Facial recognition software may allow clerks to anticipate the shopper's mood and thereby improve their interaction with the customer. Interestingly some in-person customers, when informed that in-store tracking is occurring, respond negatively to the practice even though they report little concern with website tracking.

Example Applications

We just explored the differing perspectives available to a physical bookstore versus its on-line competitor, where the insights gained regarding each customer were stacked in favor of the online offering. In Exhibit 1, examples of manufacturing applications are described (Hagerty 2013).

Exhibit 1. Monitoring Manufacturing Processes.

Companies' pursuit of "big data"—collecting and crunching ever larger amounts of information—is often thought of as another way to figure out exactly what customers want. But big data is also a means of measuring millions of little things in factories, such as how many times each screw is turned.

That is what Raytheon Co. is doing at a new missile plant in Huntsville, Ala. If a screw is supposed to be turned 13 times after it is inserted but is instead turned only 12 times, an error message flashes and production of the missile or component halts, says Randy Stevenson, a missile-systems executive at Raytheon. Improvising with a defective screw or the wrong size screw isn't an option, he says. "It's either right or it's not right."

At Harley-Davidson Inc.'s newly renovated motorcycle plant in York, Pa., software keeps a constant record of the tiniest details of production, such as the speed of fans in the painting booth. When the software detects that fan speed, temperature, humidity or some other variable is drifting away from the prescribed setting, it automatically adjusts the machinery.

"It allows us to be more consistent," says John Dansby II, vice president for global manufacturing at the motorcycle maker. In the past, he says, operators had a bit of leeway on paint jobs and each could do the work in a slightly different way. Now it is supposed to be an exact science, not an art.

Harley has also used the software to find bottlenecks that could keep it from its goal of completing a motorcycle every 86 seconds. Recently, by studying the data, Harley managers determined that installation of the rear fender was taking too long. They changed a factory configuration so those fenders would flow directly to the assembly line rather than having to be put on carts and moved across an aisle.

Recently, public attention was fixated on another Big Data application, one that didn't directly involve manufacturing or consumers. Instead it was revealed that the National Security Agency was efficiently able to parse millions of phone, text and online conversations for information. Hickens (2013) describes the advances in technology which facilitated this Big Data application. In particular, software and hardware advances are noted which drive rapid assessment of massive amounts of unstructured data. These advances often employed tools developed for commercial application.

Managerial Lessons

The reality that ICT-based advances can enhance business operations and disrupt industries is not a recent event. Indeed, for managers in the 1990s, the challenge of dealing with and taking

advantage of the "knowledge economy" parallels the attention devoted to Big Data today. At that time, there was considerable speculation regarding the advent and potential effects of the knowledge economy. However, some key concepts were identified that have proven to have long-run applicability. Central among these findings is the notion that, while the new technology is essential, the capability to exploit the learning that results from the use of the new technology is the important element of the process.

Extensive use of information technology has redefined industries throughout the economy. Although the effects often have been described in some detail, the underlying mechanisms that fuel industry transformation have been less well understood. Sampler (1997) provides an important analysis of these underlying mechanisms. His analysis stresses that, although industry transformation may be the result, we need to understand the impact of information technology at the level of the individual transaction. Two key transaction characteristics are identified:

- Separability refers to the extent to which specific information attributes can be captured in association with each transaction and
- Aggregation potential refers to the extent to which those information attributes can be leveraged to gain economic value beyond the purpose of the original transaction.

Traditionally an economic transaction is perceived as the exchange of a good or service for cash. The information attributes that *must* be captured in that exchange are relatively minimal; the amount of cash and the quantity of the product. Clearly the introduction of low cost information systems has materially altered the nature and amount of attributes that are routinely captured in many of today's economic exchanges. Considerable effort is now expended to identify the purchaser and to profile the purchaser demographically.

But information technologies are now employed in settings that require us to alter our perception of what constitutes an economically relevant transaction. Real time sensors, for example, can monitor engine tire wear so that each revolution of the tire is a transaction. When equipped with communication capabilities, such monitors can alert decision makers of the potential for critical problems before these problems occur.

The second transaction characteristic is aggregation potential. Knowing the purchase habits of one consumer is interesting but that information provides little economic value. However, being able to accumulate and analyze the purchase behaviors of many consumers can have considerable value. In the case of a sensor tracking engine performance, there is value (which must be at least greater than the cost of employing the sensor system) in knowing the status of that one engine. Again, however, there are additional benefits available if that data can be accumulated, analyzed, and used to predict and enhance future performance. These examples illustrate the key role of the aggregation potential characteristic as the use of information technology redefines industries.

Aggregation potential typically requires sophisticated analysis, extensive communications and the ability to capture returns from wide-spread application of the algorithms defined. As detailed by Shapiro and Varian (1999), these characteristics result in significant economies of scale on the

"supply-side" of information economics. First-mover advantages, therefore, accrue to the first firm to effectively create a system that can exploit aggregation potential. These "winner-takesall" effects have interesting implications for future industry structure where they occur. These scale economics (of information aggregation) naturally transfer to the realm of Big Data.

A recent analysis conducted by the Economist Intelligence Unit indicates that business leaders feel there is a strong link between use of Big Data and economic performance (Economist Intelligence Unit). Based upon surveys with several hundred executives from across the globe and industry sectors, it was found that top-performing companies:

- Process data more rapidly than their peers,
- Acquire more data from outside their internal operations, and
- Use the data in more functions across the firm.

The overall lesson is that more successful firms exploit Big Data by focusing on business priorities.

Barton and Court (2012) worked with dozens of firms in data rich industries. They identify three supportive capabilities as essential to achieving success in the application of Big Data. These are the ability to:

- Identify, combine, and manage multiple sources of data,
- Create advanced analytic models for predicting and optimizing outcomes, and
- Transform the organization so that data and models actually yield better decisions.

Big Data and Agriculture: Vision and/or Hallucination?

Big Data applications are being employed throughout the economy and society. The technologies employed are exciting, involve analysis of mind-numbing amounts of data and require fundamental rethinking as to what constitutes data. And the potential for gain through use of these technologies seems to far exceed the benefits achieved so far. However, there are issues as to what constitutes "appropriate" use of these capabilities. Societal responses to those issues, especially as it relates to privacy, will shape the future growth of Big Data.

The following discussion will tend to emphasize economic factors. However, consumer and societal forces also can materially affect technology adoption. In agribusiness, two such important forces relate to environmental and food safety concerns. If society demands (regulates) verification of agriculture's effect on an environmental phenomenon (for example, fertilizer use and its effect on the Gulf of Mexico), application of Big Data approaches may prove to be the most feasible means to respond. Similar possibilities exist relative to food safety concerns. In those instances, application of Big Data may be essential to provide "freedom to operate" in the sector.

The path by which Big Data could affect agriculture is not determined at this point. A recent article focused on identifying the "right questions" to pursue when digital technologies have the potential to disrupt industries (Wilmot 2013). The first question was, "How will IT change the

basis of competition in your industry?" While we expect Big Data applications to be used within agriculture, that doesn't mean that all applications will change the basis of competition. Indeed, the question in this section's title hopefully reminds us -- there's often a thin line between vision and hallucination.

The following discussion briefly reviews the key distinctive aspects of Big Data and discusses two technology advances that can markedly change what we think of as data in agriculture. Then two innovations will be presented where Big Data is being employed to develop potential services for agriculture. Third, the issue of industry transformation will be discussed relative to technological and organizational dynamics of the sector.

Big Data's Distinctive Features

Earlier, we considered Big Data's three dimensions; Volume, Velocity, and Variety. Variety, in many ways, is the most intriguing of these dimensions. No longer is data just numbers in a spreadsheet. A number of examples have been discussed in this article. The data types included in those examples include:

- Financial transactions
- Movements of a cursor on a webpage
- "Turns of a screw" in a manufacturing process
- Tracking of web pages examined by a customer
- Photos of plants
- GPS locations
- Text
- Conversations on cell phones
- Fan speed, temperature, and humidity in a factory producing motorcycles
- Images of plant growth taken from drones or from satellites
- Questions

The capability to rapidly process large quantities of data is one necessary feature of Big Data. Analytics, "making sense" of massive amounts of highly variable data types, can provide new insights. Our history conditions us to frame analysis as a process where data is assessed to provide an answer. However, today, powerful analytical tools today can search unstructured data with the goal of "identifying the questions" embedded in the data. The NSA use of Big Data tools noted previously appears to be an example of application of this capability.

As well, continuing technology advances are fueling Big Data applications and changing the sense of what we regard as data. Let's consider two types of innovations, remote sensing and the cell phone, as potential <u>sources</u> of data which when combined with other types of data can affect the decision making capabilities of agricultural managers.

To this point, use of GPS and VRT-related tools in crop farming have been focused on input application at pre-planting and planting and yield measurement at harvest. Measurement during the growing season, either to inform input application or to assess and learn from phenomena that occur then, typically isn't done extensively for the major crops. Of course, given prior technology, the cost of conducting these measurements exceeded the perceived benefits. However, technology developments are emerging which could change this cost/benefit ratio.

A recent *Wall Street Journal* article outlined on-going efforts to transform Unmanned Aircraft Systems (UAS) capabilities originally focused on military purposes to applications supporting production agriculture. "As the spring growing season unfolds, universities already are working with agricultural groups to experiment with different types of unmanned aircraft outfitted with sensors and other technologies to measure and protect crop health". Applications include:

- Monitoring of potato production (Oregon State University),
- Targeting pesticide spraying on hillside vineyards (University of California-Davis),
- Mapping areas of nitrogen deficiency (Kansas State University), and
- Detecting airborne microbes (Virginia Polytechnic Institute and State University).

Those specific examples are only a sample of the numerous experiments and demonstrations being conducted to identify cost effective means to employ the UAS technology to enhance agricultural systems. UAS capabilities offer flexibility and potentially lower cost relative to the use of even small manned aircraft, especially for monitoring and measurement. Although many of these efforts are being done in the Midwest, it is likely that initial commercial application will occur where higher value crops dominate. Of course, an efficient process for regulatory approval of UAS flight will be needed before widespread commercial application of UAS can be implemented.

UAS innovations have the potential to make airborne monitoring more cost effective, but there are significant technical and economic issues that need to be addressed to achieve extensive viability. For some time, satellite-based sensing abilities have been available and it is believed that information from these sources has been employed to inform crop production estimates during the growing season.

Remote Sensing-Based Information and Insurance for Crops in Emerging Economics (RIICE 2013) is a global initiative currently being implemented. The RIICE consortium of partners, which includes technology, insurance and development entities, will rely upon satellites of the European Space Agency to provide on-going observations of rice production systems in Southeast Asia. The system will measure temporal changes in reflectivity of the plants to provide estimates of growth of rice plants. The Synthetic Aperture Radar (SAR) technology employed offers an effective alternative to optical observation, which has the major disadvantage that clouds can obstruct mapping and monitoring. Because satellite coverage of any specific spot on the earth occurs only once every few days, the presence of clouds when the satellite goes by can leave significant gaps in the data gathering process.

While we've become accustomed to the extensive use of cell phones in the United States, it's awe inspiring to observe cell phone adoption in developing countries. It is estimated that there were 6.4 billion mobile phone users globally in 2012 (International Telecommunication Union). Examples of the reach of cell phone use by 2012 include:

In India		
	0	865 million mobile phone subscribers
	0	#2 Global Market (After China)
In Brazil		
	0	248 million mobile phone subscribers
	0	#6 Global Market (After China, India, USA, Indonesia, and Russia)
In Nigeria		
C	0	113 million mobile phone subscribers

• #10 Global Market

Adoption is extensive in urban areas; however, cell phone use is common in rural areas. Cell phones, of course, are not created equal, ranging from devices which receive phone and text messages to smart phones that effectively operate as small computers. In addition to receiving data and information, the use of cell phones as sensors is receiving intense interest from both private and public sector entities. The camera is a means of capturing images, which new technology is allowing to be analyzed as digital data.

Messages sent by cell phone users also can provide important data -- that when aggregated can provide important and timely insights. Figure 1 illustrates this point (Mock et al. 2013). A key factor indicating social well-being in developing countries is the food price index. While extensive efforts are made to track food prices, official reporting processes take time to collect data and therefore may unduly lag actual conditions affecting low income consumers and social stability. However, individuals "talk" about changes in food prices continually. The two graphs in Figure 1 both track movements in food prices in Indonesia during 2010 and 2011. The bottom graph provides the official monthly inflation rate for food prices. The top graph tracks the volume of tweets per month in Indonesia, where the topic was the price of rice. The similarity in direction and turning points of the two graphs provides support for the belief that important information can be acquired from social media sites.



Tweets on the Price of Rice

Figure 1. Comparison of estimates of food price inflation and tweets about the price of rice in Indonesia.

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Two Specific Big Data Applications for Agriculture

Figure 2 displays a rendition of the Lettuce Bot, a technology being developed to identify and then eliminate weeds in the field (Dawson 2013). Developed at a California start-up, Blue River Technology, the key Big Data aspect of the Lettuce Bot is its ability to identify plants and weeds instantaneously from a database of millions of images of plants. The current version of Lettuce Bot releases a spray of fertilizer on either a weed or an unwanted plant (for example, a plant growing too close to another plant). Later versions of the Lettuce Bot may use mechanical devices to remove the offending plant, for example, in organic fields where fertilizer application would not be appropriate.



Figure 2. Depiction of the Lettuce Bot weeding a vegetable field.

The Lettuce Bot has the potential to reduce or eliminate hand-weeding or thinning practices. In labor-intensive vegetable production systems, access to labor and compliance with labor regulations are significant managerial issues. Similar applications of machine recognition tied to image-based databases could be applied at several steps in agricultural supply chains, especially where use of manual labor to do sorting is an issue.

All of us are familiar with general weather forecasts delivered by the media. However, most of us are frustrated when such forecasts don't meet our business needs. Figure 3 describes Deep Thunder, an initiative from IBM, which focuses computing power, multiple data sources, and targeted software to provide "hyperlocal" weather forecasts. Here, hyperlocal refers both to geographic scale and to specificity of business needs.

Figure 3 cites numerous potential benefits of use of Deep Thunder-based services. These include direct linkage to precision agricultural practices, increased yields, reductions of postharvest loss, and consumer benefits of lower price, improved quality and presumably lesser environmental impacts. A key factor noted is the potential for more effective water use, a critical global concern.



Figure 3. Depiction of use of Big Data technology to provide hyperlocal weather forecasts to support agriculture.

Speculation about Changing the Basis of Competition

Important in their own right, the Lettuce Bot and Deep Thunder applications also were shown to illustrate a specific type of application of Big Data technology in agriculture. In these instances, the Big Data elements of the application are available independently of the agribusiness operations to which they might be applied. Individual managers can assess the value of the offered service and then adopt, or not, the service. The Big Data basis of the service is essentially irrelevant to the manager making the purchase decision. Such innovations will affect competition in specific markets, but are not likely to alter the basis of industry competition. Alternatively here are three examples of altered competition:

- Wal-Mart transformed retailing through an aggressive focus on price facilitated through path-breaking use of IT and by using those capabilities to alter relationships with suppliers.
- Amazon enhanced, in some dimensions, the customer's shopping experience and employed ICT to learn how to improve each customer's next experience.

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• Toyota's lean manufacturing techniques are based upon extensive data analysis leading to transformed relationships with suppliers.

Cutting across these and other examples, common features of changes in the basis of competition include:

- Dramatic cost reductions.
- Quality enhancements desired by customers.
- Redefined relationships across stages of the value chain.

The most dramatic and impactful of these instances results when the features occur in combination.

Figure 4 provides a highly useful illustration of data integration and analysis as an attractive vision for production agriculture (Riverside Research). In several respects the perspective shown there is similar to our now familiar concepts of precision agriculture as they affect field operations and harvest. But there is one important point of difference, the explicit emphasis on analytics and integration. Indeed Figure 4 explicitly draws attention to the need to integrate across many production sites rather than to expect to make substantial advance based upon precise data from a single field.

Field Research Field Data Collected Field Data Collected Field Data

UAS Application to Agricultural

Figure 4. Representation of data integration and analysis for production agriculture¹

Figure 4, although useful, masks two key factors that will have to be addressed if Big Data applications are to alter the basis of competition in agriculture. One factor relates to the word integration, in particular, the process of integrating across numerous sources of data – where the control of those data doesn't exist within a single entity. The second factor relates to the word

¹ Courtesy Riverside Research, Champaign, Illinois.

analysis. Figure 4 suggests that the needed data can be obtained from field operations, just as counting the turns of a screw can determine if manufacturing processes are within bounds. Field data, while essential, likely is not sufficient to truly optimize production agriculture.

Let's address each of these two factors, noting that the aggregation issue has two dimensions;

- Would an individual farming operation have enough data and/or, more importantly, the analytic capacity to create substantial new knowledge?
- How could the relevant data captured at numerous points across the agricultural value chain be aggregated and then employed to enhance operations both on and off the farm?

Commercial farms continue to grow in size, but the individual farm likely won't have sufficient scale and variety of operation to create significant new information to optimize operations. Indeed, what the individual farm operator doesn't have is detailed information on other similar units and the effect of variations in practice between farms. Scale also is critically important to justify the cost of analytic capabilities. Optimal use of field data likely will require aggregation across a number of farming units. The issue of scale also is a factor in animal agriculture.

Also, the farm operator may not have all the potentially relevant data that relates to the operations of the farm. VRT application of inputs often is done by agricultural retailers. Although planting is most typically done by the producer, the genetic capabilities of the seed planted, are not captured simply by knowing variety planted. Remote sensing, via UAS or satellites, likely will not be performed by individual farmers. Remote capture of engine and machine performance likely is best done at the manufacturer level. Therefore optimal aggregation would need to be accomplished among a number of firms even if some of the firms are competitors.

The second factor relates to the nature of the knowledge required to optimize agricultural performance. Figure 4 focuses on operational data from the farm field. A similar depiction for animal agriculture would depict the feedlot, dairy barn, farrowing and finishing unit, etc. However, having even comprehensive information based upon operational performance may not be sufficient to optimize these production systems.

Agricultural production exploits biological processes, where key factors (such as weather events and pest infestations) are not controlled – even if they are measured. US and global agriculture has made tremendous productivity advances in the last 100 years through the application of what we might call, "Small Data". Knowledge of science and engineering was necessary to unravel the interactions of biology, in the context of those uncontrollable factors. A highly effective, but distributed system emerged where knowledge gained in the laboratory was tested and refined on experimental plots and then extended to agricultural producers.

An important aggregation question is; how can the best aspects of the Small Data system be linked to the application of Big Data technologies? This factor is particularly intriguing in the context of the on-going evolution of agriculture. Not only do weather events vary from year to year but pests evolve in their location and behavior. Advances in genetics and research continue to provide enhanced but differing capabilities. Therefore it seems unlikely that even the most comprehensive data from operations will be totally satisfactory in agricultural systems. Big Data enthusiasts may not appreciate this element of agricultural systems. A recent book

Big Data enthusiasts may not appreciate this element of agricultural systems. A recent book (Mayer-Schonberger and Cukier 2013) on Big Data asserts:

Society will need to shed some of its obsession for causality in exchange for simple correlations: not knowing why but only what. This overturns centuries of established practices and challenges our most basic understanding of how to make decisions and comprehend reality.

Knowing, at increasing levels of precision, "what" happened in the field or in animal facilities does have value. However, not also knowing "why" is a concern in agricultural applications because at least some of the key factors that led to this season's "what" likely will not be identical for the next season or production cycle.

Historically the research necessary to determine the "why's" of crop and livestock production were conducted in the public sector and communicated through public extension services. Over the latter part of the last century, those functions largely shifted to the private sector in the United States. It is possible that effective linkage of these differ types of information also will occur in the private sector in regions of the world where commercial market channels are strong. It is less clear how the capabilities that link traditional ag science with data from the on-going operations of production agriculture would occur in developing agriculture settings.

From a pure technological capability perspective, the aggregation challenges just noted are not insurmountable. However, the associated economic and organizational issues likely will be significantly more difficult to surmount:

- The potential net economic benefits have to be significantly positive to initiate information system innovation. Often where ICT has made significant impact, the information capture activity was done at low or no cost. For each transaction, the cost of capturing the customer's loyalty card information approaches zero. Therefore extracting value by aggregating information that comes at such very low cost is attractive. Or if the missile may explode (and financial penalties imposed on the manufacturer) if screws aren't affixed in exactly the correct manner, the economic justification of the cost of monitoring how screws are affixed is straightforward.
- The organizational challenges of achieving "between firm collaboration" are significant. Such challenges have significant economic implications when the potential parties are competitors or when they are suppliers and customers. Relative to Big Data, the potential relationships would be affected by the different types of capabilities required to achieve advances in knowledge. The analytics required will involve very specialized skills and there is little reason for each party to possess those capabilities. However, the potential for "hold-up" would be a concern of the firms that don't possess that capability.

Of course, producers have a tradition of using the cooperative model to achieve collaboration between firms. In several Midwest states, farm records systems operate to achieve similar goals

to those noted here. Where collaboration at the input supply and the producer level is required, effective incentives structures (which may be both financial and non-financial in nature) will need to be implemented.

In addition to organizational challenges, implementation of information systems generally are characterized by relatively large initial investment and relatively low operating costs. These characteristics typically lead to first-move, winner-take-all effects (Shapiro and Varian 1999). As noted previously, at one time public funding and Land Grant/USDA institutions might have been expected to conduct the necessary research and development. Today, at least in the United States, that seems unlikely. Private firms, both those operating in agriculture and in the technology sector, are exploring Big Data opportunities. Required key capabilities, however, aren't likely to totally exist within any one of the existing challengers in either sector suggesting a fertile field for experimentation and innovation.

Wrapping It Up

Agriculture, globally and in the United States, has been identified as a target for Big Data application by technology developers, including both startups and multinationals. The established firms include those currently in the ag sector or those in the non-ag technology sector.

While the term Big Data is new, application of ICT-based innovation has driven economic transformation over the last three decades. In the 1990s, "the knowledge economy" was the hyped term of the decade and understanding the transformative role of ICT was a key research and practical question. Findings from that work focused on the need for implementation of low-cost means to capture numerous information attributes at the time transactions occurred. Although low-cost separability is necessary, industry transformation occurs only when the information acquired can be aggregated to form new knowledge --which leads to novel operations and offerings. Although the terminology has changed, these findings also apply to the successful application of Big Data technologies today.

The three commonly cited characteristics of Big Data are Volume, Velocity and Variety. A key factor to understanding the potential of Big Data is to realize that it is not **just** about lots of numbers. The variety characteristic emphasizes that data now includes a stunning range of phenomena. Further, it is important to appreciate the power of "analytics", where findings and insights are gained from multiple data sources that differ in structure and original purpose.

The experience of successful Big Data application in non-ag sectors uniformly stresses that it's the business issues and opportunities, not technological capabilities, which determine success. That counsel seems appropriate for agricultural managers as well. Existing technologies, and those on the near horizon, suggest considerable potential for Big Data applications in the agribusiness value chain. Some of those applications will employ data that is not directly captured from agricultural operations to provide enhanced product and service offerings to the sector. These offerings will be adopted or not based upon well accepted cost/benefit parameters.

The more intriguing potential relates to Big Data applications where a considerable segment of that data is generated from within the sector's operations. Data aggregation across business entities seems to be a necessary component of these applications. Competitive dynamics and intellectual property concerns will join expected net benefits among the several factors that will be needed to be addressed. For many Big Data applications, valuable business insights can be gained from capture and analysis of operational data only. However, the biologic underpinnings of agricultural production limit the gains that can be gathered solely from operational data. Linking data from operations with information and knowledge from laboratories and experimental sites (ag's Small Data) will be required to effectively optimize sector performance.

Over the last 50 years computation and analysis have enhanced performance in the economy and in agriculture. Ag sector analysts contributed to those enhancements. However with the limited computer power available then, a key to success was to effectively <u>constrain the problem</u> to fit the data and computational power available. No longer is that constraint needed as Big Data approaches come to agribusiness. Successful application will occur in US and global agriculture but that success will be determined as much by organizational and managerial factors as by technology.

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² Based upon a McKinsey & Company case study *Beyond Precision Agriculture; If Big Data's the Answer What's the Question?* 2013.



International Food and Agribusiness Management Review Volume 17 Issue 1, 2014

Food Preparation for the School Lunch Program and Body Weight of Elementary School Children in Taiwan

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Abstract

In investigating the association between the school lunch programs and children's body weight, this study focuses on the school lunch programs in Taiwan. Using a national representative dataset of elementary schoolchildren, we estimate a mixed multinomial logit model to cope with the potential endogeneity issue, and examine how different types of food preparations for school meal programs may affect children's weight in different ways. The results indicate that children who go to schools which serve lunch meals prepared by school kitchens tend to have lower weight on average. In contrast, children who go to schools offering lunch boxes purchased from outside restaurants tend to have higher weight on average. From a policy standard point of view, our findings could shed some light on how school lunch policy can be designed to help prevent children's obesity.

Keywords: school lunch program, elementary schoolchildren, body weight, mixed multinomial logit model, Taiwan

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Introduction

Childhood obesity has become a global epidemic problem and this alarming trend of obesity rates among children continues to generate serious concern. Obesity during childhood is highly correlated with being overweight throughout adulthood, and obese children are substantially more likely to develop health problems such as high blood pressure as early as adolescence, coronary problems, diabetes, etc (Whitaker et al. 1997). Moreover, childhood obesity would influence long-term psychological problems and labor market results (Daniels 2006; Dietz 1998). Many of these problems impose a substantial burden on healthcare systems. In Taiwan, one in every four children is considered overweight or obese and the prevention of childhood obesity has become one of the primary government policy objectives (Chen et al. 2006; Hsieh and FitzGerald 2005).

Precluding genetic and medical conditions among all of the factors that are associated with children's obesity, the school environment has been shown to be one of the most significant determinants, because schoolchildren normally spend more than half a day in school and school lunch meals are an important source of their daily food consumption (Mirtcheva and Powell 2009; Schanzenbach 2009). From a policy standard point of view, understanding the association between school lunch programs and children's body weight could shed some light on how school lunch policies can be designed to prevent children's obesity.

In Taiwan, the school lunch program was introduced back in 1973, and it was implemented in elementary schools for schoolchildren under 12 years old. The policy goal of the program is to ensure that every young student can have lunch at school to maintain a healthy lifestyle. Hungry and malnourished children are at a great disadvantage in succeeding in a learning environment. However, due to the limited financial budget of each county government, this program was not implemented across the entire nation. To ensure that every school child can eat lunch at school, the government is proposing to enforce that each elementary school provide lunch meals starting in 2015. Therefore, a better understanding of the relationship between school lunch programs and children's health is of particular interest in Taiwan, especially at this point in time.

According to the Hygiene Law of the school lunch program, school lunches have to include rice, at least two kinds of vegetables, one type of meat and a bowl of soup. With respect to the dietary requirement, there is no specific regulation of nutrient intakes that should be implemented in each lunch meal (Ministry of Education 2002). Prices for these lunches are set by the school board's lunch program in each school. The school board generally consists of school teachers, local government officials, and parent representatives. On average, the prices of school lunches are NT\$30–55 per meal. Parents have to pay money every month for these school lunches. However, students with disability, or from low or middle-income families, can receive their school lunches free of charge because the government will cover the cost (Ministry of Education 2002).

In general, there are two different methods for preparing school lunch meals in Taiwan. Some schools prepare the meals in their on-site kitchens, while some schools do not have a kitchen or do not have the capacity to provide cooking facilities. For those schools without food facilities on campus, hot lunch boxes are ordered from large food serving companies or restaurants nearby

according to the assessment and planning of the school. In this case, the school simply plays a supervisory role in monitoring the contents of the lunch boxes provided by the food companies to ensure that they satisfy the minimum requirement of food servings. That is, the school just makes sure that each meal contains rice, at least two kinds of vegetables, one serving of meat and a bowl of soup, but with little information on how these meals are prepared. Because the preparation/provision of school meals differs in various schools, it would be interesting to investigate whether schoolchildren's health also differs in relation to these lunch programs. Given the high public health priority to address the epidemic of childhood obesity, it seems worthwhile to investigate whether these two different types of food preparation of school lunch meals may have different influences on children's body weight.

In light of the importance of the school lunch program, empirical evidence has been provided, with most of it generated in the U.S. Among these studies, much attention had been paid to understanding the roles of socioeconomic characteristics, lifestyle behaviors of children, as well as parental and family conditions which may determine the likelihood of participation in the school lunch program (e.g., Akin et al. 1983; Fox et al. 2009; Gleason 1995; Hofferth and Curtin 2005; Maurer 1984; Mirtcheva and Powell 2009). Until very recently, a few studies examined the influence of school lunch programs on children's body weight; however, their findings are at best inconclusive. For instance, using data from the 1997 child development supplement conducted by the University of Michigan and controlling for self-selection bias, Hofferth and Curtin (2005) found no significant relationship between participation in the school lunch program and body weight of schoolchildren. In contrast, using data of 17,656 children in 994 schools drawn from the early childhood longitudinal study of kindergarten classes in 1998-1999 in the U.S., Millimet, Tchernis, and Husain (2008) found a positive effect of the school lunch program on children's body weight. Using similar data, Schanzenbach (2009) also found a positive relationship between school lunch programs and children's body weight. There are many possible reasons for the inconclusive findings of the previous studies, such as different samples or methodologies. However, no study so far has examined the role of food preparation in the school lunch program.

This study assesses the relationship between the school lunch program and children's body weight in Taiwan.¹ The primary objectives of this study are to answer the following questions: 1) What are the roles of children's socio-demographic characteristics, family factors and school environment in regard to children's participation in the school lunch program? 2) Given that there are three different types of school meal programs for elementary schoolchildren in Taiwan: (a) no school lunch programs, (b) school lunch programs with meals from restaurants outside of school and (c) school lunch programs with meals prepared in on-site kitchens at school, which is associated with the highest probability of childhood obesity?

Using a nationwide survey dataset of the elementary schoolchildren in Taiwan, a mixed multinomial logit model is estimated to investigate the effects of the school lunch programs on

¹ To the best of our knowledge, there was only one study in Taiwan on school lunch programs. Chen et al. (2009) examined the association between food insecurity and disease as well as mental health of schoolchildren in Taiwan. Their study did not find any significant effects of school lunch programs on alleviating the harmful health effects of food insecurity for poor children.

children's body weight. Several interesting findings are revealed. In accordance with the findings of previous studies, socio-demographic characteristics of children and their parents significantly determine both the likelihood of children receiving school lunch programs, and their body weight. In regard to the effects of the school lunch programs, we found that lunch meals prepared in on-site kitchens at school are significantly related to a lower likelihood of being overweight of schoolchild. In contrast, lunch meals ordered from outside restaurants appear to lead to a higher chance to be overweight of schoolchildren. Moreover, a positive self-selection bias between the school lunch program and children's body weight is evident, i.e. the school lunch programs are correlated with children's weight due to some unobserved common factors.

The remainder of this paper is organized as follows. The data used in this study are introduced in the next section. A theoretical framework for the empirical analysis and econometric strategy is then discussed. After presenting the empirical results, we conclude this paper with a brief summary.

Data

Our data were drawn from the Nutrition and Health Survey in Taiwan for Elementary School Children (NAHSITC), conducted by the Bureau of Foods and Hygiene of the Department of Health in Taiwan in 2002. The NAHSITC survey was specifically designed for elementary schoolchildren aged from 6 to 12 years. A multistage stratified sampling scheme was used. In the first stage, 359 townships of Taiwan were divided into thirteen regions according to their ethnicity and geographic location. Within each region, eight schools were selected using probability proportional to their population. Therefore, NAHSITC is representative of the population of the elementary schoolchildren population in Taiwan.²

The primary purpose of this survey was to develop and implement appropriate public health and educational measures to promote health through proper nutrition. The detailed information on nutrition, diet and health was well documented. Not only children's but also parents' profiles were included. Information at both the individual and aggregate level, such as school environment and resources, were recorded as well. In total, 2,419 elementary schoolchildren were chosen for the designated survey. After deleting some observations with missing values, the final sample consists of 2,017 elementary schoolchildren.³

The dependent variable of interest was whether each child was provided with a school lunch. As indicated earlier, schoolchildren were separated into three subgroups, due to the different types of the school lunch programs: children without school lunch, children who are served school lunch prepared by the on-site school kitchen and children with lunch meals ordered from restaurants outside their schools. The other dependent variable was the overweight status of each child. In this dataset, body mass index (BMI) measured as the ratio of weight (in kilogram) to

² Detailed information on survey designs can be found in Fu et al. (2007).

³ In the NAHSITC dataset, approximately 12% of the schoolchildren (i.e. 298 students) have missing values on body weight. Unlike self-reported measures, weight and height of each school child were measured by the school clinics. These students may have missed the scheduled body checking either because they had classes or for other reasons. For the remaining missing values in our sample, the detailed information on the parents was not reported.

height squared (in meters) is documented. Unlike the self-reported values, children's BMI were measured by the health department staff in each school. It has been documented that examining the association between school lunch programs and student's overweight is more important for policy makers than using the continuous measure of body mass index. Therefore, we define a binary variable to indicate whether or not each schoolchild is overweight, based on the official cutoffs determined by the Department of Health in Taiwan. The cutoff differs by student's age and gender.⁴

Built upon the findings of previous studies on school food programs (e.g., Akin et al. 1983; Fox et al. 2009; Gleason 1995; Hofferth and Curtin 2005; Li and Hooker 2010; Maurer 1984; Mirtcheva and Powell 2009), several variables of the socio- demographic and lifestyle behaviors of schoolchildren, parental characteristics, family structure and school environmental conditions are specified. Children's characteristics are represented by age and gender (the variables Age and Male). Since hours of watching television has been shown to be significantly correlated with children's diet and weight (e.g., Anderson et al. 1998; Chang and Nayga 2009; Li and Hooker 2010), three dummy variables are specified to indicate if the average hours of television viewing of children at home are less than 1 hour (the reference group), between 1-2 (the variable TV12), 3-4 (the variable TV34) or more than 5 hours per day (the variable TV56), respectively. Based on the findings in Chang and Nayga (2009), eating breakfast is significantly associated with the body weight of children. Therefore, a dummy variable is also specified, indicating whether the schoolchildren eat breakfast every day at home.⁵

In addition to the socio-demographic factors, some variables reflecting parental behaviors and family characteristics are included. Because the mother's education and employment status reflect the opportunity costs on time use that can be devoted to food preparation in the family (Akin et al. 1983; Chang and Nayga 2009), several dummy variables are specified to capture the effects of parental characteristics on children's body weight and the school lunch programs. With respect to the household characteristics, a variable indicating the number of siblings of each child is defined because it has been documented that the number of siblings is a significant factor of family structure concerning children's obesity in general (Formisano et al. 2013). Also, monthly family income is included to reflect the wealth and income of the household, and a variable reflecting the physical house size is specified to capture the physical home environment of each child.

The school environment also matters in regard to children's food consumption due to the fact that children usually spend at least 6 hours at school every day, and the school lunch programs provide the major food sources obtained at school (Li 2010; Story, Kaphingst, and French 2006). In recognition of the importance of the school environmental effects, we specify a continuous variable of the physical area of the school (Size_M), a variable which measures the average hours of physical education classes per week (Physical_S) and a dummy variable indicating whether the specific school is located in a metropolitan area (City_M). In the section offering our

⁴ We thank anonymous reviewers for this thoughtful suggestion. The official cutoffs used to determine students' weight status can be found in the website of the Department of Health in Taiwan.

http://www.vghtpe.gov.tw/~nutr/forum02/bmi2.htm.

⁵ In contrast to the case in the U.S, no school breakfast program is available in Taiwan.

empirical results, we first present the distribution of the body weight of schoolchildren in Table 1 according to the different school lunch programs. Detailed definitions follow, and the sample statistics of the selected explanatory variables are listed in Table 2 (see Appendix).

Methodology

One important issue related to the empirical analysis of school lunch program has to be addressed, i.e. in addition to the observed children's, parents' and school characteristics, the school lunch program and students' body weight can still be correlated due to some unobserved common factors. In the case of Taiwan, each school can decide whether the school lunch given to the students is to be provided by the on-site kitchen of the school or ordered from outside restaurants. In addition, the parents can decide whether their schoolchildren will participate in the school lunch program or if they prefer to pack a lunch for them. Evidence of previous studies has indicated the existence of the endogeneity issue on the topic of school lunch programs. A common wisdom of these studies is that failing to cope with the endogeneity issue will result in inconsistent estimations.

To investigate the effects of the school lunch program on children's weight and accommodate the potential endogeneity problem indicated above, a mixed multinomial logit model proposed by Deb and Trivedi (2006) and Deb et al. (2006) was configured.⁶ To represent this concept, suppose child *i* has *j* different choices of the school lunch program. The indirect utility of child *i* associated with the j_{th} school lunch program (V_{ij} *) can be defined as:

(1)
$$V_{ij}^* = z_i \, \alpha_j + \beta_j h_{ij} + \zeta_{ij}$$

where the vector z_i contains exogenous determinants, and h_{ij} represents the latent unobserved characteristics commonly associated with a child's participation in the school lunch program and his/her body weight; α_j , β_j are parameters to be estimated, and ζ_{ij} is the error term. If we further assume the choice structure follows a multinomial logit model, then the probability of the i_{th} child's choice of the j_{th} program j can be shown as:

(2)
$$\Pr(d_{ij} | z_i, h_{ij}) = \frac{\exp(z'_i \alpha_j + \beta_j h_{ij})}{1 + \sum_{m=1}^{J} \exp(z'_i \alpha_m + \beta_m h_{im})}$$

where d_{ij} is the indicator of the school lunch program. Given the outcome y_i (i.e. if the child is overweight) being a binary variable, the expected body weight status of the i_{th} child can be formulated as:

(3)
$$\Pr(y_i = 1 | d_{ij}, x_i, h_{ij}) = m(x_i ' g + \sum_{j=1}^{J-1} \gamma_j d_{ij} + \sum_{j=1}^{J-1} \lambda_j h_j)$$

⁶ Deb and Trivedi (2006) and Deb et al. (2006) used the mixed multinomial logit model to study the effects of different health insurance programs on healthcare utilization in the U.S.

where x_i is a set of exogenous variables that determines if a child is overweight, and g, γ_j, λ_j are the parameters to be estimated. As a result, the expected weight status equation of children is a function of the exogenous determinants (x_i) , the indicator of the school lunch program (d_{ij}) and the unobserved common factors that are correlated with the school lunch programs (h_j) ; m(.) is the link function. Therefore, parameter γ_j captures the effects of the j_{th} lunch program on the children's weight. In addition, λ_j captures the endogeneity (i.e. self-selection effect) between the j_{th} program and child's body weight.

If we further assume that the marginal density function of the weight status equation follows a logistic distribution, the joint distribution of the participation decisions of school lunch programs and the body weight status equations can be written as the product of the marginal density function, as (see Deb and Trivedi 2006):

(4)
$$\Pr(y_i, d_{ij} | x_i, z_i, h_i) = f(y_i | d_{ij}, x_i, h_j) * \Pr(d_{ij} | z_i, h_j)$$

Using Eq. (4), the consistent estimators of the parameters α_j , β_j , g, γ_j , λ_j can be estimated by the maximum likelihood estimation method. As indicated by Deb et al. (2006), Eq. (4) does not have a closed form; therefore, we use the Halton sequences random draw method suggested by Deb et al. (2006) for the empirical estimation.

Regarding the condition of model identification, Deb and Trivedi (2006) noted that the model is econometrically identified due to the non-linear functional form of the maximum likelihood function. However, to avoid the overburden of the identification relying on the functional form, some exclusion variables (i.e. the instrumental variables) can be used; they are helpful in deriving the empirical estimation. In the case of the school lunch program in Taiwan, the types of school lunch programs are jointly determined by schools and the board of parents. Therefore, both the school characteristics and socio-democratic characteristics of the parents of the schoolchildren are expected to have direct effects on the types of school lunch programs as well as the children's body weight. In this case, finding an appropriate exclusion variable (or the instrumental variable) is not obvious. In the empirical specification, we specify the same set of explanatory variables in the equation of the school lunch program and children's body weight. In so doing, the model identification condition can still be reached by relying on the non-linear functional form of the maximum likelihood function.⁷

Empirical Results

Sample Statistics of the Body Weight Status of Schoolchildren

Table 1 presents the sample statistics of the weight status of schoolchildren by different types of school lunch programs. In total, 102 elementary schools and 2,017 schoolchildren were selected in our sample. The sample distribution shows that 60 out of 102 schools purchased lunch boxes

⁷ We thank anonymous reviewers for this observation.

from outside school restaurants, while 31 of them made lunch in food facilities at school. With respect to the sample distribution of the body weight of children, it is evident that schoolchildren who were offered lunch boxes from restaurant orders exhibited higher values of BMI (19.29) compared to those who were offered lunch boxes from school facilities (16.18), on average. The corresponding rates of schoolchildren who are overweight or obese for these two groups are 28.6% and 24.2%, respectively. The differences in body weight of schoolchildren are found to correlate to different school lunch programs; however, this can only be regarded as a snapshot because the differences in school and parental characteristics among children in different school lunch program groups are not controlled.

Types of school lunch programs	Total number of schools	Total number of students	Body mass index (kg/m ²)	Overweight (%) [#]
No school lunch program	11	204	17.92	26.1%
ivo senoor funeri program			(3.27)	
Dramound has only only hitch on	31	626	16.18	24.2%
Prepared by school kitchen			(3.00)	
Purchased from outside-	60	1,187	19.29	28.6%
school restaurants			(3.75)	

Table 1 . Sample distribution	of students weight by different types	of school l	unch programs

In total, 102 elementary schools and 2,017 schoolchildren were included in our sample.

(.) is the standard deviation of the continuous variable.

[#]The official cutoffs of the body mass index into overweight status are defined by the Department of Health in Taiwan.

Effects of the School Lunch Programs on Schoolchildren's Overweight

The estimations of the mixed multinomial logit model are presented in Table 3. We begin our discussion of the empirical results by looking at the association between school lunch programs and children's body weight status. Because children's weight status is specified as a binary variable to indicate whether they are overweight, the coefficient directly estimated from the model does not capture the magnitude of the association of the explanatory variables. To provide a more intuitive interpretation of our finding, the marginal effect which captures the change in the likelihood of being overweight of schoolchildren resulting from the change in the explanatory variables is also reported. As exhibited in Table 3, a significant relationship between the school lunch programs and children's weight status is evident.⁸ Moreover, the associations do differ according to the lunch meal preparations at school. Compared to the children who go to schools which provide no school lunch programs (the reference group), children who are served

⁸ The interpretation of our findings calls for caution. Due to the confidentiality concern, sampling weights used in the NAHSITC survey are unavailable to us. Therefore, the standard errors of the estimates are calculated using the bootstrap method with 500 replications, rather than the weighted standard errors. As pointed out by an anonymous reviewer, ignoring the survey design may result in downward biased standard errors of the parameters and overstating statistical significant findings.
lunch meals provided by schools' on-site kitchens have a lower likelihood of being overweight by 9.6 percentage points (the marginal effect of the variable *School kitchen*). In contrast, students who go to schools serving lunch meals of restaurant orders have a higher propensity to be overweight by 12.5 percentage points (the marginal effect of the variable Outside-school restaurants). Both are statistically significant at the 5% level or higher. Several explanations are possible in regard to interpreting these findings. First, a positive association between ordered lunch meals and children's chances of being overweight may reflect the intense business competition between restaurants. Restaurants have to make their food attractive to schoolchildren in order to maintain their business ties to the schools. Therefore, their lunch boxes are usually more likely to be oily and to contain more saturated fat to cater to the appetite of the children (Tong Foundation 2007). For instance, fried chicken and red meat are more commonly seen in lunch boxes prepared by the outside restaurants (Tong Foundation 2007). Given the fact that schools who order lunch boxes from food companies or restaurants outside the school usually only monitor the quantities of food servings to satisfy the requirement of the School Hygiene Law, the nutrients or food quality can more easily fail to match the standards of a healthy diet. In contrast, lunch meals prepared by school kitchens are handled by nutritionists on campus; therefore, these lunch meals are more concerned with health than with taste. In addition, more vegetables and fruits are likely to be offered by the school kitchen. Our findings may also reflect the fact that children usually do not finish all of the served food prepared by the school kitchen, especially dishes with more fruits and vegetables instead of fried meat, compared to the restaurant ordered lunch boxes.⁹

Our findings may also help to explain the inconclusive findings in previous studies on the effects of school lunch programs on childhood obesity. The positive effect of lunch meals ordered from the restaurants on children's overweight is in accordance with Schanzenbach (2009). On the other hand, the negative effect of lunch meals prepared by school kitchens on a child's overweight is not inconsistent with the findings in Hofferth and Curtin (2005) and Millimet, Tchernis, and Husain (2008).

Our results are supportive of the endogeneity problem linking school lunch programs and children's overweight. The estimated self-selection parameter $\lambda_kitchen$ is significant at the 10% level, which supports the existence of selection bias. More specifically, the school lunch programs and children's overweight may be correlated due to some unobserved common factors. For instance, parents who are more knowledgeable about nutrition may pay more attention to their children's wellbeing and may take better actions to improve their children's health, such as packing a healthy lunch, restricting TV viewing, signing up their children for sports, etc. These children may have a lower likelihood of being overweight or obese. Since the information regarding this factor is not observed in our dataset, it is likely to simultaneously affect children's body weight and the type of schools that children attend, so that the endogeneity problem can occur. Our finding of the significant selection bias is not consistent with evidence in the U.S. (Millimet, Tchernis, and Husain 2008; Schanzenbach 2009).

⁹ The information can be found at http://www.epochtimes.com/gb/7/4/4/n1668075.htm

	Sch	ch Program					
	School kite	chen	Outside-sc restaura	hool nts	If child is overweight		
Variable	Coefficient	SE	Coefficient	SE	Coefficient	SE	Marginal Effect
School kitchen					-1.010 **	0.422	-0.096
Outside-school restaurants					1.631 ***	0.384	0.125
Age	-0.074 **	0.040	-0.012 ***	0.004	-0.031	0.035	-0.008
Male	-0.211	0.191	-0.136	0.170	0.265 **	0.109	0.060
Sibling	-0.028	0.106	0.140	0.092	-0.022	0.062	-0.006
House size	0.001	0.007	0.005	0.007	-0.002	0.002	-0.001
Income	0.013	0.027	-0.044 *	0.026	0.010 *	0.005	0.002
Senior_M	-0.566	0.384	-0.471	0.371	0.189	0.193	0.048
Junior_M	-0.239	0.370	-0.103	0.347	0.170	0.218	0.047
Breakfast	-0.505 **	0.245	-0.327 ***	0.135	-0.243 *	0.137	-0.056
TV56	0.126	0.414	-0.075	0.383	0.132	0.177	0.025
TV34	0.181	0.277	0.019	0.241	-0.050	0.181	-0.018
Job_M	0.038	0.314	0.020	0.308	-0.064	0.107	-0.012
City_S	1.341 *	1.016	0.446	0.982	-0.069	0.151	-0.002
Size_S	0.176 ***	0.045	0.243 **	0.094	0.093	0.067	0.021
Physical_S	0.664 **	0.309	0.140	0.768	0.033	0.093	0.012
Constant	0.804	1.141	2.025 *	1.131	-0.977 *	0.582	
λ_k itchen					-0.348 *	0.264	
$\lambda_{restaurant}$					0.020	0.403	
Log-likelihood	-2.998						

Table 3. Estimation of the mixed multinomial logit model

The reference group of the school lunch program is the non-participants.

***, **, * indicate the significance at the 1%, 5%, and 10% level, respectively.

Other Determinants of the School Lunch Programs

Although it is not the primary focus of this study, we briefly discuss the associations between other exogenous determinants and the school lunch programs. As exhibited in Table 3, children's characteristics and lifestyle behaviors, family characteristics, and mother's behaviors and school environmental conditions significantly determine the likelihood of children receiving school lunches. Age is negatively associated with these two kinds of lunch programs, and the association is more pronounced for the lunch meals prepared by school kitchens. Also, in accordance with the findings of Chang and Nayga (2009), children who eat breakfast every day are less likely to have school lunches. This finding may reflect the fact that meal planners (parents) for this group of children may have greater nutritional knowledge regarding their children's health and food consumption; therefore, they may spend more time in preparing their

own lunch boxes for their children. Compared to the school-served lunch meals, the selfprepared lunch meals by parents are expected to be much healthier.

Family characteristics also matter. Results indicate that children living in households with higher income are less likely to go to schools which serve lunch meals by outside restaurants. This result is in agreement with the policy objective whereby children of poor families are subsidized for their lunch meals; therefore, they are more likely to have school lunch. Consistent with the findings of previous studies (e.g., Akin et al. 1983), the mother's employment status is significantly correlated with children's school lunch programs. Compared to the children of unemployed mothers, children with working mothers are more likely go to a school serving lunch meals. This finding may reflect the substitution effect of time between work and preparing meals for their children. Finally, school conditions significantly determine the likelihood of children having school meals. Children who study at large elementary schools, or with more hours per week of physical education classes, or located in large cities are more likely to obtain school-served meals.

Other Determinants of Schoolchildren's Overweight

In addition to the school lunch programs, some other variables also significantly determine a child's weight status. Gender difference in body weight status is evident; the results show that boys have a higher chance of being overweight compared to girls. Although the finding is statistically insignificant, in accordance with Li and Hooker (2010), compared to the children who spend less than 1 hour in viewing television per day, children who spend at least 5 hours viewing television have a higher chance of being overweight by 2.5 percentage points. This result is supportive of the belief that TV watching usually correlates to poor diet quality, and thus affects the energy balance of the children. Eating breakfast is also important. Compared to their counterparts, children who eat breakfast have a lower chance of being overweight by 5.6 percentage points. Socio-demographic characteristics of the mothers and the family are also crucial factors. Children who live in households with higher income are more likely to be overweight. The results show that an additional \$10,000 in monthly family income increases children's chance of being overweight by 0.2 percentage points.

Conclusions

Childhood obesity is a global epidemic associated with lifestyle, dietary patterns, and living environment, especially regarding food and the school environment. A better understanding of the relationship between children's overweight and lunches eaten at school will help policymakers to identify strategies to effectively combat childhood obesity. A considerable body of literature has addressed the issues of school lunch programs; however, most of them emphasize the extent to which socio-demographic factors, family condition and parental behaviors are associated with the likelihood of school lunch participation. Only a few studies conducted in the U.S. have investigated the extent to which school food programs are correlated with children's health; studies from Asian countries are generally silent on this topic. This study contributes to previous studies by assessing the association between school lunch programs and the body weight status of the elementary schoolchildren in Taiwan. In contrast to the case in the U.S., a unique system of school lunch programs is implemented in Taiwan, i.e. each school has the option to conduct food programs using their on-site kitchen, or to simply order from food companies or restaurants nearby. This study makes distinctions of the extent to which these different types of food preparations of the school lunch programs may have different associations with children being overweight.

Using a nationwide dataset of elementary schoolchildren in Taiwan, we estimated a mixed multinomial logit model to capture the potential endogeneity between school lunch programs and children's weight status. Several interesting findings were revealed: parental characteristics, family conditions and school environmental conditions are significantly associated with the choice of school lunch programs. Most importantly, different school lunch programs have different associations with children's body weight. Compared to children who go to schools without school lunch meals, children who go to schools serving lunch meals prepared in on-site kitchens at schools have a lower likelihood of being overweight. In contrast, children who go to schools serving restaurant-ordered lunch boxes have a higher chance of being overweight.

Policy implications that can be inferred from our study are straightforward. Providing school lunch is not necessary to alleviate the increasing overweight problem of schoolchildren. Moreover, since the effectiveness of the policy depends on the way that the food is prepared, the government should manage the way food is prepared in schools. In addition, more information on healthy nutrition could be provided to the parents of schoolchildren.

Some caution is required in interpreting our findings. First, we explain the associations between different types of school lunch programs and children's overweight by the fact that restaurant-ordered lunch boxes are oilier and less healthy than lunch meals prepared at on-site kitchens (Tong Foundation 2007). Comparing the lunch menu or food list between restaurant-ordered and self-prepared lunch meals will be useful to further confirm our hypothesis. Due to the lack of detailed information on what is actually provided to schoolchildren, we are unable to further address this issue. In addition, it is likely that private and public schools may have different ways of preparing their lunch meals to students (Tsu 2005). If more detailed information of school characteristics becomes available, further research can investigate this interesting issue. Finally, despite our control over potential endogeneity between school lunch programs and children's obesity, with the empirical results supporting self-selection, using more sophisticated panel data can further attest to the robustness of our findings.

Acknowledgements

The author thanks four anonymous reviewers and the journal editor for valuable comments, as well as the Department of Health in Taiwan for making the data available. Partial funding support provided by the National Science Council in Taiwan is also appreciated. The results and conclusions are those of the author and are not those of the Department of Health in Taiwan. The author is responsible for any remaining errors or omissions.

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Variable Definition Mean Std. Dev. Mean Std. Dv. Mean <t< th=""><th>Type of th</th><th>e school lunch program</th><th>No scho</th><th>ol lunch</th><th>Prepared</th><th>l by school chen</th><th>Purchas</th><th>ied from irants</th></t<>	Type of th	e school lunch program	No scho	ol lunch	Prepared	l by school chen	Purchas	ied from irants
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Primal_M If mother didn't finished junior high school (=1). 0.09 0.29 0.10 0.29 0.11 Job_M If mother is employed for a full time job (=1). 0.66 0.47 0.66 0.47 0.63 School variables School size (10,000 m ²) 0.505 0.49 2.27 0.80 2.21 Physical_S Average hours of physical class per week (hrs) 1.86 0.93 2.03 0.62 1.92 City S If the school is located in a large city (=1) 0.20 0.40 0.35 0.48 0.22	Junior_M	If mother finished junior high school (=1).	0.20	0.40	0.21	0.41	0.25	0.43
Job_M If mother is employed for a full time job (=1). 0.66 0.47 0.63 School variables School variables 0.47 0.66 0.47 0.63 School variables School size (10,000 m ²) 2.05 0.49 2.27 0.80 2.21 Physical_S Average hours of physical class per week (hrs) 1.86 0.93 2.03 0.62 1.92 City S If the school is located in a large city (=1) 0.20 0.40 0.35 0.48 0.22	Primal M	If mother didn't finished junior high school (=1).	0.09	0.29	0.10	0.29	0.11	0.31
Size_S School size (10,000 m ²) 2.05 0.49 2.27 0.80 2.21 Physical_S Average hours of physical class per week (hrs) 1.86 0.93 2.03 0.62 1.92 City S If the school is located in a large city (=1) 0.20 0.40 0.35 0.48 0.22	Job_M School var	If mother is employed for a full time job (=1). iables	0.66	0.47	0.66	0.47	0.63	0.48
Physical SAverage hours of physical class per week (hrs)1.860.932.030.621.92City SIf the school is located in a large city (=1)0.200.400.350.480.20	Size_S	School size $(10,000 \text{ m}^2)$	2.05	0.49	2.27	0.80	2.21	1.32
City S If the school is located in a large city $(=1)$ 0.20 0.40 0.35 0.48 0.22	Physical S	Average hours of physical class per week (hrs)	1.86	0.93	2.03	0.62	1.92	0.56
	City_S	If the school is located in a large city (=1)	0.20	0.40	0.35	0.48	0.22	0.41

Appendix



International Food and Agribusiness Management Review Volume 17 Special Issue 1, 2014

The Impact of Public R&D on Marketing and Supply Chains on Small Farms' Market Sensing Capability: Evidence from the Australian Seafood Industry

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Abstract

Agri-food organizations that are capable of "sensing the market" – that is, capable of searching, processing and using market information, are usually also market oriented, innovative, entrepreneurial and successful. But how can a small farm with limited resources develop market sensing capabilities? This research explores when public Research & Development (R&D) has an impact on small farms' market sensing capabilities. The literature on the impact of public R&D on small farms' market orientation is limited despite the importance of the topic for regional competitiveness and economic development. This research follows an inductive "grounded theory" approach of investigation. Qualitative and quantitative data is collected from five cases of public-private R&D projects funded by the Australian Seafood Cooperative Research Centre (CRC). One "typical" in-depth case study of an R&D project in the oyster sector provide empirical evidence for cross-case comparison and structural equation modeling (SEM). Findings highlight the provision of R&D market information on estimated prices and quantities, end users' lower initial capabilities and higher discipline clarity, and the absence of industry associations undertaking marketing roles for farmers to enhance the impact of public R&D on small farmers' market sensing.

Keywords: market-sensing, capabilities, grounded theory, structural equation modeling, public R&D, oysters, seafood

⁽¹⁾Corresponding author: Tel: +31. 646801736 Email: D. Dentoni: domenico.dentoni@wur.nl To compete and survive in dynamic markets where consumer needs, buyer requirements, competitive and stakeholder pressures change rapidly, managers of food companies are pushed to become market oriented, that is, more adaptive to opportunities and threats coming from the market (Kohli and Jaworski 1990). For small farmers this is particularly challenging, as they have limited resources to access updated market information, absorbing knowledge and make changes based on the result of learning. So far, research analyzed the positive impact of small farms' market orientation (Martin et al. 2009) on their entrepreneurial orientation (Holster 2008) and innovation (Verhees 2005), and ultimately on their performance (Micheels and Gow 2008). Much less research is available on how organizations - including small farms - can become market oriented is *market sensing*, which is the attitude and ability of searching, processing and using market information (Day 1994).

Through dissemination of results of value chain analysis and consumer studies, public and public-private R&D (in this paper conveniently named public R&D even if sometimes have a participation of private funding) institutions attempt to stimulate market-driven innovations in pre-competitive settings (Pandey et al. 2013). For small farmers, this is an opportunity to innovate based on updated market information and to activate a "double-loop learning" (Argyris 1997), that is, to "learn how to learn" new market information on their own. In other words, small farmers have an opportunity to develop market sensing capabilities from public R&D results of marketing and value chain analysis (Capitanio 2009; Klerkx 2010). Ultimately, public R&D that is able to stimulate small farms' market orientation increases regional competitiveness, economic development and food security (Dentoni and Reardon 2010; Link and Scott 2013). Despite the managerial and policy importance of the topic, so far few empirical studies analyzed when public R&D has an impact on small actors' capabilities (Wanzenböck et al. 2012). Among these few studies, none explored the R&D impact on market sensing in the agricultural and food sector. To start filling this gap, this research explores under which conditions public R&D has an impact on small farms' market sensing capabilities, including characteristics of the individual R&D end users, of their industry associations, and of the R&D research and dissemination methods used.

Given the gap in the literature and the importance of the topic, we follow a "grounded theory" method of investigation (Glaser and Strauss 1967; Eisenhardt 1989) based on the case of the oyster value chain analysis project funded by the Australian Seafood Cooperative Research Centre (CRC). We collect quantitative and qualitative data to gain rich insights on the cause-effect relationship among variables (Eisenhardt 1989; Birkinshaw et al. 2011). For the qualitative component of the work, we compare and contrast semi-structured interviews 1) with an initial sample of 45 small oyster farmers, half of them involved in a CRC project analyzing the oyster value chain and 2) across project stakeholders in five similar projects funded by the Seafood and Beef CRC in the wild prawn, farmed prawn, finfish and beef sectors. For the quantitative component, we use SEM to analyze relationships between receiving market information through the R&D project, farmers' beliefs and attitudes towards the R&D project results, and their market-sensing capabilities. As quantitative data are collected from 34 oyster farmers only, results are exploratory and leading to the statement of testable propositions as opposed to confirmatory hypotheses-testing.

The paper is organized as follows. Section 2, the theory introducing and linking the concepts of firms' market-sensing capability, market orientation, innovation and performance are explored. In section 3 the research methods are presented and followed by a selected background in section 4. In section 5, the results from the quantitative survey are presented and integrated with the qualitative evidence collected. In section 6, the discussion session introduces the conceptual framework formed by the set of testable propositions and based on the results. Section 7 provides the conclusions.

Literature Review

Market Sensing Capabilities, Market Orientation and Competitiveness

A large number of empirical studies have recently explored how food companies increased their competitiveness by becoming more market oriented (Grunert et al. 2005; Beverland and Lindgreen 2007; Lankinnen et al. 2007; Martin et al. 2009), entrepreneurial (Knudson et al. 2004; Holster 2008) and innovative (Verhees 2005; Sankaran and Mouly 2006; Trienekens, 2008; Vogels 2008; Micheels and Gow 2008). Yet, an open debate in academia, business and policy-making is how agricultural and food firms can become market-oriented and innovative (Anderson & Narus 2007). In fact, a number of public R&D programs and public-private partnerships worldwide aim to enhance agri-food companies' market orientation and innovation (Allen 1999).

A seminal work in this area identified the firm capabilities of market sensing and customerlinking as drivers of market orientation and ultimately competitiveness (Day 1994). Building upon Kohli and Jaworski (1990) market orientation's model, Day (1994) describes market sensing as the capacity to gather market information, including information about customers, competitors and other chain members, distribute it effectively across an organization and consequently exploit a commercial and competitive benefit from possessing and correctly using this information. It is important for a firm to have a good understanding of its market(s) and what its customers are demanding. Without this understanding it would be difficult to operate an efficient business producing products or services which meet the needs of the end users. Market sensing may be the result of a market driven culture in a particular organization. Thus, rather than being a behavior, market sensing is rather an existing culture or thought process which highly values the benefits of market information and actively seeks to exploit the competitive advantage that this information may allow for (Day 1994). By empirically testing Day's theory (1994), Lindblom et al. (2008) found that market sensing is strongly related to market orientation, yet not to business profitability. This implies that, even though a business may have good market-sensing capabilities, other independent factors may limit leveraging market orientation to achieve profitability. Furthermore, the conditions under which market-sensing has an impact on market orientation were studied by Olavarrieta and Friedman (2008). In an empirical study of publicly traded Chilean firms they found that market orientation and the possession of market sensing skills is very significant to overall business performance and innovation.

Together with market sensing, customer-linking capabilities are also key drivers of a firm market orientation (Day 1994). Customer-linking refers to the organizational ability of "creating and

managing close customer relationships" (Day 1994). Historically many businesses have focused simply upon the transaction taking place with little consideration for the quality and/or establishment of a mutually beneficial and long-standing relationship between seller and buyer. This is very pertinent in the agricultural context as the market has moved from a 'push' to a 'pull' interaction with customers where the focus has shifted away from producers supplying whatever is on offer to being forced to listen to the demand of customers ('pull') and tailor their production to meet these demands. Customer linking capabilities are important in order to build a loyal customer base, increase customer satisfaction and profitability of a business (Hooley et al, 2005). Thus it is another key driver for a firm to be market oriented. This along with market sensing capabilities lead to firms being market oriented which allows them to serve their customers in the most efficient and effective way while having a competitive advantage over other firms whose capabilities are not as well developed. The impact of customer-linking on market orientation was analyzed by Rapp et al (2010) and Hooley et al (2005). Hooley et al (2005) found that having good customer linking capabilities had a positive effect on the efficacy and success of a firm to deliver what their customers want. Rapp et al (2010) also found a positive relationship and determined that having close relationships, with open and frank communication, with customers allows a firm to "better understand customer needs and develop appropriate responses to those needs". It should be noted that there are many different types of relationships and particular dynamics across types of agricultural businesses and particular industries and in many cases what constitutes a close relationship is very different and may be hard to measure in a standard format. Compared to the existing literature, our study instead examines the impact of public R&D on value chain analysis on small farmers' market-sensing, and the conditions under which market sensing can be developed.

The Impact of Public R&D on End Users' Capabilities

While the literature has widely studied the impact of public R&D programs on firms' product and process innovation both in the agricultural and other sectors (Allen 1999; Andersen and Song 2013; Pardey et al. 2013), only few studies have so far focused on the impact of public R&D on end users' capabilities (Falk 2007; Clarysse et al. 2009; Hsu et al. 2009; Wanzenböck et al. 2012; Knockaert et al. 2013). Differently from product and process innovation (Cohen and Levinthal 1990), firm capabilities refer to the ability of the organization of redeploying skills, resources and competencies (Teece et al. 1997). This is a relevant and timely area of investigation, because public R&D that has an effective impact on capabilities gives the opportunity to firms to self-sustain their future innovation processes, thus giving the opportunity to reduce the need of public R&D expenditures in the long run. In relation to markets, firms that learn to understand changing patterns at final consumer and buyer level do not need further public R&D investments every time that these changes occur.

The literature on the impact of public R&D on end users' firm capabilities has analyzed when such an effect takes place, yet neither in the agricultural sector nor with specific reference to market sensing. These studies have analyzed how firm, industry and network characteristics enhance the impact of public R&D. First, the effects of firm characteristics on public R&D impact were studied by Falk (2007), Clarysse et al. (2009) and Wanzenböck et al. (2012). In particular, firms that are less experienced in public R&D (Clarysse et al. 2009), younger (Falk 2007; Wanzenböck et al. 2012), smaller and more technologically specialized (Wanzenböck et al.

al. 2012) learn more from public R&D. Second, the effects of industry characteristics on public R&D impact were studied by Hsu et al. (2009) in Taiwan. In particular, chemical & material firms had the highest levels of learning, electronic & telecommunication and machinery & equipment industry had a significant level, while the biotechnology and pharmacy (B&P) sector had the lowest levels of learning. Thus, overall the more traditional sectors seem to benefit more from public R&D in terms of learning, while the more technology-rich seem to benefit less. Third, the effects of network characteristics on public R&D impact were studied by Clarysse et al. (2009) and Knockaert et al. (2013). In particular, a higher number of external partners in public R&D led to increased learning (Clarysse et al. 2009). Moreover, the presence of intermediaries between the public agencies delivering R&D and the firm enhances firms' chances to develop capabilities from R&D (Knockaert et al. 2013).

Thus, on the one hand literature has analyzed the importance of market-sensing capabilities for market orientation, entrepreneurship, innovation and competitiveness (also in the agricultural and food sector) (Beverland and Lindgreen, 2007; Trienekens, 2008; Micheels and Gow 2008), yet not exploring how to firms can develop market sensing. On the other hand, R&D literature has analyzed how firm, industry and network characteristics enhance public R&D impact on capabilities (Falk 2007; Clarysse et al. 2009; Hsu et al. 2009; Wanzenböck et al. 2012; Knockaert et al. 2013), yet none on market sensing capabilities or in the agricultural and food sector. This leaves a notable gap in the literature on the impact of public R&D on market sensing capabilities, especially considering the large amount of R&D investment in agricultural and food spent worldwide to make small farmers and entrepreneurs more market adaptive.

Research Methods

Grounded Theory

To analyze the conditions that enhance public R&D impact on small farms' market-sensing capabilities in a domain with no theory already developed, we follow a grounded theory approach of investigation (Glaser and Strauss 1967). Grounded theory is an inductive research method based on the development of new hypotheses during the process of data collection and an interpretative work of observation of phenomena. It requires the researchers to be open and find new patterns throughout the process of data collection. The method requires a continuous iteration between the empirical data, the existing theory in the literature and the new theory developed along the process (Eisenhardt 1989). A grounded theory approach is appropriate to be used especially in new domains where theory is still underdeveloped, as in the case studied by this research (Glaser and Strauss 1967; Eisenhardt 1989).

Consistently with the established research design methods on grounded theory (Eisenhardt 1989), we conducted two stages of iterated data collection and analysis, the first broader and unfocused, the second more specific and focused. First, in early 2010 we conducted open interviews with project stakeholders involved in five CRC value chain analysis projects. The goal of the first round on data collection was 1) to understand if the public R&D programs funded by CRC had an impact, thus whether the funding was worth being spent in "learning-oriented activities" for farmers or not, 2) to explore how characteristics of the industry and of the R&D methods influenced the impact of public R&D. Thus, we purposively selected cases from

different industries, including oysters (two), wild prawns, farmed prawns and beef, and with different R&D research and dissemination methods used. In particular, the R&D methodology on supply chain analysis and dissemination was qualitative in the case of wild and farmed prawns and quantitative in the case of oysters and beef). Moreover, oyster farmers and wild prawn fishers had a much more centralized marketing strategy through their farmers' associations than beef and farmed prawn farmers. Centralization of marketing strategies seemed to be one of the emerging drivers of different R&D impact on famers' capabilities across industries.

Within each case, project stakeholders included CRC managers, project leaders (responsible both for research implementation and dissemination), industry representatives and a purposive selection of end-users, i.e. fishermen and farmers at grassroots level. The stakeholders were reached through a snowball approach—contacting the individuals named during the interviews by the respondents (Yin 2007). At this stage, we posed broad questions on stakeholders' perceptions and attitudes on the implementation and dissemination of the value chain project, their perspective of what should be consider a positive outcome of a value chain analysis R&D project, and their perceptions on which factors made the project successful or not (Dentoni and English 2012). From this first round of interviews, we understood that effective "learningoriented activities" such as public R&D disseminating pre-competitive information about marketing and supply chain to farmers were perceived by project stakeholders as a form of success even when no financial impact were realized in the short run. Moreover, we inferred the impact of learning-oriented public R&D programs at CRC depended not only on industry characteristics and R&D methods used, but also on end users' characteristics including, among the others, their initial capabilities and their value discipline (Tracy and Wiersema 1993). This motivated the choice to proceed with a second more focused round of data collection.

In the second stage of data collection and analysis, the study was limited to only one public R&D program on marketing and supply chain to inductively explore which initial small farmers' characteristics influenced the public R&D impact on their market-sensing capabilities. The public R&D program analyzed is a value chain analysis co-funded by the Australian Seafood CRC and the Oyster Consortium (OC) and implemented by a consulting company in 2009- 2010. In this project, the principal investigator collected and analyzed market data in both qualitative (current demand trends, key issues as perceived by chain actors, relationships among supply chain partners) and quantitative form (estimation of profit margins and industry macro-trends) and disseminated results mainly though a detailed report that included the supply chain mapping and the estimated prices and quantities sold along the chain in different market channels. Dissemination of the results through the report and through shorter fact sheets took place also through numerous state association events (locally called "field days") taking place during 2010. Results of this public R&D program were also disseminated through CRC and OC websites and newsletters in the form of fact sheets with link to the full report.

In relation to the selected public R&D case in the Australian oyster sector, we undertook a survey with 34 growers whose characteristics are described in detail in Table 1. This stage of the research took place between May and December 2010. In particular, half of the selected sample (17) received the information from the Seafood CRC project and half that did not receive it. This created the variability to test the impact of the Seafood CRC information on growers' capabilities. Moreover, the selected sample was representative of the geographical distribution of

oyster growers in Australia, who are mainly focused in New South Wales and to minor extent in Victoria, South Australia and Queensland, and of size (Table 1). Contacts were obtained through complete lists of oyster growers in publicly available web lists. Farmers were contacted by email first and then, after receiving their consensus, called by phone. Among the oyster farmers contacted, twenty-one did not respond or declined the interview. A part of the oyster growers that declined the interviews mentioned that they had a negative past experience with public R&D programs, thus they did not want to collaborate with this survey. This may create a selection bias that inflates the positive impact of the public R&D on oyster growers'. In order to minimize the selection bias process, researchers used a "cheap talk technique" (Tonsor and Shupp 2012). The cheap talk was delivered both via email and on the phone. This cheap talk mentioned that the survey was a study conducted by academics independent from the public R&D agency and that results were used for evaluation purposes, therefore it was important to gain the perspective also of users that may have had negative experiences with the institution. Phone interviews lasted on average sixteen minutes.

Oyster Farmers' Characteristics	Description
States	23 from New South Wales; 5 from Victoria; 4 from South
	Australia; 2 from Queensland.
Received the CRC project	17 out of 34 (because of purposive sampling)
information	
Time passed from receiving the	Average: 11 months; Std. Dev.: 7 months.
CRC project information	
General Wholesalers as customers	19 out of 34
Distributors as customers	4 out of 34
Food Service as customers	3 out of 34
Specialized Wholesalers as	5 out of 34
customers	
Retailers as customers	8 out of 34
Direct consumers as customers	5 out of 34

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Table 1.	Descrit	otion of	sampl	e of e	ovster	growers	1nterv	'iew
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Combining Structural Equation Modeling with Qualitative Evidence

Through the interviews conducted with oyster farmers, researchers collected both quantitative and qualitative data to gain more insight on the cause-effect relationship among variables (Eisenhardt 1989). Quantitative data were analyzed with SEM (Hair et al. 2006, Kaplan 2009). First, SEM allows the researcher to combine measured variables and latent, complex concepts (Kaplan 2009) such as market sensing. Therefore, this multivariate statistic approach allows a rigorous analysis of the relationships between public R&D, dimensions of market sensing and identified conditions influencing R&D impact. Second, it provides the unique opportunity of building and testing frameworks representing complex webs of effects involving a chain of impacts relative to the project, the sector and the industry on firm's adoption of marketing research and ultimately on firm's innovation and performance. Finally, the open qualitative conversation had with the growers during the interviews allowed to make complete sense of the data, so that interpretation could be richer and more careful to the interviewees' perspectives (Birkinshaw et al. 2011). Since the sample is very small relative to the number of relationships analyzed in the model, a bootstrapping technique of simulation (Kaplan 2009; Dentoni et al. 2012) was used to reach statistical power. Yet, the real sample (n=34) remains too small for hypothesis-testing, which is left to future research.

In the questionnaire, capability measures were adapted from the model used by Lindblom et al. (2008) which drew on Day's (1994) work about conceptualizing the market sensing abilities of firms. Lindblom et al. (2008) surveyed a number of retail entrepreneurs to test the effect of market sensing capabilities on the growth and profitability of the retailers. The questions were split into three sub constructs, namely sensing, sense making and response (Lindblom et al. 2008). These categories were then adapted to form our survey in conjunction with seeking feedback about the survey from seafood industry experts, the Seafood CRC management, utilizing our own new hypotheses and our observations from the face to face interviews that we had already conducted. The oyster project leader was also consulted and he modified and added questions to better focus the survey. The survey was split into four sections dealing with awareness of the oyster project, the search and use of information on customers and markets, relationships with customers, and understanding customers.

Section 1 of the questionnaire is meant to establish whether the respondent had received information on the public R&D program, the time of receipt of this information and the particular way it was received. This allows for analysis of the method and timing of dissemination of project outcomes and the most efficient or popular way to distribute the information. The second group of questions in section 1 is necessary in order to ascertain the extent or otherwise of use of the outcomes of the project. In order to determine whether or not firms are developing capabilities derived from the project outcomes it is necessary to identify what aspects of the project outcomes are most useful, if they were not useful, why not, and whether or not there has been a change to business practices from the project outcomes. Identifying whether a change has been made and what it is or if there is intention to make changes, and if there is some impediment to making those changes is also imperative. This will allow analysis of what specific aspects of the project are most useful for firms and whether other changes need to be made in the supply chain, regulations or operations of a particular industry in order to allow business to adapt and grow their capabilities.

Section 2 focused on the sub construct of 'sensing' as adapted by Lindblom et al. (2008) from Day's work (1994). In order to understand an industry's capability to sense the needs of their market the survey posed questions about what sources firms use to gather customer information, whether they exchange information with fellow growers to augment the information they find independently and how they evaluate the usefulness of this information. The final 4 questions in this section analyzed the degree to which the information that firms find about their markets and customers influence their business decisions. In business not all decisions are based on customers' needs, some decisions may be based on other drivers such as personal desires or the need to pay off debt. These questions were adapted from the 'sense-making' and 'response' sub construct as detailed by Lindblom et al. (2008).

Section 3 aimed to analyze the relationship growers have with their customers. Hooley et al (2005) identified that creating good customer relationships, loyalty and satisfaction helped to

build "superior market performance". The questions in this section were based on a list of marketing resources and performance items identified as key factors in building effective customer relationships (Hooley et al. 2005). The questions posed asked growers to rate their capability in building and maintaining good relationships in comparison to other growers and to clearly identify their main customers. This information helps to reinforce the results from the 'sense-making' section of the survey and determine the level of ability firms have in using the information in a profitable way to gain new customers, retain existing customers and build new relationships.

Section 4 drew on questions from both Hooley et al (2005) and some questions used to describe the norms operating in a selection of Japanese firms in an analysis of a variety of Japanese businesses as part of an organizational behavior study conducted by Deshpandé et al. (1993). The study posed questions about how well a firm knows their customers and if there is any procedure in place to measure or check that they their customers are happy and if they are using market and customer information effectively. In our survey we asked questions to determine how committed firms are to serving their customers, to what degree the firm's strategy is based on understanding customers and how firms go about increasing customer value if at all. Determining if there is a check system in place to understand and monitor customer satisfaction was also important to cross check against other sections of the survey and ascertain whether or not firms are actually sensing the market correctly and responding to that information in the most effective way.

In section 5 includes twelve questions assessing oyster growers' value discipline (Tracy and Wiersema 1993). We included variables on value discipline because the first round of data collection suggested that this oyster growers' characteristic may have an impact on their learning from public R&D. Value discipline refers to the competitive posture that a business organization chooses to deliver superior value to customers (Tracy and Wiersema 1993). Three value disciplines are identified: customer intimacy, product leadership and operational excellence. Firms competing on customer intimacy strive to develop products that tightly fit their customer needs. Firms competing on product leadership strive to continuously innovate on technology to provide superior tangible quality and convenience. Firms competing on operational excellence strive to improve efficiency of operations to keep low costs and prices (Tracy and Wiersema 1993). The three measures are in a trade-off among them, that is, respondents need to assign percentages to the three value disciplines for four questions. From the measures of value discipline, value discipline clarity is assessed (Micheels and Gow 2009). Firms that do not have a strong preference for one or two out of the three value disciplines have low value discipline clarity (Micheels and Gow 2009). Agri-food firms with low value discipline clarity have lower performance than companies with higher clarity (Micheels and Gow 2009). Finally, questions concluded with questions on the size of the firm in terms of number of employees and managers' past experience, age, gender and education (Damanpour 2006).

Key Selected Background

The Seafood CRC is a public-private R&D institution, which since 2007, undertakes and disseminates research on production, post-harvest and marketing issues throughout the seafood sector collaboratively with research institutions and industry organizations. This is one of the many Cooperative Research Centres instituted by the Australian Government since 1991 to

enhance collaboration between researchers and private actors in both agricultural and nonagricultural sector. It involves a seven-year plan of investment equal to Australian \$140 million from 2007 to 2013. Out of this amount, \$77 million is cash from the Commonwealth Government, the Fisheries and Research Development Corporation and the seafood industry, and in minor part from the South Australian Government and other research and development providers.

Three major R&D programs characterize the Seafood CRC: production innovation, innovation in post-harvest technologies and marketing, and education. Specifically, the Seafood CRC program on innovation in post-harvest technologies and marketing included more than seventy projects which are completed, being undertaken or just started. Overall, this program aims at improving profit margins of the primary seafood industry by 1) providing knowledge and expertise for the industry to seize profitable market opportunities and by 2) providing innovation concepts in post-harvest technology for the industry to optimize their operations (i.e. to reduce spoilage and losses). In particular, a set of projects in the Seafood CRC program on innovation in post-harvest technologies and marketing has the more specific aim of transferring knowledge and capabilities to the industry for expanding their vision and search of market opportunities. This set included among the others projects with the Australian oyster grower and farmed prawn industry, the Spencer Gulf wild prawn fishery in South Australia and the finfish industry in Western Australia.

The project with the oyster industry was based on a partnership between the Seafood CRC, the Oyster Consortium and an external consulting company as research provider. The research was conducted in 2008 and disseminated to the Oyster Consortium and oyster growers between 2009 and 2010. The project was designed as a broad information gathering exercise with no predefined commercial outcome. The project aimed to deliver information to oyster growers and the Ovster Consortium to achieve a better understanding of the supply chain from farm gate to the consumer's plate. The project had five main objectives: to map the entire supply chain and provide approximate numbers of oysters moving along each section of the chain; to calculate the volume, location and production for each species of oyster; to elicit and discuss drivers of oyster demand; to calculate the various transaction costs to ascertain where and to whom the profits are going and provide recommendations to help ensure the long term sustainability of the oyster industry. The study was conducted by performing a detailed analysis of eight market channels tracking the oysters from the grower to the final stage of consumption by the consumer. This was conducted through research, observation of the chain and interviews with various players along the chain. This research resulted in a detailed supply chain analysis detailing each step in the chain. A detailed financial breakdown was also provided showing the margins along each step in the supply chain. Some of the retail margins were approximate due to commercial sensitivities from some players not wanting to reveal actual costs. Once the data collection and analysis was completed, the information was disseminated in a variety of ways including newsletters and hard copies of the report but mainly thorough presentations by the research provider at field days, Oyster Consortium meetings and state oyster association meetings. The Seafood CRC projects with the farmed prawn and finfish industry had the same approach of research and dissemination.

The project with the Spencer Gulf wild prawn industry was based on a partnership among the Seafood CRC, Spencer Gulf Wild Prawn Fishermen Association (SGWPFA) and a consultant at

the Department of Primary Industries and Resources of South Australia (PIRSA). The project was conducted in late 2009 and the information was presented to the SGWPFA, the fisherman and the partners in the prawn value chain through meetings and distribution of the final report. The main objective of the project was to screen and analyze market opportunities which could derive greater profit from the fishery. This involved a detailed value chain analysis and close collaboration with various members of the value chain. The license holders involved in the fishery involved were thirty-seven, six of the key portside buyers, as well as local retailer and restaurant managers. In this case, a rapid appraisal of the chain was performed to identify the partners along the chain and the expectations and requirements on prawn supply. This research also used secondary data from consumer research on prawns along with interviews with chain members. It followed analysis of interview results, which involved mapping the product flow and information flow and establishing the strength of relationships along the chain. Finally, results from this analysis were disseminated to the industry with meetings to the group of prawn licence-holders and individual meetings with buyers, processors, retailers and restaurants.

Both of these two R&D project methodologies involved detailed analysis of the supply chain in each of the fisheries. Similarly both involved interviews and detailed analysis of the each step in the chain through close collaboration with chain members, research providers and the growers or fishermen themselves. In both cases a large amount of information about the chain has been provided back to the relevant industry associations, growers and fishermen with suggestions to make strategic and operational changes or adjustments to how their businesses or industries are operated. The main difference between the projects is that the oyster project was focused on providing information to the growers and industry whereas the prawn value chain project has a specific commercially-based outcome to expand specific market opportunities to increase the value of the fishery. This might include utilizing a new brand emphasizing the local and sustainability attributes of prawns, changing the marketing strategy by switching to a single desk joint selling point or introducing new post-harvest technological innovations.

Results of the Survey with Oyster Farmers

Results from the structural equation models (Table 2, see Appendix) and related qualitative data analysis can be synthesized as follows:

- 1. The value chain information disseminated by the CRC project had a positive impact on farmers' market sensing capabilities (Table 3). In particular, the project information had an impact on farmers' capability of searching information (F1) and processing information (F2). The causality between information from the project and market sensing capabilities is confirmed by the qualitative evidence collected in the semi-structured interview. Around 80% of the farmers receiving the project information mentioned that before receiving project information they were unaware of 1) the number of actors downstream the oyster value chain between their customer and the final consumer and 2) of the margins made by each actor within the chain, and particularly by their customers.
- 2. Farmers that have learned most from the project (BLearning) are the ones that had lower capabilities of searching market information (F1). These are mainly the farmers that showed higher surprise on information about margin and value chain structure. Around

40% of farmers mentioned that, if they knew this information earlier, they would 1) have attempted to take different market strategies in the recent past and 2) they would have exercised less pressure on their customers and built a more trust-based relationship. Instead, the segment of farmers with highest market sensing capabilities did not really get a marginal increase in learning from receiving this information. As many farmers in this segment stated, the information from the value chain analysis mostly confirmed knowledge that they already had.

- 3. Farmers' capability of searching (F1), processing (F2) and using market information (F3) are strongly correlated among each other. This confirms that these three subsequent activities can be effectively synthesized by the concept of market sensing. Moreover, market sensing is positively associated with building stronger ties with customers (F4). In 10 interviews, farmers with high market sensing capabilities demonstrated that they used the new information not only to evaluate their current market strategy but also to reassess the strategic intent of the on-going public-private R&D projects. In particular, farmer mentioned: 1) the importance of keeping strong relationships with existing customers and collectively promote the healthy properties of the product; 2) the scarce relevance of shifting market channels towards supermarkets; 3) the importance of creating new occasions of use of the oyster product and facilitate the access and disposal to the product, especially for new consumers.
- 4. Results on oyster growers' value discipline (Figure 1) show that the majority of growers create value by attempting to anticipate and serve customer needs and by innovating to have the up-todate product for quality. Out of the 34 sampled, 19 growers have a value discipline that is close to the customer intimacy/ product leader ship line (Figure 1). Seven of them are very close to the "customer leadership" corner. A smaller amount of growers create value by serving customer needs while focusing on operational efficiency. Out of the 34 sampled, six growers are close to the customer intimacy/ product leadership line.



Figure 1. Sampled Oyster Farmers' Value Discipline and Value Discipline Clarity

Legend. Each dot represents a graphical representation of the value discipline of one oyster farmer sampled. The ternary plot was created using an Excel program developed by Graham and Midgley (2000). Value discipline clarity is calculated as the minimum distance from coordinate to a boundary of the triangle through a half-taxi metric (Miller 2002).

- 5. Farmers' value discipline clarity is strongly associated with their market sensing capabilities. In particular, farmers with the highest levels of value discipline clarity are the most able to search for market information and, consistently with point 2 above, have learned fewer new information from the dissemination of project results.
- 6. Demographic factors seldom play a role in the impact of project information on farmers' market sensing capabilities. In particular:
- 7. Project information has been received mainly by younger farmers with less years of experience in the oyster sector. Although younger, open interviews revealed that many of them have already a central role in the oyster growers' networks within their state and national associations.
- 8. Elder farmers have a relatively higher capability in processing market information and customer advantage, while farmers that had previous job before growing oysters have a capability advantage in searching market information.
- 9. The rejection of the other models based on the overall goodness-of-fit indexes (Table 1) implies that:
- 10. After an average of eight months after receiving the project information, no significant impact on changes in farmers' marketing activity took place. Most of the farmers (14 out of 17 receiving the project information) mentioned that value chain information from the project was useful learning to future negotiations with existing customers and to explore future opportunities, but they do not intend to make market changes in the short run. Moreover, 50% of the farmers mentioned that, although they would like to make changes, financial and/or volume of supply constraints do not allow them to innovate. Only three farmers out of 17 mentioned that they already made changes in their product development and customer channels after receiving the project (on average, these three received the information more than one year after the time of the interview).
- 11. The impact of the disseminated value chain information does not have an impact on farmers' customer-linking capabilities, but only on market sensing capabilities.
- 12. The impact of the disseminated value chain information on market sensing capabilities does not depend on what the existing customer channels (general or specialized wholesalers, fishmongers, direct to consumers, food service or retail) that the farmers had.



Figure 2. The Proposed Framework: The Impact of Public R&D on Marketing and Supply Chain on End Users' Market-Sensing Capability

Legend. Each arrow represents a causal relationship between two concepts (represented by boxes), either positive (+) or negative (-). P1, P2, P3, P4 refer to the propositions stated in Section 6. Dotted arrows represent propositions established based on qualitative evidence through comparison across cases. Full arrows represent propositions based on quantitative evidence through SEM within the "typical" oyster case.

Discussion and Research Implications

Impact of Public R&D on Small Farmers' Market Sensing

Results from the cross-comparison of five value chain projects and the in-depth analysis of the oyster sector provide evidence supporting the following set of propositions on the impact of public R&D value chain information on farmers' market sensing capabilities.

First, chain actors systematically found that the quantitative information from the R&D value chain projects was more useful than qualitative information about the structure and the relationships along the supply chain. Out of 17 sampled, 15 oyster farmers mentioned that information on estimated chain partners' margins was the key information from the R&D project report. This is information immediately gave respondents knowledge on the magnitude of the market opportunities that were in place for them if they had upgraded their services and supply to current customers or if they had switched to a different customer or channel. Based on

information on estimated margins, respondents could begin comparing potential benefits and costs of taking individual actions on marketing and supply chain. Similarly, chain actors in the beef and farmed prawn receiving quantitative information from the chain analysis found the information useful, as opposed to the chain actors in the beef and wild prawn sectors that received only qualitative information. This evidence leads to the following propositions:

P1. Research methods involving a quantitative estimation of chain players' profit margins have a positive role on the relationship between R&D projects and targeted firms' market-sensing capabilities.

Second, data from the 34 oyster growers sampled revealed that value discipline clarity and initial lower levels of market-sensing made end users' learning from public R&D on marketing and supply chain more effective (Table 2 and 3, see Appendix). Therefore, the two propositions follow:

P2. The lower the initial levels of end users' market sensing, the higher the impact of public R&D on marketing and supply chains on their market-sensing capabilities.
P3. The higher the end users' value discipline clarity, the higher the impact of public R&D on marketing and supply chains on their market-sensing capabilities.

Qualitative data from the cross-comparison of five value chain projects and the in-depth analysis of the oyster sector provided evidence on the relationship between end users' capabilities and their industry association capabilities. In particular, the level of centralization of the decision-making within the industry association partnering within the R&D project influences the extent of capability transfer to the grassroots levels of the organization and therefore to the individual end users. In the Australian seafood industry, associations that take highly centralized strategic decisions about markets, with fishermen and growers remaining mainly focused on their daily operations. This is the case of local oyster associations and wild prawn associations. In these cases, individual end users learned less extensively from public R&D projects than in cases of large, decentralized associations. Conversely, national industry associations often have a decentralized structure, such that R&D project information flows from the center to the periphery with a larger number of industry members accessing and elaborating it. Therefore a higher number of individual end users learn more from public R&D value chain project results when the project is delivered to national-level industry associations with a de-centralized structure. Therefore, the following final hypothesis is stated:

P4. The level of industry association's centralization of strategic decision-making has a negative moderating role on the relationship between R&D projects and targeted firms' market-sensing capabilities.

These seven propositions compose the theoretical framework described in Figure 2, which can be tested in future research based on the empirical evidence so far collected.

Conclusions

Developing "double-loop learning" (Argyris 1977) is instrumental to ensure sustainability of public R&D project outcomes. This applies also to public R&D on marketing and supply chains in the agri-food sector, where the policy objective justifying the public R&D investment is two-fold: 1) providing valuable pre-competitive information to allow farmers making market–driven innovations; 2) developing farmers' market-sensing capabilities, which is a key driver of market orientation, innovation and entrepreneurship (Day 1994; Micheels and Gow 2008). Based on the evidence from five cases of public R&D in the seafood sector and from an-depth "typical" case of public R&D in the oyster sector, this study explored under which conditions public R&D on marketing and supply chains has an impact on the market-sensing capabilities of small farmers. A grounded theory approach of inductive research (Eisenhardt 1989) based on mixed qualitative and quantitative data collection and analysis (Birkinshaw et al. 2011) was applied to discern the impact of public R&D on small farmers' accessing market information from the impact on their double-loop learning, that is, their ability of searching, processing and learning market information in the future.

Empirical evidence from the Australian Seafood CRC cases revealed that that receiving quantitative information on profit margins and quantity flows along the chain is an essential information for the development of market-sensing capabilities. Moreover, small farmers with initial lower levels of market sensing capabilities and high value discipline clarity are the ones learning most from the public R&D dissemination process. Finally,; public R&D has stronger impact on small farmers' capabilities when the industry association is also market oriented and when it decentralizes marketing decisions to the individual member firms.

In this research, an inductive "grounded theory" approach which is exploratory in nature is used to gain knowledge in an area where there is no previous research done, that is, when public R&D has an impact end users' market sensing capabilities in the agri-food sector. This theory-building study led to the development of propositions to be tested in future research. In particular, research would benefit from expanding the quantitative data collection to a set of purposive public R&D cases selected based on the structure of the inter-organizational industry associations which public R&D end users belong to and the characteristics of the public R&D research and dissemination methods. Finally, collecting baseline data on the initial farmers' market sensing capabilities into a panel database would effectively test the change in market sensing capability over time due to public R&D. This would also provide a test for the causal relationship between public R&D and development of market-sensing capabilities, which in this study is proposed based on qualitative discussions with the interviewees.

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Appendix

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Satorra-Bentler	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Goodness of Fit	n=34	n=34	n=34	n=34	n=34	n=34
Measures						Bootstrap
X ² ; d.f.	35.69; 66	51.23, 78	95.01, 136	105.7, 98	145.35, 96	137.82, 136
X ² p-value	0.58	0.31	0.45	0.28	0.00	0.00
RMSEA	0.000	0.052	0.018	0.049	0.125	0.2279
RMSEA l.b.	0.000	0.000	0.000	0.000	0.080	0.1790
RMSEA u.b.	0.110	0.127	0.094	0.105	0.162	0.2701
CFI	1.000	0.986	0.997	0.977	0.870	0.723
AIC	-40.3	-42.76	-92.99	-90.30	-46.65	88.96

Table 2. Goodness of Fit Comparison across Competing Models

Legend. Model 1 = Impact of public R&D (=INFOCRC in Table 3 and 4) on market sensing.

Model 2 = Impact of public R&D on market sensing, controlling for farmers' belief of learning.

Model 3 = Impact of public R&D on market sensing, controlling for farmers' belief of learning and demographics (Results presented in Table 3a)

Model 4 = Impact of public R&D on market sensing, controlling for farmers' belief of learning, demographics and value discipline clarity (Results presented in Table 3b)

Model 5 = Impact of public R&D on market sensing, controlling for farmers' market strategy change and demographics.

Model 6 = Impact of public R&D on market sensing, controlling for farmers' belief of learning and demographics (Model 3 after bootstrapping with 35 repetitions).

Dependent Variable	Independent Variable	Standardized Path Estimates	t-test
Age	Male	-0.53	3.06
-	Error	0.85	
Experience	Age	0.46	2.97
	Previous Job	-0.39	2.67
	Error	0.80	
INFOCRC	Age	-0.25	-1.46
	Experience	-0.37*	-2.18
	Error	0.85	
BLearning	Age	-0.23	1.39
	Previous Job	-0.21	1.23
	Error	0.95	
IS1	Info Searching (F1)	0.60*	2.51
	Error	0.80	
IS2	Info Searching (F1)	0.63*	3.03
	Error	0.78	
IS3	BLearning	0.33	1.71
	Info Searching (F1)	0.72*	4.14
	Error	0.74	
IP1	Age	0.18*	1.99
	Info Processing (F2)	0.95*	3.84
	Error	0.41	
IP2	Info Processing (F2)	1.30*	8.21
	INFOCRC	-0.40*	2.90
	Previous Job	0.17	1.06
	Error	0.00	
IP3	Info Processing (F2)	0.88*	3.91
	BLearning	0.33*	2.18
	Male	-0.17	1.37
	Error	0.50	
IU1	Info Using (F3)	0.89*	9.60
	INFOCRC	0.14	1.50
	Error	0.26	
IU2	Info Using (F3)	0.96*	10.90
	Error	0.27	
CA1	Customer Advantage (F4)	0.94*	8.82
	Error	0.34	
CA2	Customer Advantage (F4)	0.93*	8.89
	INFOCRC	0.33*	4.40
	Error	0.26	
CA3	Customer Advantage (F4)	0.68*	5.47
	INFOCRC	0.21	1.26
	Age	0.26*	1.95
	Error	0.62	
F1	INFOCRC	0.38*	1.82
	BLearning	-0.30	-1.18
	Male	0.22	0.82
	Previous Job	0.49*	1.83
	Error	0.59	
F2	INFOCRC	0.31	1.25
	Experience	-0.13	-1.32
	F1	0.62*	2.00
	Error	0.47	
F3	F2	0.75*	3.28
	Error	0.66	
F4	F2	-0.10	-0.66
	Error	0.99	

Table 3a. The Impact of Public R&D on End Users' Market-Sensing Capabilities

Goodness to Fit Indices: Satorra-Bentler scaled $\chi 2=95.01$ on 136 d.f.; P-value for $\chi 2=0.45$ CFI = 0.997; RMSEA = 0.018; RMSEA 90% Confidence Interval = (0.000, 0.094). Note. Asterisk (*) denotes variables significant at 5%.

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Dependent Variable	Independent Variable	Standardized Path Estimates	t-test
Value Discipline	Age	-0.37*	2.35
Clarity	Previous Job	0.25	1.46
Age	Male	-0.53*	3.55
Experience	Age	0.46*	3.27
F F	Previous Job	-0.39*	2.67
INFOCRC	Age	-0.25	1 39
nubere	Experience	-0.25	1.05
DI coming	Ago	-0.57	2.11
DLearning	Age Value Dissipline Clarity	-0.41	2.11
101		-0.30*	2.07
181	Info Searching (F1)	-0.52*	2.27
	Male	-0.3/*	1.78
182	Info Searching (F1)	-0.38	1.38
	Previous Job	0.19	1.57
	Male	0.35	1.30
IS3	BLearning	0.23	0.19
	Info Searching (F1)	0.39	0.21
	Male	0.16	0.47
	Previous Job	0.39	1.02
IP1	Age	0.17*	2.22
	Info Processing (F2)	0.93	1.82
IP2	Info Processing (F2)	-0.36*	2.16
	INFOCRC	1 26*	2.09
	Previous Job	0.14	1 34
103	Info Process (F2)	0.33	1.54
11.5	BL earning	0.86*	2.21
	Mala	-0.00	2.21
TT 11	Info Llaing (E2)	-0.23	2.19
101	IIIO Using (F3)	0.15*	1.05
	INFOCRC	0.15*	8.98
102	Info Using (F3)	0.9/*	11.35
CA1	Customer Advantage (F4)	-0.9/*	9.26
CA2	Customer Advantage (F4)	-0.95*	7.15
	INFOCRC	0.35*	4.44
CA3	Customer Advantage (F4)	-0.30*	4.48
	INFOCRC	0.23	1.47
	Age	0.34*	2.28
	Male	-0.54	1.13
	IS2	0.30*	2.25
F1	INFOCRC	-0.66*	2.50
	BLearning	0.39*	2.15
	Value Discipline Clarity	0.48*	1.98
	Previous Job	0.25	1.20
F?	Value Discipline Clarity	-0.20	0.63
12	Experience	0.23	1.67
	Experience	0.23	1.07
F2	Г1 F2	0.05	1.32
ГЭ	$\Gamma 2$	0.74	.39
54	value Discipline Clarity	0.96	1.75
F4	BLearning	0.34	1.10
	Value Discipline Clarity	0.36	1.40
	F2	0.27	0.95
	Previous Job	-0.26	1.17

Table 3b. The Impact of Public R&D on End Users' Market-Sensing Capabilities, Controlling for Farmers' Value Discipline Clarity

Goodness to Fit Indices: Satorra-Bentler scaled $\chi^2 = 105.70$ on 153 d.f.; P-value for $\chi^2 = 0.28$ CFI = 0.977; RMSEA = 0.049; RMSEA 90% Confidence Interval = (0.000, 0.105). **Note.** Asterisk (*) denotes variables significant at 5%. **Legend:** *INFOCRC* = public R&D information; *BLearning* = end users' perception of learning from R&D information; IS1, IS2, IS3: items on information searching (F1); IP1, IP2, IP3: items on information processing (F2); IU1, IU2: items on information searching (F3); CA1, CA2, CA3: items on customer advantage (F4).



International Food and Agribusiness Management Review Volume 17 Issue 1, 2014

Consumer Preferences for Sustainably Produced Bananas: A Discrete Choice Experiment

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Abstract

Even though sustainability has become an omnipresent mega-trend, very little related research has been done in Europe. The objective of the present paper is to discover consumers' perceptions concerning sustainably produced bananas. To this end, 316 German consumers participated in a discrete choice experiment and filled in a questionnaire. The results confirm that trust in the standard setter plays a particularly important role for the success of a label. Generally there is need for further simplification and information.

Keywords: sustainability, discrete choice experiment, label, consumer preferences, bananas

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Introduction

Sustainability can be regarded as one of the current mega-trends in all industries. However, neither consumers nor experts can define it clearly, so that a common basic understanding does not exist (Rat fuer Nachhaltige Entwicklung 2008). Nevertheless, a large proportion of consumers are intensely interested in the topic of sustainability. The consumer segment that buys products according to ethical or sustainability criteria has increased in recent years (Saunders et al. 2011). Credence attributes such as sustainable production are typically conveyed to the consumer via labeling. In the course of the last decade, hundreds of labels intended to guarantee various process qualities have flooded the market. Especially since a lot of institutions (both private and public) have developed individual labels pursuing differing aims, lack of standardization has rendered any comparability of these diverse "sustainability" labels difficult. Decisive factors for the acceptance of a label can be seen in the credibility of the label and the general trust and acceptance of the customer (Vermeir and Verbeke 2004), and detailed knowledge of consumer preferences greatly influences label design (Eberle et al. 2011). In this context, Hobbs et al. (2010) assume that strong consumer preferences for different credence goods and characteristics vary.

Studies on consumer preferences for sustainable products are relatively rare. The overview by Moser et al. (2011) in the area of fruit and vegetables revealed that hardly any appropriate research has been done in Europe. The closest research pertains to the effects on consumer behavior of the attributes environment, rejection of pesticide use, certification, source and quality. In contrast, very little is known regarding attributes such as regionality and organic production. This lack of knowledge is surprising in light of the EU's desire to support sustainable development in the agri-food industry. Tropical fruits like bananas are popular but often associated with unacceptable production conditions. Lehnert (2009) noted a positive consumer preference for bananas carrying an organic and fair trade label. Although prices were integrated in the analysis, the standard setter—namely, that differing levels of consumer trust were placed in the organizations behind the labels and the varying degrees of influence exerted by other labels (e.g., carbon footprint)—was not. The influence of consumer attitude on the purchase of "green food products" was researched by Tanner and Woelfing Kast (2003). Their literature review reveals that few studies have been undertaken on consumer preferences regarding sustainable products in the food industry.

The present study will research more closely consumer preferences regarding production qualities using the example of bananas. Bananas are a particularly appropriate study object because, as a typical export product of developing countries, their production automatically brings up concerns about ecological and social sustainability. Those with specific production process qualities are already found in supermarkets. Furthermore, they are traded on a large scale and eaten by the vast majority of consumers.

Besides existing labels (organic and fair trade), a hypothetic sustainability label was used in the study combining the currently existing process qualities for bananas found on the market: organic production, fair trade and carbon neutrality. Likewise, the impacts of the standard setter and of the product price were included in the analysis since they are directly related to the certification of sustainable production processes.

Using an empirical consumer study with an integrated discrete choice experiment (DCE), this study will seek to answer the following research questions:

- What preferences do consumers have concerning sustainable process qualities in their purchase of bananas?
- Are consumers interested in a label that combines all currently existing sustainable process qualities?
- What preferences do consumers have concerning the organization that certifies sustainable process qualities?
- What impact does price have?
- Do differing attitudes and socio-demographic parameters lead to differences in consumer preferences?

Theoretical Background

As mentioned in the introduction, there is no clear definition for sustainable production as there is for ecological or biological production (Institut der deutschen Wirtschaft 2011; Rat fuer Nachhaltige Entwicklung 2008). The concept of sustainability was first introduced at the beginning of the 18th century by the forest economist Hans Carl von Carlowitz. In his paper "Sylvicultura oeconomica" he demanded that only as many trees be logged as could be regrown (Schein 2003).

Current notions about sustainability lean heavily on the conservation and ecology movements. In the late 1980s, the ecological crisis began increasingly to be perceived as a global crisis which could not be viewed independently of its social and economic interrelationships (Littig and Griessler 2004). Because of this, an evaluation of sustainable practices must take into account three factors—economy, ecology and social welfare. Strict attention must be paid that these factors, which were alternatively referred to as "pillars" or "dimensions", were given equal consideration. Despite this, the historical development of the concept of sustainability has focused largely on the ecological pillar (Littig and Griessler 2004; Pacini et al. 2003).

In contemporary discourse, the terms "sustainable development "and "sustainability" are frequently used synonymously (Christen and Halloran-Wietzholtz 2002). "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (WCED 1987). This definition from the Brundtland Report has received acceptance and acknowledgment by influential economists, politicians and researchers. It unites the need to address the demands of an increasing global population with the need to protect natural resources and reduce environmental pollutants (Breitschuh 2003).

The Brundtland Report, originally entitled Our Common Future, was published by the World Commission for Environment and Development in 1987; it describes key global issues which present problems for sustainable development (Littig und Grießler 2004).

A further definition pertaining to agriculture is suggested by Allen et al. (1991): "A sustainable food and agriculture system is one which is environmentally sound, economically viable, socially responsible, non-exploitative, and which serves as the foundation for future generations." This definition is centered on an interdisciplinary approach in which the diverse factors act in relation to one another. This applies to agriculture on the whole as well as to the industries downstream in the supply chain, whether on the local, regional, national or international level.

The Sustainable Agriculture Initiative (SAI 2013) offers the following definition: "Sustainable agriculture is a productive, competitive and efficient way to produce safe agricultural products, while at the same time protecting and improving the natural environment and social/economic conditions of local communities."

In 1992, an agreement was reached in Rio de Janeiro in which governments bound themselves to the implementation of Agenda 21 in their national sustainability strategies. Sustainable development became part of the central approach. Appropriate indicators were to serve as measures of success (Korczak 2002). National governments as well as international and non-governmental organizations (NGOs) were asked to assist in the development of indicators to measure sustainability. In 1994, the principle of sustainability became a national goal anchored in German legislation (Luetke Entrup 1999). The conference in Rio is generally recognized as a significant catalyst for global debate on the subject of sustainability (Huelsbergen 2003).

The Enquete Commission (1997) defined sustainability as a development which works to provide long-term fulfillment of the needs of a growing world population despite limitations caused by the decline of natural resources, while it simultaneously reduces pollution.

This selection of definitions shows the wide variation in the interpretation of sustainability. In this, sustainability is characteristic of a dynamic system which conserves itself. That is to say, no fixed endpoint can be determined. Thus, ecological sustainability can be seen to be based on the use of natural resources in the context of human or social development (Esty et al. 2005).

In principle, it can be assumed that a development is sustainable when capital assets remain stabilized and when efficiency and justice are achieved. Elements of these capital assets include natural capital, human capital and reproductive capital, ensuring that a certain standard of living can be maintained (European Commission 2001).

The application of sustainable development in the area of nutrition can be achieved by many activities simultaneously (Empacher and Hayn 2005). One of these is the improvement of production conditions in a sustainable context. The improved production process is not visible to the consumer and must therefore be communicated through labeling of the product in order to justify a higher price.

According to information economics (Darby and Karni 1973; Nelson 1970, 1974), product cues can be categorized into search attributes, experience or sensory attributes, and credence attributes. Color, price and label can be classified as search attributes. Search attributes can be evaluated before actual purchase. From experience or sensory attributes (e.g., flavor, aroma and tenderness) quality can be derived during preparation or consumption. Credence features cannot

be ascertained even after the consumption of the product; neither buying nor eating the product provides consumers with perceptible evidence. Therefore, the judgment of others (e.g., information from a producer or retailer) has to be trusted (Henson and Reardon 2005). Sustainable process qualities are among these credence attributes. For the consumer, it is impossible—or so labor-intensive that it is virtually impossible—to monitor whether workers on a plantation are paid fairly or whether pesticides are used there. In the worst case scenario, the resulting information asymmetry between producer and consumer can lead to a total market failure, as Akerlof (1970) described in his famous article "Market of Lemons": Consumers are unwilling to pay more for better quality and thus, producers have no motivation to offer higher quality. As a solution, a (third-party) label can serve as an objective quality signal.

In a society that is largely estranged from food production, food labels should also (re)gain consumers' trust in agriculture and suggest food safety (Discherl 2005). Consumers can choose between labels from diverse institutions—public institutions, nongovernmental organizations (NGOs), producers, retailers, dealers—or even combinations of these (Gawron and Theuvsen 2008). In such cases, the private label of a supermarket or producer is only valid for the individual organization. Hobbs (2010) classified these private standards in three categories: "proprietary standards", "consensus standards" and "third-party private standards". The main objective of private standards can be seen as differentiation from competitors (Codron and Giraud-Héraud 2005; Henson and Reardon 2005; Hobbs 2010). To which extent the reputation of a company is improved and/or responsibility or liability in the value chain is distributed depends mainly on the individual standard itself (Hobbs 2010).

Since, as explained above, a standard can be established by nearly any player in the food industry, a large number of standards exist that are, to a greater or lesser degree, similar (Jaffe and Henson 2004; Henson and Reardon 2005).

In general, as Gilg et al. (2005) revealed, a trend has developed in recent years toward "green consumption". Consumers associate more than organically produced products with it. They also include fair trade, regional production and other qualities that lead to sustainability. Thus, there appears to be a need for the creation of a complex label.

Regarding willingness-to-pay for sustainable production characteristics, a positive influence can be assumed. Gil et al. (2000), for instance, found that consumers will pay more for fresh and perishable food, such as fruits and vegetables that are produced organically. Regarding different consumer segments, as consumer income rises, so does sensitization to environmental issues (Borgstedt et al. 2010).

The buyer of environmentally friendly products is commonly someone aged 30 to 49 years with a high income of 2,000 to 2,999 per month. In contrast, younger persons with lower incomes rarely purchase environmentally friendly products (Borgstedt et al. 2010). This positive influence of a high income on consumer preference for ethically produced products was confirmed by Lehnert (2009), though solely for fair trade products and not for the organic segment. Regarding education, Lehnert (2009) likewise determined only positive effects on consumer preference for fair trade products. However, de Pelsmacker et al. (2005) detected no correlation between

preferences and educational level. In fact, simply having been awarded the label led to more favorable product perception among individuals with a low level of education.

Concerning gender, Lehnert (2009) observed a clear preference among women for ethically produced goods.

The attitudes of consumers towards the environment in general can also explain their preference for products with sustainability labels. Thus, consumers who are aware of environmental and social issues and involved in sustainable issues have a higher willingness to pay for corresponding products (Mueller et al. 2011; Sirieix et al. 2011).

As to sustainably produced food, there is a discrepancy between the attitudes and the actual behavior of consumers (attitude-behavior gap) (cf. Kollmuss and Agyeman 2002; Gupta and Ogden 2006). Nevertheless, positive correlations have been observed. Robinson and Smith (2002) showed that psycho-social variables (attitudes and opinions, acknowledged behavior and subjective norms) predict the buying intention of sustainably produced products.

The effect of attitudes, opinions and norms on the preference for sustainably produced products (organic and fair trade) was likewise confirmed by Lehnert (2009). These results underline Theuvsen's conclusion (2008) that consumers are only aware of product declarations that are already of interest to them.

Lehnert (2009) additionally determined that consumer behavior (price and quality orientation) impacts consumers' preference for ethical products. People who are price oriented therefore have a lower preference for ethical products, and people who are quality oriented have a greater preference for them.

De Pelsmacker et al. (2005) revealed that the intensity of consumption also has a positive impact on individual preferences. In this context, Tonsor and Shupp (2009) observed that people who eat apples more often than others were more willing to pay extra for sustainably produced apples. Nevertheless, the Eurobarometer study, which contains only ecological dimensions of sustainability, found that only 21% of the participants believed their consumer behavior had any influence on environmental problems (The Gallup Organization 2009).

Another effect on consumer behavior is seen in the consumers' trust in the product label. Consumers with a high degree of trust in an organic or fair trade label have a higher preference for products with sustainable process qualities (Lehnert 2009). In their qualitative study, Sirieix et al. (2011) revealed the high significance of trust in the standard setter. Trust in the quality assurance combined with trust in the organization behind the label can be regarded as the most important dimensions for explaining the success of labels in the food market (Hobbs et al. 2010). The fact that trust in a label is important for its success is also proven by Innes (2008), who identified lack of trust as a reason for purchase refusal of organic products. Furthermore, Teisl et al. (2002) confirm that the credibility of the standard setter is a focal point in combination with the design and format of the information given. Mistrust in the certification has likewise been documented by Roehr et al. (2005) (cf. Moser et al. 2011). They found that German consumers consider information from ecological organizations (NGOs), nutritionists and medical experts
more credible than information from agricultural ministries, food producers or the media. Midmore et al. (2005) add the various food scandals of the recent past as reasons for mistrust. Jensen and Sandoe (2002) share this appraisal and also found that, particularly in the European area, there is little trust in public oversight systems. Hence, a fair trade label awarded by an independent organization was evaluated positively, while a label awarded by the supermarket chain Tesco certifying sustainable agriculture was liked less due to the suspicion of greenwashing (Sirieix et al. 2011).

Based on the results of former studies discussed above and on the research questions listed in the introduction, the research design of this study was created, which is described in the next section.

Sample Description and Research Design

The empirical data were retrieved with the support of a private panel provider via an online survey. The panel provider recruited the respondents from their panel and collected a data set with 316 completed questionnaires. Due to a lack of internal accuracy, three sets of answers had to be deleted; hence, 313 observations were analyzed. The survey was taken in Germany from February 28 to March 6, 2012. The sample matches with the German average in age, sex, place of residence and income (Statistisches Bundesamt 2009). The average age of the test persons was 44 years; 48% were male, and 52% were female. Their residence reflected the distribution of quotas within Germany (Statistisches Bundesamt 2009). The majority of the respondents have children (75.4%).

The questionnaire was divided into four main parts. After several questions about the individual's lifestyle and consumer behavior, the discrete choice experiment (DCE) included questions concerning attitudes towards product information from various organizations. The questionnaire finished with sociodemographic questions. In all, there were 27 choice sets, which were divided into three questionnaires with nine sets apiece. Thus, the model was appraised using the 2,817 answered choice sets.

We chose the DCE as our research method because it is especially well suited for research on preferences for products which are not yet on the market (Auspurg and Liebe 2011). With this method, test persons are confronted with a decision-making process similar to that found in a supermarket (Ashok et al. 2002), making it optimal for use in this study.

The discrete choice method is a technique for the detection of complex decision patterns and analyses of preference structures (Hahn 1997, Louviere et al. 2000). In this process, the participants make a choice on the basis of a limited number of alternative products. The decision to present only a few products (discrete goods) is justified by the fact that in real purchase situations, the subjects would usually also be offered only a limited number of alternatives (evoked set) from which they would have to make their choice (Hahn 1997).

The process of a discrete choice analysis is comparable to a conjoint analysis, but, in a conjoint analysis, ordinal scaled data is required. Hence, respondents have to rank their preferences or

compare them using a rating scale. In contrast, DCE works with nominally scaled values, which allows for a simple and realistic buying decision on the basis of a simulated assortment.

Methodologically, this analysis is based on a conditional logit model. Several studies have already applied DCE in the food industry, analyzing various preference patterns, such as the value the consumer places on food safety, labels, brands or sensory aspects (e.g. Teisl et al. 1997; Lockshin et al. 2006; Loureiro and Umberger 2007; Gracia and de Magistris 2008).

Besides looking at sustainability characteristics, the following study will also include the factors of standard setters and price as criteria relevant for purchase. The characteristic sustainable production quality is offered to the consumer through organic certification, organic & fair trade certification and sustainability certification. Sustainability certification is a hypothetical label that combines all the sustainability attributes of previous labels for bananas (organic, fair trade and carbon footprint).

	Status quo	Level 1	Level 2	Level 3
Sustainable	none	organic	organic & fair	sustainability
production quality		certification	trade certification	certification
				(organic & fair trade
				& carbon neutral)
Standard setter	none	government	supermarket chain	independent
		institution	-	organization
Price	1.29 €kg	1.79 €kg	1.99 €kg	2.19 €kg

Table 1. Attributes and their levels in the DCE

The measured presence of the characteristic standard setter agrees with the previous activity in the banana market: government institutions, independent organizations and supermarket chains. Furthermore, as many studies have shown, price is one of the most important criteria in consumer decision-making. As suggested by Peyer and Balderjahn (2007), the prices used in the experiment took into account the current market prices.¹ The status quo in the study was represented by a conventional banana without certification being sold at $1.29 \notin kg$. In this experiment, the subjects had to choose between the status quo product and three alternatives reflecting Levels 1 to 3 as shown in Table 1.

The usefulness of the product attributes depends on the characteristics of the test persons. In forming a theoretical framework, Hahn (1997) suggests the use of preference analysis and product choice behavior, approaches used in the behavioral sciences. By taking into consideration hypothetical constructs as well as intervening variables, we hoped to duly account for intra-individual behavioral processes, thus gaining insight into individual decision-making processes. To this end, we constructed our models upon the stimulus organism response (SOR) paradigm, a principle successfully applied by Lehnert (2009).

¹ In the fifth week of 2012, random samples were taken in various grocery stores in Goettingen, Germany, and the price was equally derived. The average price from 2010 (AMI 2010) provided the basis for comparison.

Consumer behavior studies have provided comprehensive knowledge about the intervening variables of usage (Solomon et al. 2010). With this in mind, the following intervening variables or constructs will be used in this study:

- Socio demographic variables
- Consumer behavior and likeability of the product (bananas)
- Trust in organizations
- Attitudes

The reference groups for the calculated logit regression models were the conventional banana (status quo), the organic label and the organization "government institution."²

The Maximum Likelihood Method was applied to estimate the parameters (Louviere et al. 2000, Greene 2003), using a multinomial logit and a mixed multinomial logit model calculated with the statistics program STATA 10.0 IC. Positive values allude to a higher degree of preference in comparison with the reference group, and negative values to a lower degree of preference. The first model consisted solely of the product attributes of the bananas (see Table 1). In the second, individual variables were included in order to analyze interactions with the product attributes (dummy variables³).

The respondents' attitudes were summed up in indices for integration in the model (cf. Hartl 2008). The indices contain the arithmetic mean for each participant and were re-coded in cases of negative wording. Ordinal variables, such as education, were grouped and integrated in the model as dummy variables.

The quality of the model was confirmed through a likelihood ratio test (LR), a pseudo-R² and the Aikaike Information Criterion (AIC). The LR test serves to reject the null hypothesis—that all parameters of the model are 0—and thus confirms the significance of the total model. The significance level is indicated as follows: $p \le 0.1$ ([§]), $p \le 0.05$ (*), $p \le 0.01$ (**), $p \le 0.001$ (***) (cf. Hartl 2008). The AIC values determined the choice of the model. In this way, a compromise was reached between good data fit and too great model complexity (Fahrmeir et al. 2009).

Furthermore, the quality of the model can be evaluated using the pseudo- R^2 . Values between 0.2 and 0.4 indicate that a model possesses good explanatory power. They correspond to values of about 0.7 to 0.9 of the R^2 in linear regressions (Louviere et al. 2000). The final step was to eliminate the effects that might arise through multiple rating of a participant's choice sets.

Results of the Analysis

In order to gain insight into the respondents' consumer behavior concerning products with sustainable features, they were asked to state how often they buy such products. The majority of

² Due to the experimental design, these could not be separated when making calculations.

³ Dummy variables are binary variables with the characteristic 1 = characteristic exists; 0 = characteristic does not exist.

respondents buy organic (66.45%) and fair traded products (58.33%) at least occasionally. The assumption that bananas are a neutral product eaten by almost all customers was confirmed; only 2.88% reported that they never eat bananas.

On the one hand, respondents declared that they prefer to buy high quality food (66.46%). On the other hand, they are very price-oriented; 68.37% stated that price is very important when shopping for groceries. Thus, prices and quality are the most important attributes in making purchase decisions in supermarkets. For the logit model, the statements concerning price and quality orientation combined in an index summing up the means of each respondent (see Appendix).

Besides other attitudes, such as attitudes towards organic or fair trade products, which are likewise included as indexes in the model (see Appendix), the respondents were asked about the general effect of labels.

As seen in Table 2 only a quarter of the respondents (25.56%) agreed that a label enables them to purchase a product that suits their wishes. Respondents were asked twice whether they believe they are able to influence production method through their consumer behavior, once before and once after the DCE. The results did not deviate markedly; before the DCE, 38.34% agreed with the statement, and afterwards 41.21% agreed.

Statements "effect of product labels" (Agreement in %)	1	2	3	4	5	Mean (μ) Standard deviation (σ)
Product labels enable me to buy products that were produced in accordance with my wishes.	9.90	17.89	46.65	21.73	3.83	$\mu = 2.916933$ $\sigma = 0.970462$
Through my choice of product, I can influence production methods.	8.63	18.53	34.50	27.48	10.86	$\mu = 3.134185$ $\sigma = 1.107034$
By purchasing foods with product labels, I can influence production methods.	7.99	12.46	38.34	29.71	11.50	$\mu = 3.242812$ $\sigma = 1.070505$

Table 2. Statements on the effect of product labels (n= 313)

Likert scale from 1= totally disagree to 5= totally agree

Besides the possible effect of a label, trust and credibility are of distinct importance. In general, trust in product labels is not very pronounced (μ = 2.62) (see Table 3); 39.3% of the respondents did not agree with this statement, whereas only 13.1% said that they trust product labels. One reason for this lack of trust might be that product labels lack credibility. In fact, 36.1% of the respondents agreed with this statement. Furthermore, there is uncertainty among consumers as to which label can be trusted; only 12.46% did not agree with this statement.

Correspondingly, trust in a product label is influenced by trust in the organization that serves as the standard setter. To test this, respondents were asked which criteria are important for them in appraising a label. As can be seen in Table 4, the standard underlying the label is regarded as more important than the standard setter.

Statements "trust in product labels" (Agreement in %)	1	2	3	4	5	Mean (μ) Standard deviation (σ)
I trust product labels.	13.74	25.56	47.60	11.18	1.92	$\mu = 2.619808$ $\sigma = 0.922923$
Product labels are not very credible.*	1.60	12.46	49.84	22.68	13.42	$\mu = 2.664557$ $\sigma = 0.916554$
I'm not sure which product labels are trustworthy.*	3.51	8.95	31.95	36.74	18.85	$\mu = 2.405063$ $\sigma = 1.0064$

Table 3. Trust in product labels (n= 313)

Table 4 Importance of organization and standard for a product label (n = 313)

Statements "importance of organization and standard for a product label"(Agreement in %)	1	2	3	4	5	Mean (μ) Standard deviation (σ)
The organization that awards the label	8.63	10.22	27.48	38.34	15.34	$\mu = 3.415335$
						σ= 1.129452
The standards certified by the label	6.71	3.83	21.09	44.41	23.96	μ= 3.750799
						σ= 1.072025

Likert scale from 1= totally disagree to 5= totally agree

Concerning the so-called "label flood," Table 5 shows that 68.06% of the respondents believed there are too many different labels. When asked if two or more labels indicate a good product safely produced, the majority (42.17%) were uncertain and only 12.78% agreed with this statement. Also, when asked whether they can differentiate between environmentally friendly and environmentally harmful products, the respondents showed uncertainty. Here, only 21.4% agreed with the statement.

Table 5. Number of la	abels on a p	product ((n = 313)	
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Statements "number of labels on a product" (Agreement in %)	1	2	3	4	5	Mean (μ) Standard deviation (σ)
There are too many different product labels.	2.88	4.47	24.60	40.26	27.80	$\mu = 3.85623$ $\sigma = 0.971601$
Two labels on one product indicate a good product/safe production methods.*	15.02	30.03	42.17	10.86	1.92	μ = 3.439873 σ = 0.947820
I can differentiate between environmentally friendly and environmentally harmful products in the shop.	7.35	22.04	49.20	15.97	5.43	μ = 2.900958 σ = 0.940420

Likert scale from 1= totally disagree to 5= totally agree, * re-coded

Besides these assessments, our study emphasized the logit model, which was calculated on the basis of the DCE. The results are presented in Table 6.

	Variables	Basic Model	Model 1	Model 2 (3)
70	y2	1.104265***	-3.173118***	-3.10453***(***)
C Ife	y3	0.4786202***	-1.500826*	-1.478562*
-ibr AS	z2	-0.2174748***	-2.081752***	-2.223213***(***)
& It	z3	0.3178736***	-3.326333***	-3.390993***(***)
A	Prices	-1.697908***	-1.599455***	-1.598599***(***)
	y2*IndPriceorient		-0.2698215**	-0.2726883**(\$)
	y3*IndPriceorient		-0.4940081***	-0.4894604***(**)
les	z2*trust2		0.528817***	0.5332045***(***)
abl	z3*trust3		0.5199108***	0.5174342***(***)
ari	z2*trust3		0.0780528	0.0708152
C V	z3*trust2		-0.0699107	-0.0695159
ciff	y2*banan		0.1166092 ^{\$}	0.1165766*
spe	y3*banan		0.1814956**	0.1842293**
al	z3*educate		0.4178934***	0.4167834***(*)
idu	z2*educate		0.0192769	0.0191605
livi	y2*educate		0.3565318**	0.368071**(^{\$})
inc	y3*educate		0.2447553 ^{\$}	0.2414211
pu	z2*IndQuality		0.0456259	0.0736657
s S	z3*IndQuality		0.4397429***	0.4612168***(**)
oute	y3*IndFair		0.3887131***	0.4048309***(*)
rib	y2*IndFair		0.7457323***	0.759087***(***)
att	y2*age		-0.0136134***	-0.0130587**(^{\$})
of	y3*age		-0.0136836**	-0.0137834**(^{\$})
suo	y2*IndSust		0.8551294***	0.8770411***(***)
cti	y3*IndSust		0.8393029***	0.8533328***(***)
era	y3*IndCO2		-0.0217103	-0.0181785
Int	y2*IndCO2		0.2494453*	0.2548839*
	y3*IndEco		-0.1321536	-0.1023158
	y2*IndEco		-0.2457381 ^{\$}	-0.2209696 [§]
	z3*banan		0.0019334	
out	z2*banan		-0.0120621	
e the	y3*IndQuality		0.0833342	
wi enc	y2*IndQuality		0.1024831	
les Auc	y3*child		0.0642344	
iab inf	y2*child		-0.0776101	
/ar	y3*sex		-0.1655631	
	y2*sex		-0.1259302	
	N (n)	11268 (313)	11160 (310)	11160 (310)
v u	LR Chi ²	584.73	1657.23	1650.25 ⁽⁴⁾
lit	$Prob > Chi^2$	0.0000	0,0000	0.0000
Zua ite	Pseudo-R ²	0.0749	0.2142	0.2137
0 5	Log Likelihood	-3,612.8257	-3,039.1466	-3,041.0943
	AIC	7 235 651	6 1 5 2 2 9 3	6 140 189

Table 6. Estimation model for the analysis of preference

AIC7,235.6516,152.2936,140.189Significance level = ***: 99.9% **: 99% *: 95% *90% (cf. Hartl 2008), explanations of the variables see A1

⁴ Wald Test (465.67) for Model 3

Concerning the sustainability of production quality, it was determined in the basic model that the consumer recognizes that organic and fair trade labels make a positive contribution (1.104265***), as does the organic & fair trade & carbon neutral label (0.4786202***). Interestingly, for the hypothetical sustainability label, this recognition is somewhat less pronounced than for the organic & fair trade labels. In comparison with governmental certification or no certification at all, the test persons saw a positive contribution in certification by an independent organization (0.3178736***). Labels given by the supermarket itself lowered preference for bananas (-0.2174748***). The test persons' interest in the bananas also decreased with rising prices (-1.697908***). All variables specific to the product have a highly significant influence on the preferences of the consumers.

With regard to statistical calculation, the explanatory power of the multinomial model is relatively small (pseudo $R^2 = 0.0749$); the variables considered did not adequately explain the preferences of the test persons. Therefore, the model was expanded to include the previously introduced intervening variables (Model 1). Also, their influence on the preference was researched using a mixed multinomial logit model. In this expanded model, few variables are included that do not exert an influence (are not significant). To find an optimal model, the AIC was applied. Stepwise regression was used to find the best compromise between the number of variables in the model and the quality criterion of the model. However, in order to better interpret the data, several insignificant variables are included in Model 2 (e.g., z2*trust3).

To lower the number of respondents required, every respondent had to make nine choices. This can lead to over dispersion, which is why we calculated Model 3. In comparison to Model 2, only standard deviations are higher. Including the intervening variables improved the performance of the model to very good (pseudo R^2 : 0.2137).

In general, the positive contribution of the sustainable production qualities can be tied to the following personal characteristics (cf. Model 3):

Sociodemographic Variables

Younger test persons have a greater preference for the production qualities labeled organic & fair trade and organic & fair trade & carbon neutral. Educational level influences not only the usefulness of the production quality but also the usefulness of the organization. The preference for sustainable production qualities is positively influenced by a higher level of education (trade school or college preparatory school). A higher level of education likewise increases the perceived usefulness of the independent organization as the organization of certification. Educational level did not have a perceptible effect in connection with the supermarket labels.

Consumer Behavior and Likeability of the Product (Bananas)

The consumer behavior of the test persons significantly influenced preference for sustainable process qualities and the certifying organizations. A strong price orientation results in a smaller preference for sustainable production qualities in comparison with conventional and organic production, whereby this is more strongly seen with the sustainability label. Quality orientation exerts no influence on preference with regard to the sustainability of production qualities,

although it does influence the perceived usefulness of the organization. The greater the test person's orientation to quality, the greater the perceived usefulness of an independent organization for certification. In contrast, a strong quality orientation exerts no influence on the preference for supermarkets as the organization of certification. Concerning the usefulness of production qualities, this is a significant positive parameter for test persons who especially like bananas, whereas the value of the label organic & fair trade & carbon neutral is somewhat greater.

Trust in Organizations

Furthermore, the model measured significant influences for attitudes and trust in the organization. The more the test persons trust the supermarkets to provide reliable information regarding the production of foodstuffs, the higher the supermarkets rate in their positive usefulness as organizations for certification when compared to governmental institutions or "no organization", as in conventional production quality.

Attitudes

The test persons perceived sustainable production qualities as increasingly more useful in direct relation to the degree that they were fair trade products. The effect of this production quality was observed for organic & fair trade products even more than for organic & fair trade & carbon neutral products. As expected, the positive response to sustainable production also exerted a positive influence on the perceived usefulness of sustainable production qualities in comparison to the reference. This effect was observed somewhat more with the organic & fair trade & carbon neutral production quality. The usefulness of the organic & fair trade & carbon neutral production quality was not significantly influenced by attitude towards environmentally friendly products.

Discussion

In general, we found that a sustainability label significantly positively influences consumer preferences for sustainably produced bananas. This is in keeping with earlier findings regarding sustainable production and the general trend towards "green consumption" observed by Gilg et al. (2005).

It is striking that the hypothetical sustainability label combining the current existing process qualities on the market for bananas (organic production, fair trade and carbon neutrality) makes a less positive contribution to consumers' choice than an organic & fair trade label. This might be related to the fact that the majority of the recipients feel that there are too many labels on the market, whereas they are uncertain whether more labels on a product indicate a healthy and safely produced food product.

In view of this consumer uncertainty, the observed importance of trust in the standard setter might be a helpful indicator. As seen in the results, consumers are also uncertain which label can be trusted. Therefore, the standard underlying a label is more important than the organization that awarded it. In the DCE it then became clear that there was a positive impact on the respondents'

purchase behavior when certification was awarded by an independent organization as compared to governmental certification or no certification at all. Labels given by the supermarket itself actually lowered the preference for the bananas with those labels. However, the more the test persons generally trusted in supermarkets to provide reliable information about the production of the food they sell, the more positively they were ranked in their usefulness as a certifying organization. The importance of trust observed in this study confirms earlier findings, (cf. Innes [2008] or Lehnert [2009]). Likewise, the high significance of the standard setter as revealed by Sirieix et al. (2011) and Teisl et al. (2002) is confirmed. Similarly, as also documented by Roehr et al. (2005), independent standard setters are assigned the highest credibility in the present study. The findings also particularly correlate with the results of Sirieix et al. (2011), who found that the supermarket chain Tesco was liked less as a certifier than an independent organization. Regarding the impact of product price, Lehnert (2009) found that people who are price oriented have a lower preference for ethical products in comparison with people who are more quality oriented. In the basic model of the DCE, price has the highest impact in this study. Thus, a higher price leads to a decreased interest in the bananas being offered. Even though the respondents stated that they prefer to buy high quality food, price orientation plays the greater role in the present study, as the quality orientation affects only the perceived usefulness of an independent organization for certification.

Concerning socio demographic variables, which were shown to have a significant influence in the DCE, it can be stated that younger test persons show a greater preference for sustainable production qualities. In the existing literature, age is often related to income. Borgstedt et al. (2010), for example, discovered that younger people with lower incomes only rarely purchase environmentally friendly products. However, this effect couldn't be tested in the present study due to missing values.

Unlike de Pelsmacker et al. (2005) who did not detect a correlation between consumer preferences and educational level, this study revealed that a higher level of education does indeed influence the perceived usefulness of production qualities as well as that of an independent organization as standard setter.

In addition, the impact of the likeability of a product or the intensity of consumption analyzed by de Pelsmacker et al. (2005) was confirmed in this study. Correspondingly, just as Tonsor and Shupp (2009) found that people who eat apples were often more willing than others to pay more for sustainably produced apples, this study revealed that the usefulness of production qualities was a significant positive parameter for respondents who particularly like bananas.

An especially interesting result of this study is that the fair trade certification seems to be a very important sustainable production quality. Since this study used bananas as a research object, this finding might be the result of media reports on the labor conditions of banana farmers.

Conclusions and Limitations

Even though sustainability is an omnipresent factor in all industries, very little research has been done in the area of fruits and vegetables in Europe (Moser et al. 2011). In the case of bananas, our results show that there is interest in more production information than is divulged by

conventional and government-regulated organic certification. For enterprises involved in the supply chains, it follows that they should increase their supply of products that would meet this need. However, the variables specific to individuals continue to exert a great influence on preferences for sustainable production qualities. Therefore, a detailed analysis of the specific target group is essential.

Contrary to expectations, the hypothetical label (organic & fair trade & carbon neutral) was only accepted with reservations. This may have been due to the high profile of the organic & fair trade label or to the complexity and abstraction of information behind the organic & fair trade & carbon neutral label. This was also seen in observations of test persons with a positive attitude towards environmentally friendly products. Therefore, due to the complexity of the label, there seems to be a need for further information. The term "sustainability" is already interpreted so heterogeneously that consumers can hardly avoid being confused by it. Likewise, the possibility of simplification throughout the market, with its various labels, should be considered. As our results indicated, the "overload" from the many diverse labels and standard-setting organizations leads to uncertainty on the part of consumers and may cause reluctance.

Regarding the standard setter, it is clear that trust plays an important role in consumer preferences. Organizations that want to establish sustainability labels would therefore do well to pay particular attention to the role of consumer trust. Cooperation with NGOs, which are more credible for consumers (Moser et al. 2011 ct. Roehr et al. 2005), might overcome this problem to a certain degree. In this context, the criteria on which the given standard is based are of particular importance. Attempting to improve image through "greenwashing" appears ineffectual and, in fact, will (sooner or later) have the opposite effect (cf. Sirieix et al. 2011).

Even though this study was based on well-founded data, it is limited by the fact that the sample is a convenience sample. Moreover, the social expectancy effect might have led to deviations from the true results, especially since this study examined social and ecological factors.

Regarding the research design, it must be noted that a DCE tries to simulate a real purchase decision. In fact, at the real point of sale, a lot of additional factors play a role, such as the appearance of the product and the consumer's buying habits.

All in all, further research is needed that focuses on the suitability of scientific research for practical application in order to derive reliable information about consumer preferences and purchase behavior concerning sustainably produced food.

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Appendix

Label	Variable	Description
Organic label	y1	= 1 if banana in choice set was labeled with an organic
		label, 0 if not
Organic & fair trade	y2	= 1 if banana in choice set was labeled with organic & fair
label		trade label, 0 if not
Sustainable label	y3	= 1 if banana in choice set was labeled with sustainable
		label, 0 if not
Governmental	z1	= 1 if standard setter is a governmental organization, 0 if
organization		not
Supermarket	z2	= 1 if standard setter is a supermarket, 0 if not
Independent organiza-	z3	= 1 if standard setter is an independent organization, 0 if
tion		not
Price	prices	Price for 1 kg bananas: $1.29 \notin 1.79 \notin 2.19 \notin$
ASC _{Statusquo}	Alt4	= alternative specific constant for status quo option
Sex	sex	= 1 if male, 0 if female
Age	age	Age of respondent
Index price orientation	IndPriceorient	Index concludes variables concerning price orientation
Index quality	IndQuality	Index concludes variables concerning quality orientation
orientation		
Trust in organization	trust2,trust3	Respectively a statement concerning trust in an
		organization (supermarket (trust2), independent
-		organization (trust3))
Income	income	Not included in the model due to missing values
Education	educate	= dummy variable, 1= if trade school or college
		preparatory school diploma exists, otherwise 0
Children	child	= dummy variable, $l = if$ children are present, otherwise 0
Index attitudes green	IndEco	Index concludes variables concerning attitudes towards
products	T 10 '	green products
Index attitudes fair	IndFair	Index concludes variables concerning attitudes towards
trade products	T 10	fair trade products
Index attitudes	IndSust	Index concludes variables concerning attitudes towards
sustainable products	1. 1002	sustainably-produced products
Index attitudes carbon	IndCO2	index concludes variables concerning attitudes towards
neutral products	1	carbon-neutral products
Likeability of bananas	banan	Respondents' likeability of bananas (Scale from $l=1$
		dislike to $5 = 1$ like)

	A1.	Explanation	of the	variables	of the	logit model
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(cf. Zou and Hobbs 2010)

A2. Composition of the index price orientation (n=313)

1 1		· ·	/			
Statements " price orientation" (Agreement in %)	1	2	3	4	5	Mean (μ) Standard deviation (σ)
I notice price changes in products I buy	0.32	5.43	21.41	42.49	30.35	μ= 3.971246
regularly.						$\sigma = 0.874755$
When I buy food, price is important to	0	4.47	27.16	45.37	23.00	μ= 3.86901
me.						$\sigma = 0.815769$

Likert scale from 1= totally disagree to 5= totally agree

A3. Composition of the index quality orientation (n=313)

Statements "quality orientation" (Agreement in %)	1	2	3	4	5	Mean (µ) Standard
						deviation (σ)
It is important to me to buy high-quality	1.60	4.15	27.80	52.72	13.74	$\mu = 3.728435$
food.						$\sigma = 0.808443$
Quality is of the highest importance to	0.96	3.83	31.63	49.52	14.06	$\mu = 3.71885$
me.						$\sigma = 0.787032$

Likert scale from 1= totally disagree to 5= totally agree

A4. Composition of the index attitudes towards green products (n = 313)

Statements "green products" (Agreement in %)	1	2	3	4	5	Mean (μ) Standard deviation (σ)
When I can choose between green products and conventional products, I prefer to buy green.	5.43	13.10	36.74	31.31	13.42	$\mu = 3.341853$ $\sigma = 1.041482$
When I shop for food, protecting the environment is very important to me.	4.47	12.78	42.49	32.59	7.67	$\mu = 3.261981$ $\sigma = 0.934588$
It is unimportant to me whether or not a product has been produced in an environmentally safe way.*	15.34	25.88	38.34	14.38	6.07	$\mu = 3.291139$ $\sigma = 1.080974$

Likert scale from 1= totally disagree to 5= totally agree, (cf. Tanner and Woelfing Kast 2003), * re-coded

A5. Composition of the index attitudes towards fair traded products (n = 313)

Statements "fair trade products" (Agreement in %)	1	2	3	4	5	Mean (μ) Standard deviation(σ)
I feel connected with third-world countries.	11.18	25.24	40.26	16.29	7.03	$\mu = 2.827476$ $\sigma = 1.057155$
I don't buy bananas or coffee if I am not sure that the farmers and workers who produced it have been fairly paid.	15.65	31.63	39.30	7.99	5.43	μ = 2.559105 σ = 1.024001
When I buy bananas, I look for a fair trade label.	11.82	25.56	37.70	20.45	4.47	$\mu = 2.801917$ $\sigma = 1.037315$

Likert scale from 1= totally disagree to 5= totally agree, (cf. Tanner and Woelfing Kast 2003)

A6.	Composition	of the index	attitudes t	owards sus	stainable	products ((n=313)
-----	-------------	--------------	-------------	------------	-----------	------------	---------

Statements "sustainable products" (Agreement in %)	1	2	3	4	5	Mean (μ) Standard deviation (σ)
If I have a choice between a sustainably produced item and one that was conventionally produced, I opt for sustainability.	5.11	7.35	40.89	35.14	11.50	μ = 3.405751 σ = 0.963217
I am prepared to pay a higher price for products that were produced under environmentally safe and socially and economically compatible conditions.	7.35	15.34	38.02	29.07	10.22	μ = 3.194888 σ = 1.054769

Likert scale from 1 = totally disagree to 5 = totally agree

A7. Composition of the index attitudes towards carbon friendly products (n = 313)

Statements "carbon friendly products"	1	2	3	4	5	Mean (µ)
(Agreement in %)						Standard
						deviation (o)
It is important to reduce or neutralize the	4.15	6.07	24.28	45.05	20.45	μ= 3.715655
carbon footprint, especially for products						σ= 0.993074
that must be transported for long distances.						
I prefer to buy products that are produced	7.03	22.68	43.13	21.41	5.75	μ= 2.961661
with carbon saving methods.						σ= 0.976552
Reducing ecologically harmful emissions	3.51	5.75	17.57	46.01	27.16	$\mu = 3.875440$
is very important.						σ= 0.990565

Likert scale from 1= totally disagree to 5= totally agree



International Food and Agribusiness Management Review Volume 17 Issue 1, 2014

Market Analysis of Ethanol Capacity

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Abstract

The ethanol industry experienced rapid growth and capacity expansion during the mid-2000s. The fast expansion could result from the high industry profitability in 2005 and 2006. The present study applies the real options approach to analyze the U.S. corn ethanol industry and derive the optimal industry manufacturing capacities during 1999 and 2010. The optimal capacity is dependent on various parameters such as market uncertainty, processing margin, marginal variable cost, and incremental investment cost. The major finding is that the industry-wide capacity expansions occurred in 2007 and 2008 might not have been recommended by the real options model. Driven by the potential high market profitability, the industry might have been expanded to a level higher than optimal.

Keywords: ethanol, optimal capacity, real options, processing margin

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Introduction

Because the production capacity decisions in capital-intensive industries are usually irreversible, selecting the appropriate level of investment could be truly important as well as risky. Specifically, if the firm misses the best timing to expand capacity, its short-run profitability is affected and it might lose the market share. In addition, its competitive position in the industry in the long term might as well be affected. However, if the firm over-expands its capacity, the fixed cost of managing the excess supply and the opportunity cost of holding the excess supply could be enormous. The appropriate capacity decision is especially critical in those industries that produce homogeneous output, such as the ethanol industry. The firms in this industry are not differentiated by product. Therefore, their production and profitability could be affected by the others' mistaken capacity decisions (Stiegert and Hertel 1997).

The structure of the U.S. corn ethanol industry has changed dramatically over the past 15 years. Specifically, the number of firms has increased by more than three times from 50 in 1999 to 189 in 2010 (Figure 1). As of January 2010, the vast majority of the firms are in the Midwest where corns are massively produced (Figure 2).



Figure 1. Number of Ethanol Plants, 1999-2010 Source. RFA 2011.



Figure 2. Location of U.S. Ethanol Plants, January 2010 Source. USDA

As the number of ethanol plants rises, the ethanol production and capacity both have increased by over 10 times since 1999 (Figure 3). Currently, the ethanol industry is comprised of nearly 200 plants with an annual capacity of 13.5 billion gallons. Dry mill plants account for more than 70 percent of capacity and virtually all new ethanol plants under construction are dry mills (U.S. Department of Energy 2010). The dramatic increase in production and capacity during the mid-2000s could be attributed to reduced grain prices, increased oil prices, the elimination of MTBE use in several States (Eidman 2007), and the federal incentives for ethanol. There are numerous federal and state policies that support the corn ethanol industry. For examples, Renewable Fuel Standard (RFS) 2005 required that 7.5 billion gallons of renewable fuels be blended with gasoline by 2012. The subsequent RFS 2007 required that 36 billion gallons of renewable fuels be used in the nation's motor fuel supply by 2022 (U.S. Department of Energy 2010). In addition, Cox and Hug (2010) estimated that the U.S. government has provided \$17 billion of ethanol subsidies between 2005 and 2009. Meanwhile, the domestic ethanol producers were protected by a \$0.54/gallon import tariff from foreign competitors, mainly from Brazilian ethanol producers.



Figure 3. U.S. Ethanol Capacity and Production, 1999-2010 **Source.** RFA 2011

As shown in Figure 4, during the first couple of years in the 2000s, there was little capacity expansion in the ethanol industry. Since 2002, this industry has seen an increasing expansion until 2008. The capacity expansion numbers really stood out in 2007 and 2008. This is mainly because the ethanol industry experienced significant profitability in the two years earlier (Caphart 2009). From 2008 to early 2009, the ethanol prices kept increasing while demand for ethanol dropped (Caphart 2009). As a result, the capacity expansion continued but at a much slower rate. With the economic recession, demand for alternative energy including ethanol continued to decrease and banks became more cautious about risk and lending, the ethanol production reduced further. In 2011, the capacity expansion declined significantly to the 2003 level.

In practice, most corporate investment decisions are based on the traditional discounted cash flow methods (DCF), such as the standard net present value approach (NPV) or internal rate of return (IRR). However, in the presence of uncertainty about future margin and irreversible investment, the application of DCF methods could be problematic. The DCF methods do not consider firms' call options on future investment and hence might miss important dimensions that shape the investment decision (Stiegert and Hertel 1997).



Figure 4. Ethanol Capacity Expansion, 1999-2011 **Source.** RFA 2011

In the literature, the NPV and IRR approaches have been widely used for evaluating ethanol investments such as Whims (2002), Gallagher et al. (2007), and Ellinger (2007). With the real options approaches developed by financial economists (such as Bowban et al. 2001; Aguerrevere 2003; Dangl 1999; Dixit and Pindyck 1994), the applied real options approach has been adopted to examine various agricultural investments, such as the ammonia industry, dairy farming, forestry, irrigation system and etc. (Stiegert and Hertel 1997; Duku-Kaakyire and Nanang 2002; Carey and Zilberman 2002; Tauer 2006; Bockman 2006; Ghoddusi 2009). In recent years, applied economists began to use applied real options approach to evaluate firms' investment in the ethanol industry (e.g., Pederson and Zou 2009; Schmit et al. 2008, 2009a, 2009b).

However, no prior research has been conducted to evaluate the ethanol industry's historical optimal capacity levels using real options approach. In the present study, there are three specific objectives. First, we develop a real options model to examine the bases for the firms' decision with regard to capacity expansion. Firms in the ethanol industry face market uncertainty related to input supplies, input and output prices, competition from overseas, and irreversibility feature of their capital investments. Given the production knowledge, the management skills and the patents, firms have the options to wait (i.e., growth option) before making the irreversible large investments to expand capacity. The growth option makes future investment opportunities attempting because better decisions can be made given the additional market information. Therefore, investing today is riskier and might require more returns than what the traditional DCF methods would suggest.

We first estimate the values of the growth option based on various parameters from 1999 to 2010. And we analyze how these parameters influence the evolution of the U.S. corn ethanol industry. Moreover, we derive the optimal levels of capacity in this industry based on the trade-off between the growth option values and the expected benefit of investment. Finally, we make a

comparison between the observed industry capacities and derived optimal capacities to determine whether the industry experienced overcapacity or under-capacity during the study years.

Our estimation results show that there is a discrepancy between the optimal capacity and the real capacity in 2007 and 2008. The ethanol capacity expansions in these two years could be related to the industry-wide high margins and profitability during 2005 and 2006. However, the ethanol industry experienced more capacity expansion than the optimal expansion levels suggested by the real options model.

The remainder of the paper is organized as follows. The conceptual model and the foundations of the real options modeling are presented in Section 2. Section 3 presents the parameter estimation procedure, the model estimation results and the sensitivity analyses. The last section concludes.

Conceptual Model

Corn-ethanol plants produce ethanol from corn and natural gas with the by-product DDGs. Returns to the corn ethanol investments are tied closely to the firm's gross processing margin given by the following equation:

(1)
$$M = p_e - \theta_1 p_c - \theta_2 p_g$$

where θ_1 and θ_2 are conversion ratios for corn-ethanol and for natural gas-ethanol respectively¹. p_c is the net price of corn in \$/bushel, and p_g is the natural gas price in \$/MMBtu. The net price of corn is obtained by deducting the price of DDGs from the price of corn. In reality, there are various sources of uncertainties for the ethanol plants, such as the fluctuating input (i.e., corn and natural gas) prices, gasoline prices, outdated technology, closing facilities and consolidations, short corn supplies in certain years due to the weather problems, government subsidy changes, and global competitions. These uncertainties all affect blenders' gross processing margin.

The ethanol industry has been receiving the federal tax incentive since 1984. So tax credit needs to be added to the processing margin equation. The tax credit was \$0.54/gallon between 1990 and 1999. The 1998 Transportation Equity Act reduced the credit to \$0.53/gallon for 2001 and 2002, \$0.52/gallon for 2003 and 2004, and \$0.51/gallon through September 2007. The 2008 Farm Bill reduced the Volumetric Ethanol Excise Tax Credit to \$0.45/gallon. It was determined in the American Jobs Creation Act of 2004 that the federal tax incentive would be extended through December 31, 2010 (US Department of Energy 2010).

Table 1 contains the corn prices, the ethanol prices, tax credit and the gross processing margins for ethanol blenders. The processing margin is the price of ethanol subtracted by the net corn price and the natural gas price. Comparing with 2001, processing margins in 2002 and 2003

¹ Based on EPA (2009), $\theta_1 = 0.36$ and $\theta_1 = 0.035$. This means that 1 bushel of corn can produce 0.36 gallons of ethanol and 1 MMBtu of natural gas can produce 0.035 gallons of ethanol.

dropped from \$1.41/gallon to \$0.97/gallon and \$1.18/gallon respectively because the ethanol prices reduced while the corn prices increased in those two years. Between 2003 and 2006, processing margins increased fast from less than \$1.20/gallon to almost \$2.00/gallon mainly due to the ethanol price increases. In 2006, the processing margin hit a record high in the first decade of the 21st century. However, the processing margin began to drop again in 2007 and the decreasing trend continued after 2008. From 2009 to 2010, the ethanol industry experienced low margins due to the effects of the economic and financial crisis, lower gasoline prices, and reduced government tax credit.

Year	Annual Capacity (millions of gallons)	Ethanol (\$/gallon)	Corn (\$/bushel)	DDGs (\$/bushel)	Natural Gas (\$/MMBtu)	Tax Credit (\$/gallon)	Margin (\$/gallon)
1999	1701.7	0.98	1.82	0.68	5.06	0.54	1.13
2000	1748.7	1.35	1.85	0.69	6.43	0.54	1.46
2001	1921.9	1.48	1.97	0.68	8.71	0.53	1.41
2002	2347.3	1.12	2.32	0.75	6.18	0.53	0.97
2003	2706.8	1.35	2.42	0.98	7.83	0.52	1.18
2004	3100.8	1.69	2.06	0.65	9.06	0.52	1.48
2005	3643.7	1.80	2	0.73	10.68	0.51	1.53
2006	4336.4	2.58	3.04	0.93	11.3	0.51	1.93
2007	5493.4	2.24	4.2	1.33	11.15	0.51	1.29
2008	7888.4	2.47	4.06	0.99	11.11	0.45	1.34
2009	10569.4	1.79	3.55	0.98	9.34	0.45	0.93
2010	11877.4	1.93	3.98	1.08	8.96	0.45	0.95

 Table 1. Annual Capacity and Costs for the Ethanol Industry, 1999-2010

Note. The margin numbers are in 2006 dollars.

The market uncertainty not only affects the ethanol market, but the corn and natural gas markets as well. In addition, the ethanol market is influenced by the gasoline market, such as the fluctuating oil prices. Considering the multiple uncertain factors and the pattern of the historical margin movement, we follow Guthrie (2009) and assume that the gross processing margin in the ethanol industry evolves as a mean-reverting geometric Brownian motion:

(2)
$$M_{t+1} - M_t = \alpha (M^e - M_t) \Delta t + \sigma \, dW_t$$

where α is mean reversion rate which is the speed at which the processing margins revert, M^e is the long-run margin equilibrium level, σ is the instantaneous standard deviation per unit time and it is a measure of the process volatility, and W_t is a Brownian motion and dW_t is normally distributed as N(0, φ^2).

We assume the net variable costs are a non-stochastic linear function of output which implies a flat net marginal cost: C(Q) = cQ, where c is the marginal cost for the net variable inputs and Q is the production quantity. The variable costs include enzymes, yeasts, other processing chemicals and antibiotics, electricity, water, repairs and maintenance, transportation, labor, management and quality control, real estate taxes, licenses and insurance. Therefore, the firm's

instantaneous profit at time t is determined by the production, the gross processing margin and variable costs at t:

(3)
$$\pi(M_t, Q, c) = Max(M_tQ - cQ)$$

However, there is a time lag between construction and completion, and it is denoted by h. For example, if h = 3, it takes three years for the ethanol plant to complete the construction and the units under construction now will be available for use in three years. Therefore, the firm's decision with regard to marginal capacity expansion at time t is not dependent on the profit at time t, but rather the profit flow during [t-h, t].

The value of the marginal unit of capacity is a function of the investment cost for each unit of capacity construction/expansion k and the stochastic shock to the processing margin. Let $\Delta F(K, M)$ be the value of investment option when the intended marginal capacity is K and the current processing margin is M. So the exercise price of the call option is the cost of construction. The value of incremental unit of capacity is denoted by $\Delta V(K, M)$, which is the sum of discounted cash flow. The optimal capacity solution is subject to the following conditions:

 $\begin{array}{l} 4(a) \\ 4(b) \\ 4(c) \end{array} \begin{cases} \Delta F(K;0) = 0 \\ \Delta F(K;M^*) = \Delta V(K;M^*) - k \\ \Delta F_M(K;M^*) = \Delta V_M(K;M^*) \end{cases}$

Equation (4a) specifies that the stochastic process would end if M goes to 0. It is the lower absorbing barrier of the stochastic process. Equation (4b) is the value-matching optimality condition. M^* is the strike value for exercising the option to invest. At the optimal capacity level, the incremental value of installed capacity will equal the incremental costs. Condition (4c) is the smooth pasting condition. At the optimal solution, the derivatives of the two functions should equal.

Parameter Estimation Procedure and Estimation Results

In order to estimate the parameters in equation (2), we start estimating the AR(1) model for the gross processing margin using the annual data from 1990 to 2010:

(5)
$$M_{t+1} - M_t = \alpha_0 + \alpha_1 M_t + \mu_{t+1} = 0.773 - 0.587 M_t + \mu_{t+1}$$

where the variance of μ_{t+1} , φ^2 , is 0.071. We then derive the values of the parameters in equation (2) based on the equations below:

(6)
$$\alpha = \frac{-\log(1+\alpha_1)}{\Delta t}, M^e = -\frac{\alpha_0}{\alpha_1}, \sigma = \varphi(\frac{2\log(1+\alpha_1)}{\alpha_1(2+\alpha_1)\Delta t})^{1/2}$$

 $\Delta t = 1$ because our data are yearly. The normalized estimates of the required parameters in equation (2) are therefore $\alpha = 0.384$, $M^e = 1.317$ and $\sigma = 0.256$. These parameters imply that in the long run the gross processing margin in the corn ethanol industry is normally distributed with

mean \$1.317/gallon and the standard deviation $\sigma/\sqrt{2\alpha} = 0.292$. The implied half-life of shocks to the margin is $\log 2/\alpha = 0.783$ years, or 9.4 months. This means that half of each shock to the margin is expected to have faded away after 9.4 months.

In addition, the model needs the estimates of four other parameters: r, h, c and k. r is the CAPM risk-adjusted rate of return in the ethanol industry and the industry average is about 12%. h is the investment lag and the industry average is approximately 3 years. The marginal variable cost parameter c is \$1.32/gallon. k is the capital investment cost for each additional gallon of capacity, and the historical average is \$1.52/gallon.

We calculated the optimal industry capacity levels during 1999 and 2010. Table 2 shows the comparisons between the optimal capacities derived from the real options model and the observed capacities.

Tuble 2: Real Capacity VS. Optimal Capacity (Infinition Canons						
Year	Real Capacity	Optimal Capacity				
1999	1701.7	1704.8				
2000	1748.7	1752.4				
2001	1921.9	1925.8				
2002	2347.3	2352.1				
2003	2706.8	2712.2				
2004	3100.8	3106.9				
2005	3643.7	3651.1				
2006	4336.4	4345.2				
2007	5493.4	5354.7				
2008	7888.4	7773.9				
2009	10569.4	10591.6				
2010	11877.4	11901.1				

Table 2. Real Capacity vs. Optimal Capacity (Million Gallons)

As shown in Table 2, most years have seen the real capacity numbers fairly close to the optimal real options capacity values. However, during 2007 and 2008, the real capacity numbers are more than the optimal capacity levels suggested by the real options model. This could be due to the fact that the gross processing margin hit the record high in 2006 and the capacity expansion lasted a couple of years since 2006. The industry might have been too optimistic about the market profitability and become aggressive in building up its capacity. It led to overcapacity in the later years which in turn reduced the processing margin.

Furthermore, we conducted the sensitivity analyses for the major parameters that influence the optimal capacity values. The results show that the processing margin uncertainty σ contributes the most to the optimal capacity value, followed by the processing margin mean M^e , the investment cost k, the unit marginal variable cost c, and the investment lag h. Specifically, a 1% increase in σ could decrease the optimal capacity by 0.1%. During the years when market

uncertainty is high, it seems that σ has a dominant role in determining the optimal capacity through the option value. In addition, a 1% increase in the processing margin mean could increase the derived optimal capacity by 0.06%. And a 1% increase in the investment cost k, the unit marginal variable cost c and the investment lag h decreased the optimal industry capacity by 0.02%, 0.01% and 0.007%, respectively. Since these elasticity terms for optimal capacity are highly inelastic, the values in Table 2 are rather robust.

Conclusions

During the mid-2000s, the U.S. ethanol industry saw rapid growth and capacity expansion due to the high industry profitability before 2008. The feasibility studies on ethanol industry capacity in the literature have mainly used traditional DCF methods such as NPV and IRR. This study applies the real options approach to derive the optimal U.S. corn ethanol capacities from 1999 to 2010. The impact of market uncertainty on the capacity investment decision was examined under the assumption that the gross processing margin follows a stochastic process characterized by mean-reverting geometric Brownian motion. We find that the expansions in 2007 and 2008 might not have been recommended by the real options model because the industry might have been too optimistic about the market profitability. The real options approach properly incorporated the value of waiting to invest irreversibly. It could serve as an important mechanism to prevent business planners from being overly aggressive when there is high market uncertainty.

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International Food and Agribusiness Management Review Volume 17 Issue 1, 2014

Mechanisms for Effective Alliance Management: Insights from a Federated Cooperative Marketing System

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Abstract

Despite their continuing popularity and value-creation potential, strategic alliances fail as often as they succeed. Alliance failure is often attributed to opportunistic behavior by one or more of the partners. This paper draws upon empirical evidence from a successful alliance – a federated cooperative marketing system – to shed light on some of the economic and behavioral strategies and mechanisms that alliances can use to promote effective cooperation among alliance partners. The paper also shows how the alliance management body can generate the resources needed to develop and implement such mechanisms, and make alliance partners buy into these mechanisms.

Keywords: strategic alliances, federated cooperative system, opportunistic behavior, alliance management mechanisms

[©]Corresponding author: Tel: + 1 519.661.2111 x 89142 Email: F. N. Uzea: nuzea@ivey.ca M. E. Fulton: murray.fulton@usask.ca Strategic alliances, broadly defined as agreements between two or more firms to cooperate in an effort to accomplish some strategic purpose and work jointly for mutual benefits (Sporleder 1994), are an important organizational form for governing business transactions in the agrifood sector (Sporleder 1994, 2006; Saes et al. 2003; Azevedo and Chaddad 2006; Gall and Schroder 2006; Chaddad 2010; Ng 2011). Historically, farmers have hedged risk and enhanced market access with farmer-owned cooperatives and landlord-tenant sharecropping alliances. Nowadays, small farms engaged in the local food movement use alliances to facilitate information and resource exchange, while seed-developing biotechnology firms and food processing firms use alliances to foster innovation and appropriate its returns, to give but a few examples. As a result, competition is shifting from 'firms versus firms' to 'supply chain versus supply chain' or to 'network versus network' (e.g., Sporleder et al. 2005; Chaddad and Rodriguez-Alcalá 2010).

But what determines alliance performance and ultimately supply chain or network competitiveness? What makes some alliances successful, resulting in risk sharing, information exchange, innovation, and greater returns to scale, and what causes other alliances to fail, such as the famous clash between Monsanto and DuPont over intellectual property rights? Importantly, the business literature (e.g., Kale et al. 2002; Sammer 2006; Arend 2009) reports failure¹ rates of 50 percent or higher, suggesting that alliances more often fail than succeed.

Alliance failure is often attributed to opportunistic behavior by one or more of the partners (e.g., Parkhe 1993a; Zeng and Chen 2003; Hoskisson et al. 2008). In general terms, opportunistic behavior refers to "self-interest seeking with guile" (Williamson 1975, 9). As applied to alliances, opportunism is defined as "behavior by a partner firm that is motivated to pursue its self-interest with deceit to achieve gains at the expense of the other alliance members" (Das and Rahman 2010). That is, partner opportunism denotes any situation in which one partner seeks gain for oneself at the expense of the others and ultimately the alliance. As such, it takes a wide range of forms such as free riding, hold up, moral hazard, adverse selection, and misappropriation of resources, to name but a few (see, for instance, Wathne and Heide (2000) and Das (2004) for specific examples and classifications of opportunistic behavior in interfirm relationships).²

Opportunistic behavior, however, can be overcome. There is a substantial literature on the factors that enhance cooperation in interfirm relationships (e.g., Parkhe 1993a; Gulati and Singh 1998; Adams and Goldsmith 1999; Zeng and Chen 2003; Yaqub 2009). For instance, Zeng and Chen (2003) argue that, among other strategies, alliance partners can improve their chances for cooperation by establishing cooperative norms, creating high identification with the alliance, establishing long-term goals, and making each partner's action identifiable. However, with the exception of Browning et al. (1995), Cozzarin and Westgren (2000), Dyer and Nobeoka (2000), and Gardet and Mothe (2011), there is little work done on the real-life mechanisms that partners

¹ There are different operationalizations of this term as they relate to alliance stability, survival, and goal attainment. ² The basic logic of these situations is captured in the Prisoners' Dilemma game (e.g., Albanese and van Fleet 1985; Hill 1990; Parkhe 1993a; Zeng and Cheng 2003; Arend and Seale 2005). As Arend and Seale (2005) argue, the Prisoners' Dilemma game is "similar to a two-way agency problem; each firm has incentives to defect on the other for its own private advantage (p. 1058)". We explore the Prisoners' Dilemma more fully in the main text of the paper.

can use to promote a cooperative norm, to build high group identification within the alliance, to increase the time horizon or to effectively monitor behavior.

The objective of this paper is to examine how a particular alliance has operationalized the solutions to opportunism suggested in the literature. The alliance in question is the Co-operative Retailing System (CRS), a network of 236 independent retail cooperatives in western Canada that own and operate their wholesaler, Federated Co-operatives Limited (FCL). Affiliation with the CRS allows retail cooperatives to strengthen their bargaining position relative to manufacturers through centralized negotiation, and to achieve economies of scale and efficiencies by pooling resources in transportation, promotion and other marketing functions (e.g., price management, the development of private label products). As well, retail cooperative managers can benefit from sharing their experience on what does and does not work, including sharing of successful marketing ideas.

However, these benefits do not ensure cooperation among retails in the CRS. Retail cooperatives are locally-owned businesses, independent from each other and from FCL. Owned and controlled by local consumers in the community it serves, each retail cooperative is interested in maximizing benefits to its consumer members. Thus, retails' autonomy in pursuing individual goals gives each one of them an incentive to behave opportunistically in order to appropriate a larger share of the benefit they collectively generate by working as the CRS.

The contribution of this paper is to draw upon empirical evidence from the CRS to shed light on some of the economic and behavioral mechanisms that federated cooperative systems can use to manage member opportunism.³ Federated cooperative systems (i.e., associations of cooperative business firms) are a form of strategic alliance (Gall and Schroder 2006) that is of particular importance to the agrifood sector (Chaddad 2006). However, Hogeland (2002) and Zeuli and Foltz (2005) argue that the opportunism (i.e., failure of member cooperatives to commit to the system) present in such systems is severe enough that the federated business structure is viewed to be inherently inefficient and unstable.⁴ The findings from this study of an alliance of cooperative firms are also applicable to alliances among non-cooperative firms, particularly strategic networks. Strategic networks share a governance function performed by powerful lead firms (Lorenzoni and Ornati 1988) or strategic hubs or centers (Dyer and Nobeoka 2000). These core firms can be represented by a central buyer or supplier that acts as a focal point or one of the partners in a horizontal alliance that has more to gain from the alliance.

The paper also identifies some of the second-order cooperation problems that arise in alliances – namely the lack of incentives by alliance partners to contribute the resources necessary to develop alliance management mechanisms and/or to abide by the decisions made by the alliance

³ The role of incentives and property rights in determining cooperative performance has a long history in the cooperative literature (see Vitaliano 1983; Cook 1995; Fulton and Giannakas 2013).

⁴ The prediction is that the federated structure will be replaced by centralized structures or hybrid structures with federated and centralized characteristics as a way to ensure greater commitment by member organizations and system efficiency.

management body on their behalf – and offers examples of the strategies that can be used to deal with these problems.

The remainder of the paper is organized as follows. The next section uses a game-theoretic framework to describe the cooperation problems that arise among alliance partners and reviews the potential solutions to these problems suggested in the economics, business, and psychology literatures. The section following presents a case study of the CRS, focusing on the cooperation problems that arise among members of the CRS and the business mechanisms that the system has deliberately designed and implemented to address these problems. The final section presents the managerial implications of this research.

Cooperation Problems and Solutions

Cooperation Problems in Strategic Alliances – A Game-Theoretic Approach

Firms form alliances when they expect value-enhancing synergies – by combining resources and capabilities, business partners can achieve their mutual strategic objectives more effectively than if any one partner operated independently (Spekman et al. 1998). At the same time, a situation of mutual interdependence is created, whereby "one party is vulnerable to another whose behavior is not under the control of the first" (Parkhe 1993a, 796). While mutual cooperation is required for partners to fully realize the potential of an alliance, cooperative behavior is not automatic. Business partners exhibit an inherent tendency to cheat to gain at the expense of others (Hennart 1991). This incentive can lead to actions that are individually rational, yet produce a collectively suboptimal outcome – a situation isomorphous to the Prisoners' Dilemma.

To better understand how interactions among firms in each alliance stage are captured in Prisoners' Dilemma-like games, consider the simple example of two symmetric firms participating as equal partners in an alliance that requires costly irreversible commitments by the partners (the assumption of two firms and symmetry is made for ease of presentation; the results derived here also apply to asymmetric N-player games). Each firm can cooperate by investing superior resources (human, tangible and intangible) at cost i_C or they can defect by investing low-quality resources at cost i_D , where $i_C > i_D$. Defection is a private cost saving, whereas the output effect of defection is not private.

The outcome of the alliance improves with better-quality investments. Mutual cooperation (i.e., where partners invest high-quality resources) provides the highest total gross alliance output (P_{CC}). Essentially, the alliance allows firms to collectively generate benefits (e.g., access to complementary resources to reduce production costs, ability to share risks and costs among alliance partners) that are greater than the costs to bring the partner resources together. Single defection provides the second highest output (P_{CD}), while double defection provides the lowest output (P_{DD}). A defective alliance causes firms to collectively and individually waste resources due to a lack of synergies. Essentially, any benefits of bringing the low-quality resources together are well below the opportunity costs of the firms to do so. To ensure that the benefits of any cooperative behavior outweigh its costs, which is consistent with the original reason for the alliance, $P_{CC}-P_{CD} > i_C - i_D$ and $P_{CD}-P_{DD} > i_C - i_D$.

Table 1 describes the game. The net payoff to each firm from mutual cooperation, $P_{CC}/2-i_C$, is greater than the net payoff from mutual defection, $P_{DD}/2-i_D$. However, if one firm does not cooperate, while the other cooperates, the non-cooperative partner receives the highest possible payoff, $P_{CD}/2-i_D$, while the cooperative partner receives the lowest possible payoff, $P_{CD}/2-i_C$. That is, $P_{CD}/2-i_D > P_{CC}/2-i_C > P_{DD}/2-i_D > P_{CD}/2-i_C$. Thus, it always pays for a firm to defect, regardless of what its partner does (i.e., in the case of the other firm cooperating, $P_{CD}/2-i_D > P_{CC}/2-i_C$; in the case of the other firm defecting, $P_{DD}/2-i_D > P_{CD}/2-i_C$). Put in game theory terms, defection is the dominant strategy. However, if both firms do so, both are worse off than if they had cooperated (i.e., $P_{CC}/2-i_C > P_{DD}/2-i_D$). In sum, alliance partners face a conflict between maximizing the interests of the alliance as a whole (cooperation with the others to generate maximum benefits for everyone) and maximizing their own interests at the expense of others (acting opportunistically to capture a larger portion of the benefits that the alliance generates), which is the key characteristic of a Prisoners' Dilemma.

Table 1	. The	Prisoners'	Dilemma
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		Firm A				
		Cooperate	Defect			
Finm D	Cooperate	$(P_{CC}/2-i_C, P_{CC}/2-i_C)$	$(P_{CD}/2-i_D, P_{CD}/2-i_C)$			
FIFM B	Defect	$(P_{CD}/2-i_C, P_{CD}/2-i_D)$	$(P_{DD}/2-i_D, P_{DD}/2-i_D)$			

Indeed, an increasing number of authors have used the Prisoners' Dilemma metaphor (most notably Hill 1990; Parkhe 1993a; Zeng and Chen 2003; Arend and Seale 2005; Phelan et al. 2005; Seale et al. 2006; McCarter and Northcraft 2007) to model alliance behavior and the risk of opportunism. Also, Parkhe et al. (1993) conclude, from a survey of senior executives involved in strategic alliances, that many business alliances exhibit Prisoners' Dilemma-type payoffs.⁵

As evidence from the CRS suggests, alliances also suffer from the so-called second-order cooperation (dilemma) problem that has been identified in collective action situations (Ostrom 1990). The second-order problem arises as a result of attempts to solve the original cooperation problem. For instance, one solution to the first-order cooperation problem is the use of selective incentives, as reviewed in the next section. However, the provision of these incentives requires resources, which the various players are likely to be reluctant to provide because of a second-order cooperation problem – since the players can enjoy the benefits of a selective incentive system without contributing to its provision, the system may not be provided. Another solution to collective action problems is to have the individual players turn over authority to a single central decision maker. This strategy, however, is also subject to a second-order dilemma problem. What incentive does an individual player have to abide by the decisions made on its behalf?

⁵ It has been shown that, under certain circumstances, an alliance may represent a coordination or assurance game rather than a Prisoners' Dilemma (see Gulati et al. (1994) and McCarter and Northcraft (2007) for more details).

Potential Solutions

The economics, business, and psychology literatures have suggested a number of potential solutions to the first-order cooperation (Prisoners' Dilemma) problem. A distinction is often made between structural and motivational solutions.

Structural solutions involve changing the fundamental structure of the situation ('the rules of the game'), so that the dilemma is either modified or eliminated. Included among these solutions are mechanisms such as: (a) changing the payoff structure, (b) providing selective incentives, (c) monitoring partner behavior or its outcomes, (d) reducing group size, and (e) drawing boundaries around the collective good.

(a) Payoff structure. Prisoners' Dilemma research indicates that cooperation can be enhanced by increasing payoffs for cooperation and/or decreasing payoffs for defection (e.g., Rapoport and Chammah 1965; Ahn et al. 2001). As Oye (1986) suggested, two possible scenarios may arise. One scenario is when shifts in preferences transform the situation from one class of game into another, fundamentally altering the character of the relationship. For instance, the relationship structure may be transformed from that of a Prisoners' Dilemma to that of a less conflictual game – e.g., the assurance game. The structure of the payoffs in an assurance game-type situation is such that it is best for a player to cooperate when its counterpart cooperates and to defect when its counterpart defects. That is, each player wants to match its counterpart's choice, or, put in game theory terms, the players prefer to coordinate on one of the two equilibria – either both cooperating or both defecting (Weber 2008). Confidence and assurance about others' cooperative actions is what is needed for cooperation to emerge in such a situation (for empirical evidence, see Uzea and Fulton, forthcoming).

The other scenario is when the Prisoners' Dilemma nature of the situation is maintained and only payoff differences change. In particular, if all partners can gain a bigger benefit when they pool their resources than when they are on their own (i.e., if the difference between the payoff from universal cooperation and the payoff from universal defection is larger), they will be more likely to cooperate. Moreover, partners will be more willing to cooperate if little benefit is associated with the single defection behavior (i.e., if the difference between the payoff from single defection and the payoff from universal cooperation is smaller) and little risk is involved in the single cooperation situation (i.e., if the difference between the payoff from single defection and the payoff from single cooperation is smaller).

(b) Selective incentives. As Dawes (1980) pointed out, one of the big challenges in *N*-person dilemmas is that it is often not possible to directly affect others' outcomes and hence shape their behavior. If cooperators could be rewarded for their action and defectors punished, even large-scale dilemmas could be solved. Indeed, one of the key conclusions of the free-rider theory (Olson 1965; Albanese and van Fleet 1985) was the need to use selective incentives in encouraging cooperation among group members. As the name suggests, selective incentives are additional incentives that distinguish between individuals who contribute to the common interests of the group (collective good) and

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those who do not. These incentives are used to punish those who fail to contribute their fair share to the collective good (i.e., sanctions) or to reward those who act in the group interest (i.e., rewards).

- (c) Monitoring. To the extent that information asymmetry (e.g., information regarding the unobservable effort that partners need to contribute to an alliance) exists in a relationship, it is possible for a party to defect without being detected. Monitoring of either a partner's behavior or its outcomes can, at least partially, overcome this problem (e.g., Heide et al. 2007). There are at least two reasons why monitoring may reduce defection. First, from a behavioral perspective, the monitoring process itself may place uncomfortable social pressure on a party and thereby increase the motivation to cooperate (Murry and Heide 1998). Second, from an economic perspective, monitoring enhances the ability to detect defection and to match rewards and sanctions to the partner's behavior (Celly and Frazier 1996).
- (d) Group size. Numerous studies have found that cooperation declines as group size increases, particularly in infinitely interated Prisoners' Dilemma games (see Franzen (1994) for a review). Increasing group size may make it harder to shape others' behavior and make it easier to defect anonymously (Dawes 1980). The costs of organizing can also increase as group size grows i.e., groups can find it harder to communicate and coordinate their actions (Olson 1965). These studies suggest that cooperation can be made more likely by reducing group size.
- (e) **Boundaries.** When players face the dilemma of how much to take from a collective good so that it continues to exist, the solution is to draw some kind of boundary around the collective good. Hardin (1968) argued for the establishment of an external authority to regulate who has access to the collective good or how players are to withdraw resources from the collective good.

Motivational solutions, in contrast to structural solutions, focus on changing partners' perceptions of the social environment (e.g., expectations of other partners' behavior; feelings of group identity, trust) and therefore their motivation for cooperation. These solutions include mechanisms such as: (a) selecting the 'right' partners; (b) establishing long-term goals or "extending the shadow of the future"; (c) improving communication; and (d) fostering a group identity among partners.

- (a) Selection. Perhaps the most straightforward way of managing opportunism is to select exchange partners *a priori* that are not opportunistically inclined or are inherently cooperative with respect to a particular task (Orbell and Dawes 1993; Hitt et al. 2000).
- (b) Long time horizons. Experimental research has shown that the longer people interact in a Prisoners' Dilemma, the more likely they are to cooperate (e.g., Roth and Murnighan 1978; Dal Bó 2005). The influence of such a time horizon on cooperative behavior has also been observed in field studies (e.g., Heide and Miner 1992; Parkhe 1993a; Das and Teng 1998).

There are several potential explanations for why longer time horizons can be effective in enhancing cooperation among partners. First, longer time horizons allow partners to realize the importance of cooperation through the experience of the undesirable consequences of defection (Pruitt and Kimmel 1977). In other words, it takes time for all partners to fully understand that they are in a dilemma situation.

Second, a longer time horizon provides more opportunities to develop trust among partners. As pointed out by Gulati (1995, 1998), trust develops over time as a consequence of opportunities to share information and learn about each partner's tendency toward trustworthy behavior. To the extent that people gain reputations for cooperation/trust, the risk of cooperating with them declines and this encourages cooperative strategies.

Third, in a long-term relationship, partners are more likely to have opportunities to reciprocate other partners' behavior (Parkhe 1993a). A typical example of reciprocal behavior is represented by the tit-for-tat strategy, which consists of starting with cooperation and then being responsive to other partners' behavior so as to "reward" cooperation by cooperation and "punish" defection by defection (Axelrod 1984). Through such expectations of reciprocity – and the anticipated gains from cooperation versus defection – the future casts a shadow back upon the present, affecting current behavior patterns. A longer "shadow of the future" (Axelrod 1984, 126) enhances cooperation by increasing the net present value of a cooperative strategy relative to the net present value of a defective strategy.

(c) Communication. Research has shown that communication increases cooperation significantly in Prisoners' Dilemma situations (see Balliet (2010) for a meta-analytic review). The communication effect is also well accepted in the alliance literature (e.g., Kanter 1994; Doz 1996).

The Prisoners' Dilemma literature provides a number of potential explanations for the communication effect. First, group discussion of the dilemma helps people understand the nature of the dilemma better, so that all realize the negative consequences associated with universal defection and the positive outcomes of universal cooperation (Dawes 1980). Second, discussing the dilemma provides information on what choices others in the group say they are willing to make, thus establishing group norms and introducing conformity pressures in favor of collective choices (Deutsch and Gerard 1955). However, the extent to which a cooperative norm increases cooperation depends on how much a member identifies with the group (Chen 1997). Third, discussion and interaction foster trust among group members. Talking about decisions may cause group members to believe that others are committed to making cooperative choices oneself (Messick and Brewer 1983). Fourth, group discussion fosters group identity. In fact, Dawes (1991) argued that the most important effect of communication comes from eliciting group identity.

(d) Group identity. Making group identity salient has been shown to increase cooperation in Prisoners' Dilemma situations (e.g., Kramer and Brewer 1984, 1986; Goette et al. 2006). One effective way to build identity with the group is to make all group members aware of intergroup competition, so as to create the feeling that all members within the group share a common fate (Tajfel and Turner 1979). The business literature confirms that partners feeling a sense of common fate or facing a common enemy are more likely to cooperate (e.g., Hamel 1991).

One explanation for the identity effect is that group identity creates a sense of cohesion that increases the probability that group members take group interest into account when making their own decisions (Dawes et al. 1988). Along the same lines, Kramer (1991) argued that through identification, a member's identity becomes coupled with the group. This coupling process increases the member's concern for the well-being of the group and, consequently, the willingness to cooperate with other group members.

However, Karp et al. (1993) argued that the effect of group identity stems from a belief in the interdependencies of group members and expectations of reciprocity among the members. That is, it is the belief in future reciprocal exchanges between members, they argue, that moderates the temptation to defect and encourages cooperation. The expectation of in-group reciprocity seems to serve as a very deep heuristic that shapes people's strategic decisions (Brewer 1981).

To conclude, the studies reviewed in this section all provide evidence that the various structural and motivational mechanisms can address opportunism. They do so by transforming the partners' payoff function so that collective and individual goals are aligned. The purpose of this paper is to see whether successful alliances actually do use these mechanisms and, if so, how they operationalize them. The next section draws upon empirical evidence from the CRS to show that these mechanisms are being used and to provide examples of the operational ways of implementing them in a business setting.

Achieving Cooperation in the CRS

Methodology

A qualitative case study methodology was employed to examine the cooperation problems that arise among members of the CRS, as well as the manner with which they have been dealt. Qualitative research methods have been found particularly valuable when addressing strategy questions that require a comprehensive, in-depth understanding of such complex phenomena as interfirm relationships from the perspective of those who are living them – the managers (Parkhe 1993b; Barr 2004). The case study approach makes it possible to take a closer look at the phenomenon and consider it from a holistic perspective in order to study its unique characteristics and complexities (Yin 2009). The qualitative research paradigm, including the case study, has been previously recognized as an important research approach for the agribusiness sector (e.g., Sterns et al. 1998; Saes et al. 2003; Bitsch 2005; Abatekassa and Peterson 2011).

As mentioned earlier, the CRS is a network of 236 autonomous retail cooperatives across western Canada that own and operate their wholesaler, FCL. These retails, in turn, are owned by more than 1.5 million individual cooperative members. The retail cooperatives in the CRS vary in size from Calgary Co-op – the largest retail cooperative in the CRS, with annual sales of just over \$1.097 billion in 2011 (Calgary Co-operative Association Limited 2012) – to cooperatives like Elm Creek Co-op, which made \$8.87 million in sales in the same year (Elm Creek Co-operative Oil and Supplies Limited 2012).

FCL provides central wholesaling, manufacturing, and administrative services to its member retails. Specifically, FCL supplies retail cooperatives with a variety of products including food, petroleum, crop supplies, livestock feed, and general merchandise. Of these products, FCL manufactures petroleum, feed, and lumber and plywood products. As well, FCL provides member retails with a wide range of support services including recruitment, industrial relations and training, retail accounting, advertising and printing, communications and legal services, member relations, and retail facilities project planning and construction. FCL has two wholly-owned subsidiaries – Consumers' Co-operative Refineries Limited (CCRL), a petroleum refining/heavy oil upgrader facility and The Grocery People Limited (TGP), a grocery wholesaler and fresh produce supplier.

As a second-tier cooperative, FCL is controlled through a democratic decision-making process by the 236 retail cooperatives it serves. FCL's member retails are divided into 15 electoral districts, with each district entitled to one representative on the FCL's Board of Directors. Retail cooperatives are represented at FCL's Annual Meeting through the appointment of delegates (retails are eligible for up to six delegates, depending on their annual purchases from FCL). Through this system, member retails can influence the way their organization is run, and the type of goods and services offered.

The CRS case is insightful because of the decision in the 1970s to retain a federated structure and to eschew a centralized structure that would have created a single decision-making body. As a result, the CRS does not have access to the control instruments that characterize integrated structures, and therefore has had to find alternative ways to promote cooperation among its otherwise autonomous members.

The data for this study was obtained from semi-structured interviews and internal documents, and was collected between March and July 2008. A total of ten interviews (see Table 2) were conducted with executives and elected members of the Board of Directors of FCL, and Calgary and Saskatoon Co-ops. The Calgary and Saskatoon Co-ops were chosen because of their size. Calgary Co-op (Calgary, Alberta) is the largest retail cooperative in the CRS, with annual sales of just over \$1.097 billion in 2011 (Calgary Co-operative Association Limited 2012). It accounts for a significant share of FCL's sales – for instance, in 2008, Calgary Co-op accounted for 25 percent of FCL's food sales. Saskatoon Co-op (Saskatoon, Saskatchewan) used to be the second largest retail cooperative in the CRS at the time of the study and ranked third in 2011 when it made \$313.8 million in sales (Saskatoon Co-operative Association Limited 2012). The larger size of these two cooperatives makes them the most likely to act opportunistically (for instance, the smaller cooperatives are less likely to be courted by other wholesalers).

An extensive review of the literature focusing on the behavior of the CRS over time was undertaken, along with the review of the literature on potential solutions to the first-order cooperation (dilemma) problem, in order to develop the interview guide. Following are some of the key questions that were included in the guide.⁶

- > What are the key coordination issues that arise in the CRS?
- > What impact does a lack of coordination have on CRS performance? How important is opportunism by local retail cooperatives?
- > How is opportunism and lack of coordination minimized within the CRS?
- > Please describe your relationship with other retail cooperatives in the CRS.
- > Please discuss the implications you think the financial crisis of the early 1980s had on the relationships among members of the CRS.

Table 2. Interview Data Collection

Interviewee position and organization	Interview date
Chief Executive Officer, FCL	April 10, 2008
President of the Board of Directors, FCL	April 15, 2008
Vice-President Corporate and Legal Affairs, FCL	April 17, 2008
Vice-President Retail Operations, FCL	April 17, 2008
Senior Vice-President Human Resources, FCL	April 18, 2008
Vice-President Consumer Products and Logistics, FCL	April 30, 2008
Vice-President Agro-Products, FCL	April 30, 2008
General Manager, Saskatoon Co-op	April 30, 2008
Chief Executive Officer, Calgary Co-op	July 15, 2008
Director and Board Chair, Calgary Co-op	July 15, 2008

The semi-structured interview format allowed consistency in questions across interviewees (hence, their responses could be compared and contrasted), while also permitting follow-up questions to explore participants' responses more thoroughly. It also allowed for the research question to be answered without imposing on interviewees. For instance, to determine whether or not the CRS has used the various mechanisms suggested in the literature to deal with opportunism, a broad question – "How is opportunism minimized within the CRS?" – was asked. Participants' responses were subsequently classified according to the various mechanisms suggested in the literature review.

Ten interviews proved to be sufficient to gain an understanding of the strategies and mechanisms that the CRS – led by FCL – has implemented to promote cooperation among member retails. Indeed, by the time of the last interview, the same themes were emerging again and again. The choice of senior executives may bias the results; others in the system may have different views. However, the views expressed are those of the people making the decisions over the last 30 years (out of the ten interviewees, eight had been with the CRS for more than three decades) and capture the way they see the problem (or at least the way they have expressed the problem to outsiders and to themselves).

⁶ The interview guide is available from the authors upon request.

Interviews took between one and two hours and were conducted in person at the interviewee's place of business. To ensure an accurate rendition of the responses, the interviews were audio recorded and subsequently transcribed. Transcripts were then forwarded to the interviewees for review, editing, and approval.

A substantial body of secondary data was also used. Access was gained to the FCL Annual Reports for the period 1978-2007 and to the FCL weekly Bulletin for Co-op General Managers for the period July 2007-July 2008. The FCL Annual Reports provided comprehensive data on the financial performance of FCL, the patronage refunds FCL paid to member retails in cash and/or allocated to them as additional equity, and the strategic decisions FCL made with regard to the reinvestment of retained savings, while the Bulletin for Co-op General Managers provided complementary information on the various programs that FCL developed for the retails.

The data from these two sources were analyzed and coded to identify common themes using content analysis procedures (Strauss 1987). Validity was secured by using multiple data sources (Yin 2009). The statements and views of respondents who represented different organizations in the CRS (i.e., the alliance management body – FCL – and alliance partners – Calgary and Saskatoon Co-ops) and organizational positions were compared and contrasted, and documentary evidence was used to verify the validity of the data.

Results: Opportunism in the CRS

Interviews with CRS executives and documentary evidence revealed three main forms of opportunistic behavior by the retails: (1) decision to shirk on quality maintenance of the Co-op brand name (e.g., allow their store quality or their customer service quality to degrade); (2) decision to purchase from outside suppliers instead of patronizing FCL; and (3) decision to over-expand through loans that retails guaranteed with their shares in FCL (see Table 3).

10	iole 5. Opportunism in the CKS		
Forms of opportunistic behavior		Occurrence	
\blacktriangleright	Retails' incentive to shirk on quality maintenance of	ongoing	
	the Co-op brand name	oligonig	
≻	Retails' incentive to purchase from outside suppliers	ongoing	
	instead of patronizing FCL	ongoing	
≻	Retails' decision to over-expand through loans they	lata 1070a	
	guaranteed with their shares in FCL	Tate $1970s - early 1980s$	

Table 3. Opportunism in the CRS

First, the Co-op brand name is a signal to customers of the quality of the products and services that retail cooperatives offer and, as such, is the major strategic asset that differentiates retail cooperatives in the CRS from their competitors.⁷ However, because of the collective good nature of the Co-op brand name, the benefit to a local retail of maintaining its quality is less than the benefit to the CRS – that is, while retail cooperatives receive the benefit in their local market of brand quality maintenance, they cannot capture the benefits that accrue to the other retails. As a

⁷ See Norton (1988) for a discussion of the role of the brand name in differentiating outlets in a franchise system from outlets in other franchise systems or independent businesses in the same industry.

result, each retail cooperative has an incentive to free ride on the efforts of other retail cooperatives, and to consequently under-develop and under-maintain the Co-op brand name. Such opportunistic behavior creates spillover effects that are experienced by the other retail cooperatives in the CRS – customers that have a bad experience in one Co-op store are likely to believe that other Co-op stores will provide a similar bad experience. In short, if quality control decisions are made independently, retail cooperatives are likely to be worse off than if they had cooperated to develop and maintain the Co-op brand name.

The general manager of Saskatoon Co-op, the second largest retail cooperative in the CRS at the time of the study, speaking about the importance of retail cooperatives contributing to the quality maintenance of the Co-op brand name, stated: "Our cooperative is surrounded by lots of small retails within 25 miles of the city [...] and if they do badly in one small retail, it affects our membership here in our cooperative. Customers perceive us to being the same; they know we are two separate companies, but they want that continuity. And when one of them does not follow the programs, it makes customers start doubting the whole system. Customers lose that trust level we have built up (General Manager, Saskatoon Co-op)."

Retail cooperatives also have the freedom to purchase from other suppliers besides their wholesaler, FCL. This gives each of them an incentive to operate outside the system when they receive better offers on wholesale merchandise. This opportunistic behavior negates the economies of scale and countervailing power the CRS could provide if it had access to all the business of the local retails. As a result, the total system profits will be smaller than what the CRS could generate if retails were to operate inside the system (the implicit assumption here is that there are economies of scale so that when all retails patronize their wholesaler, the result is lower prices than what a retail could obtain from outside the system; otherwise, there would be no sense for the CRS to exist).

This form of opportunism was a real issue in the CRS in the late 1970s and during the 1980s. In the early 1980s, FCL distinguished between active and inactive (in terms of purchasing from FCL) members and strongly encouraged those members unlikely to become active to terminate their membership (FCL 1981). In 1986, the FCL Board's Membership Committee raised the question of whether retail cooperatives should be required to achieve a minimum level of purchases to qualify for payment of expenses for delegates attending the FCL Annual Meeting. In 1989, participants at the FCL Annual Meeting adopted a bylaw amendment that required retails to purchase at least \$50,000 of goods before FCL would provide expense allowances and per diems for their delegates.

The third form of opportunism that was mentioned in the interviews was the over-expansion by retail cooperatives in the late 1970s and early 1980s that was financed by loans that the retails guaranteed with their shares in FCL. The negative real interest rates and high consumer demand of the 1970s encouraged retail cooperatives to borrow money and build expensive malls, using their shares in FCL as collateral for their loans. Retail long-term debt had increased 272 percent over the period from 1974 to1981 (Fairbairn 2003). In 1982, retails had only 32 percent member equity – that is, the consumer members' stake in the retails was less than one third of the assets, with the rest being covered by loans, accounts owed to the cooperative and the like (Fairbairn 2003). Each retail believed that if it were to experience financial hardship, then FCL (i.e., the

other retails) would bail it out. A FCL manager of the day recalls: "There was a mindset in the system [...] that as long as there was any money available anywhere [...] there never would be a time when a retail cooperative would be allowed to disintegrate" (as cited in Fairbairn 2003, 39). As a consequence, the retails collectively took on a debt level that could not be supported by the system; indeed, with the economic slowdown and the high interest rates of the early 1980s, the magnitude of this debt almost drove FCL and the CRS to bankruptcy in 1982. One FCL board member of the day recalls: "As high interest rates hit at that time, a lot of those loans became very dicey as to whether they could be repaid. Federated had so many liens – liens against the shares – had they all been called, or gone bad, the entire CRS would have collapsed" (as cited in Fairbairn 2003, 29).

Results: Mechanisms for Achieving Cooperation in the CRS

The financial crisis that the CRS experienced in the early 1980s created an opportunity for FCL to take a leading role in the CRS. In addition to having an overview of the entire system, given its direct ties with each retail cooperative, FCL had a direct interest in seeing that the retails regained their financial health, since without their purchases, FCL could not survive financially. Because FCL did not have enough money to pull all retails out of their problems, they decided to help those cooperatives that would allow the total system to survive, while closing others. When FCL's plan led to tangible improvements taking place in the activity of insolvent retails and the system as a whole year by year, FCL gained retails' credibility and was accepted as the leader⁸ of the CRS (Fairbairn 2003).

As the leader of the CRS, FCL was instrumental at promoting robust cooperation among the retails following the financial crisis of the 1982. They did that by developing programs that alter retails' incentives and counter opportunistic behavior, and by gathering the resources needed to develop such programs. As will be seen, the strategies and mechanisms chosen by FCL to deal with opportunistic behavior closely match those suggested in the literature.

Today, the CRS is a strong business organization. Figure 1 illustrates the evolution of FCL's real sales and net savings over the 1978-2011 period. As illustrated, FCL went from being on the brink of financial collapse in the early 1980s to record sales and profits year after year during the 1990s and 2000s. Since the financial crisis of 1982, FCL's real sales to the local retails have grown at an annual rate of 4.8%, while real net profits have grown at an annual rate of 20.4%.

⁸ While FCL plays the leading role in the CRS, it is important to acknowledge that the CRS is not a totally top-down driven system. Rather, the retails influence the decisions that FCL makes through their representatives on FCL's Board of Directors and their delegates to FCL's Annual General Meeting, among other avenues. Ketilson (1991) documented the existence within the CRS of countervailing power which enables the retails to not only maintain control over their organizational decision making, but also have input into FCL's decisions.



Figure 1. Evolution of FCL's Sales and Net Profits, 1978-2011 (2011 constant dollars) **Source.** Authors' own calculations based on data from FCL Annual Reports 1978-2011.

The 2008-2009 economic recession that affected retail businesses across Canada generated a decline in FCL's sales and net savings in 2009 and 2010 compared to the record year of 2008. However, the CRS came through the recession quite strong – the organization established a new record in terms of profits in 2011. With sales of \$8.3 billion and net profits of \$839 million, FCL was the largest non-financial cooperative in Canada (The Globe and Mail Report on Business Magazine 2012) and the second largest business in Saskatchewan in 2011 (Saskatchewan Business Magazine 2012).

Table 4 summarizes the mechanisms that FCL has developed and implemented to promote cooperation among retails along two dimensions – shirking on quality and purchasing from outside suppliers. As discussed above, these two dimensions represent opportunities for opportunistic behavior by member retails at the current time. As suggested in the literature, FCL has developed mechanisms for: (a) changing the payoff structure; (b) providing selective incentives; (c) monitoring behavior or its outcomes; (d) selection of the 'right' partners; (e) improving communication; (f) reducing group size; (g) fostering high identification with the group; and (h) increasing the time horizon. The strategy of drawing boundaries around the collective good, as will be discussed below, was used to deter further instances of opportunistic borrowing (remember, this borrowing was at the core of the financial crisis the CRS experienced during the early 1980s).

	Opportunistic behavior by retail cooperatives			
Mechanisms for	Shirking on quality maintenance	Purchasing from outside suppliers		
	of the Co-op brand name	instead of patronizing FCL		
Changing the payoff structure	n.a.	Common flyer program; Patronage refund system; Discount and rebate program		
Providing selective incentives	Subsidy programs; Ag Team program; Succession planning	Subsidy programs; Ag Team program; Reaching out programs; Support services; Succession planning		
Monitoring behavior or its outcomes	Store checklists and customer checks; Retail advisors	Price management system; Retail advisors		
Selecting the 'right' partners	Assistance with general manager hiring; Succession planning	Assistance with general manager hiring; Succession planning		
Improving communication	Group training programs; Commodity clinics; Tours of successful U.S. retailers; Trade shows; Committees; Meetings	Group training programs; Commodity clinics; Tours of successful U.S. retailers; Trade shows; Committees; Meetings		
Reducing group size	District and regional organization of the CRS	District and regional organization of the CRS		
Fostering group identity	Group training programs; Commodity clinics; Tours of successful U.S. retailers; Trade shows; Committees; Meetings; Succession planning; Marketing programs	Group training programs; Commodity clinics; Tours of successful U.S. retailers; Trade shows; Committees; Meetings; Succession planning; Marketing programs		
Enlarging the time horizon	Patronage refund system	Patronage refund system		

Table 4. Mechanisms for Countering Opportunistic Behavior in the CRS

Mechanisms for changing the payoff structure. Perhaps the most obvious way to encourage retails to patronize their wholesaler is to increase their payoffs for operating inside the system. FCL has used the common flyer program, the patronage refund system, and the discount and rebate program to do just that. In the *common flyer program*, FCL plans the layout and composition of a store flyer that all retail cooperatives in the CRS can use to feature grocery promotions and price discounts (a smaller version of this flyer – i.e., a pantry flyer – is developed for the small retail stores). To be eligible to use the flyer, retails must inform FCL on the quantity they need of the grocery items included in the flyer three months out. FCL conducts the negotiations with suppliers on behalf of all the retails. FCL negotiates not only a price for the store flyer. As a result, retails benefit not only from volume rebate dollars, but also from advertising dollars, when they purchase groceries through FCL.

As well, retails receive *patronage refunds* when they do business with FCL. In particular, FCL uses the patronage refund system to distribute part of their net savings to member retails in proportion to their patronage. Patronage refunds can be significant – e.g., in 2008, the patronage

refund rates varied from a low of 5.3 percent on groceries to a high of 12.4 cents a litre on fuel – providing retails with strong incentives to cooperate in dealing with their wholesaler.

Moreover, retails are eligible for *discounts and rebates* when they purchase petroleum products from FCL. Unlike the patronage refunds, the discounts and rebates are given at the time of purchase, and are used to effectively reduce retails' costs in certain markets and to allow them to match their competitors' prices. A senior FCL manager explained: "Individually, we would be crushed by the competition if we did not have an overall CRS program to help retails in the event of price wars. If a retail was on its own, with no system support, all that the competition would have to do in each little community is drop the price and put the pressure on until that retail went out of business because they could not afford to stay in it anymore. Then, they could effectively come back with their price in this community and move on to the next one. Over time, we would simply be out of business (Vice-President Agro-Products, FCL)." Through the support it provides in situations of price wars, the discount and rebate program increases retails' payoffs from purchasing petroleum products from FCL.

Mechanisms for providing selective incentives. Selective incentives represent a closely related strategy that has been used to encourage cooperation among retails in patronizing their wholesaler, and in developing and maintaining the Co-op brand name. FCL has used subsidy programs, the Ag Team program, reaching out programs, a wide range of support services, and succession planning to reward those retails that contribute to the common interests of the system.

With its *subsidy program*, FCL provides a subsidy of 50 percent of the total cost of petroleum assets to any retail cooperative that wishes to upgrade or expand its gas bar, bulk plant, or card lock, or to build a new one. In addition to the grant, FCL also finances the other 50 percent of the cost interest free over a 25-month period and assists retails in the construction of the project. However, to have access to the program, retails must purchase their petroleum products from FCL and keep their standards up in terms of store quality and service. In short, the grants, interest-free loans and project assistance are private benefits given to the retails as an inducement to contribute towards collective benefits – the competitiveness of FCL and the quality of the Coop brand name.

The *Ag Team program* is another example of tying retails' access to a private benefit with the contributions needed to supply collective benefits. The Ag Team program involves suppliers and retail cooperatives working together through FCL. By taking part in the Ag Team, suppliers receive input from the retails as to what is required by the end user and are able to develop the best programs for them. Because suppliers value the marketing opportunities that the Ag Team program creates, they have an incentive to contribute funds that FCL can distribute to the retails. However, to be part of the Ag Team and to participate in marketing funds, retails must purchase crop supplies through FCL and meet certain requirements with respect to their facilities, the training of their staff, customer contact and customer files. Thus, the Ag Team program enhances cooperation among retails in patronizing FCL, and in preserving and promoting the Co-op brand name.

Also, to support local marketing and sales activities for seed and farm equipment product lines, FCL provides retails with *reaching out funds* that are made available by suppliers. Because

payments are based on retails' fall buymart bookings with FCL, the reaching out funds can be viewed as a private benefit given to retails as an inducement to contributing toward a collective benefit – the competitiveness of FCL.

Moreover, FCL provides the retails with a wide range of *support services*, including human resource support (i.e., assistance with general manager hiring, and training for managers, board members, and staff), assistance in merchandising and operations, and audit and accounting services, at a cost that is less than what could be obtained elsewhere. However, to have access to these services, retails must patronize FCL: "We [FCL] provide just a whole myriad of services in behind. If one [retail cooperative] wants to go elsewhere, those services are no longer available to you. Now, if you come back, we will provide them again. But that is all part of the parcel or the package. And that is why I think retails stay with us – we have got so many of those programs in place and they recognize the value of those things. Where else would they get it? You can go to another wholesaler, for example, and buy, but that is all you are going to do because you are just going to buy that item; there is no other support services... (CEO, FCL)." These support services thus encourage retails to patronize FCL.

Succession planning (i.e., the promotion of competent general managers to larger retails in the system) also provides private benefits to retails. In particular, the opportunity for promotion makes small retail cooperatives more attractive to outside managers (prospective candidates) relative to stores in other retail chains and gives large retail cooperatives a proven set of candidates. However, to take part in succession planning, retails need to cooperate with the others in patronizing their wholesaler, and in developing and maintaining the Co-op brand name.

Monitoring mechanisms. Effective implementation of these selective incentive mechanisms requires that FCL distinguish between retails that contribute to the common interest of the system and those that do not. FCL has used the price management system, retail advisors, and store checklists and customer checks to monitor retails' behavior. The price management system, which is meant to coordinate pricing across the CRS, also allows FCL to detect whether retails purchase from outside suppliers: "We [FCL] will know if they [retail cooperatives] are selling stuff they are not supposed to, because it will give us a report saying: here is items that are not authorized to sell in the stores (Vice-President Consumer Products and Logistics, FCL)." The retail advisors that FCL hires to assist retails in merchandising and operations also play a monitoring role in the CRS. By getting directly involved in multiple aspects of the retails' activity, as well as in discussions at the board and general manager level, retail advisors are able to detect whether retails shirk on quality maintenance of the Co-op brand name or purchase from outside suppliers instead of patronizing FCL: "Retail advisors are really the eyes and ears out there for the region managers ... and it is usually through them that we [FCL] get the feedback (Vice-President Retail Operations, FCL)." Moreover, FCL runs store checklists and customer checks to monitor how retails maintain their facilities and the quality of the service they give to their customers.

Selection mechanisms. A more straightforward strategy than monitoring retails' behavior to detect defection is to select retail general managers *a priori* that are inherently cooperative. Assistance with general manager hiring and succession planning are two mechanisms that FCL has used to attract and retain those managers with a cooperative orientation in the CRS.

In particular, FCL's *assistance with general manager hiring* involves all the stages of the hiring process from reviewing the position description and making recommendations on the kind of skills to be required from a candidate to getting involved in the actual interview. Through this process, FCL aims to ensure not only that the managers that are being hired are good professionals, but also that they have a perspective on the entire system – i.e., they see themselves as part of the CRS and not just the manager of a particular retail cooperative – and will likely cooperate with the other retails for the common benefit of all. Moreover, the *succession planning* process allows an opportunity to promote the general managers of smaller retails who have shown a disposition to act in the common interest of the system.

Communication mechanisms. Like other organizations, FCL has created numerous opportunities for communication among retails to promote cooperation, including: group training programs, commodity clinics, tours of successful U.S. retailers, trade shows (i.e., buymarts and Marketing Expos), committees (e.g., Executive Management Committee), and a wide range of meetings (e.g., spring district meetings, fall regional meetings, the Annual Meeting of FCL). Moreover, retail managers communicate during the meetings they themselves organize and to which they invite FCL personnel – the two key examples are the *Fairmont Conference*, which is organized annually by the Co-operative Managers' Association, and the annual *Co-operative Financial Managers' Association Meeting*.

Communication is expected to enhance cooperation among retails, for instance, by ensuring that each retail has the same understanding of the dilemma that they collectively face, helping retails see the whole picture (both advantages and disadvantages) of cooperation and defection, and reinforcing the desirable outcome of universal cooperation (i.e., CRS success) and the undesirable outcome of universal defection (i.e., CRS failure). For instance, FCL often reviews the history of the financial crisis of the early 1980s. By emphasizing the cause of the crisis – i.e., opportunistic behavior by retail cooperatives – FCL makes the new retail decision-makers conscious of the negative consequences of defection and of the importance of working together with the other retails for the long-term benefit of the system.

Discussion of the dilemma may also provide retail decision-makers with information on what choices other retail decision-makers in the CRS say they are willing to make, thus establishing group norms and conformity pressures in favor of cooperative choices. Alternatively, talking about decisions may cause retail decision-makers to believe that others are committed to make cooperative choices. Enhanced trust, in turn, reduces the perceived risk involved in making cooperative choices oneself, hence, fostering cooperation among retails.

Mechanisms for reducing group size. Communication among the 236 retail cooperatives in the CRS is made easier by the *district and regional organization* of the system. In particular, the 236 retail cooperatives have been divided into 15 electoral districts to facilitate the democratic decision-making process through which retails influence the way FCL is run, and the type of goods and services offered. In turn, the 15 districts have been organized into five regions. Thus, before meeting on a total membership basis to make decisions, retails meet at the district and regional level. Apart from making it easier for the retails to communicate, the district and regional organization of the CRS is expected to enhance cooperation among retails by also

increasing the visibility of individual actions and enabling the districts and regions to use social inducements to enhance collective actions.

Mechanisms for creating group identity. A less obvious strategy that FCL has used to promote cooperation among retails is to foster a system identity among them. The communication mechanisms described earlier and the succession planning system that FCL uses are mechanisms that induce retail cooperatives to identify with the system. They do this by exposing retail managers and directors to a system-wide perspective. The *Annual Meeting of FCL*, for instance, is an effective mechanism for enhancing a common understanding among delegates that they are part of a larger group – the CRS: *"When I first got elected, there was a little bit of an anti-Federated sentiment because we just understood that they are our wholesaler and we are Calgary Co-op. I do not know if a lot of us understood what the big picture was. Then I went to one of FCL's Annual General Meetings and that was just kind of like: wow, we are part of this whole bigger picture ... (Director and Board Chair of Calgary Co-op)." Also, the succession planning system gives retail general managers a system-wide perspective: <i>"General Managers have moved around lots; like myself – this is the eighth time I have moved in 30 years. And we understand that this whole thing* [the CRS] *is the same* (General Manager, Saskatoon Co-op)."

The communication mechanisms also contribute to the creation of a shared identity among retails by providing them with an opportunity to socialize and network: "Apart from the work that happens, the opportunity to network with other general managers and the CEO of FCL is important. As a young general manager, you feel that you are the only manager that has ever had retail problems. At my first conference [the Fairmont Conference] in 1991, I had the opportunity to sit with the CEO of Calgary Co-op at that time. It was a great learning opportunity to talk to him and other seasoned general managers around the table. I found out that I was not the first person to experience retail problems. I received some advice and a few phone numbers so that I could call them. That was important to me; it made me feel like I belonged (CEO, Calgary Co-op)." Through this process, these meetings induce retail general managers to feel a oneness with or a belongingness to the system. Also, by allowing retail cooperatives and FCL to come together in a social setting, meetings and trade shows contribute to creating and nurturing a sense of 'groupness' among them: "The Co-op Marketing Expo has been one of the strongest team-building relationship-forming parts of our organization (Vice-President Retail Operations of FCL);" "The Expos bring everybody together and they make you feel like you are part of a bigger system (General Manager, Saskatoon Co-op)."

Finally, the communication mechanisms (e.g., group training programs) foster a common identity among retails by allowing them to discover that they all face similar problems (e.g., they compete against the same competitors): "When the Board of Directors from Saskatoon Co-op gets mixed into a training course with other Boards of Directors from other retails, it really opens your eyes up saying: yes, we are big, but we have got the same problems that Colonsay Co-op [Colonsay is a small community in Saskatchewan, Canada] has got (General Manager, Saskatoon Co-op)." When retails understand that they share a common fate, it is expected that they more strongly identify with each other: "I believe our system has come a long way in terms of communicating more openly both the good news and the bad news. I think the more that we communicate the stronger that identity grows (CEO of Calgary Co-op)."

Coordinated action by the retails in adopting the various marketing programs (e.g., programs regarding store layout, signage and décor, Co-op[®] product programs, the common flyer program, and the unique price management system) that FCL puts forward also contributes to the creation of a shared identity. The *programs regarding store layout, signage and décor* contribute to the creation of a visual identity across the CRS. Moreover, when retails share the same (*computer*) *pricing system, store flyer, and private label products*, it is expected that they get a sense of being part of a system.

This sense of shared identity is expected to enhance cooperation among retails by creating a sense of cohesion that increases the probability that system members will take the common interest of the CRS into account when making their own decisions. Alternatively, strong identification with the CRS is expected to lead to the coupling of a retail's identity with the system. This coupling process, in turn, increases the retail's concern for the success of the CRS and, consequently, the willingness to cooperate with the other system members: "When you look at where the CRS came from back in the early 1980s to where we are today, our success could not have happened without working together for the benefit of all (CEO, Calgary Co-op, emphasis added)." Indeed, this CEO thinks of Calgary Co-op as a member of the CRS and perceives the success of the system as Calgary Co-op's. Through this process, identification with the System may increase retails' awareness of their interdependencies and strengthen their expectations of future interactions. These expectations likely moderate retails' temptation to defect and encourage cooperation.

Mechanisms for increasing the time horizon. By their nature, interactions among retail cooperatives in the CRS are repetitive. Retails have joined the CRS to gain countervailing power against their suppliers, and to benefit from economies of scale in warehousing, transportation, promotion and other marketing functions. Moreover, once a retail cooperative joins the CRS and contributes its share of investment in FCL, it cannot costlessly withdraw from membership. Only under certain circumstances and with the approval of FCL's Board of Directors may retail member shares in FCL be redeemed. As a result, a situation of repeated interactions emerges among retails.

The *patronage refund system* further raises retails' costs of withdrawing from membership in the CRS and increases the time horizon over which retails are likely to interact. As discussed earlier, FCL uses the patronage refund system to distribute part of their net savings to retail cooperatives in proportion to their patronage. However, only a certain share (e.g., 81 percent in 2010) of the patronage refunds is returned to retails in cash, the rest being allocated to them in the form of additional equity in FCL. This patronage allocation adds to the retails' initial investment in FCL, hence increasing the amount of money a retail would forfeit should it decide to step out. Moreover, FCL uses the retained savings to develop new programs for the retails or reinvests them to grow the business. The retained savings, together with the return on their investment, are a cost for the retails that choose to step out from the CRS. The significant amount of retained savings (e.g., \$146.3 million of the \$498 million net savings in 2010) and the high rate of return on their investment provides retails with strong incentives to continue their membership in the CRS into the future.

The reinvestment of retained savings plays a particularly important role in promoting cooperation in the CRS. For instance, some of the most important investments that FCL has made since the early 1980s were targeted at growing the petroleum operations, which have been a strength for the CRS. These investments included a long stream of expansions at the Co-op Refinery (owned by an FCL subsidiary) and the NewGrade Energy Inc. upgrader. Interest in the future potential benefits to be generated by these investments (e.g., new efficiencies from the refinery's larger production volume, extra earnings for the refinery from upgrading heavy crude oil to the light, sweet crude it uses in production) has provided retails with incentives to cooperate in patronizing FCL for their petroleum purchases, and in preserving and promoting the Co-op brand name. Apart from establishing long term goals among retails, these investments are expected to also promote trust by signaling calculations of payoffs from universal cooperation stretching well into the future.

It must be mentioned that apart from the mechanisms that FCL has put in place to deter opportunistic behavior by retail cooperatives, there have also been changes in the competitive environment that diminished retails' incentives to act opportunistically. In particular, consolidation in the food and petroleum industries reduced retails' incentives to purchase from outside suppliers, as they would have to patronize their competitors. As well, increasing competition in retailing reduced retails' incentives to shirk on quality maintenance of the Co-op brand name, as retails had to differentiate themselves through service and quality rather than through price: "To my mind, that is what is going to differentiate us [the CRS] from the rest of the pack – service and more service and more service and a great shopping experience. Because as big as we are, we are very small when it comes to the other companies. So, if we wanted to go head and head on price, we were dead in water; we would not survive (CEO, FCL)."

Mechanisms for drawing boundaries around the collective good. These mechanisms were specifically targeted at resolving the problem of over-expansion that created the 1982 financial crisis. One way to view the over-expansion by retail cooperatives in the late 1970s and early 1980s is that there was a lack of well-defined property rights over FCL's assets. In particular, because retail cooperatives could borrow as much money as they needed to build new stores and could guarantee their loans with their shares in FCL, each retail cooperative viewed the solvency of FCL, and with it the CRS, as a common property, a resource that could be exploited. As a result, each of the retails took on a debt level that together could not be supported by the CRS; the magnitude of this debt almost drove the entire system to bankruptcy in 1982. To avoid such a situation from happening again, FCL made each retail responsible for its debt. That is, credit was no longer a common pool good that retails could exploit. Put it in property rights theory terms, FCL changed the residual control rights among retails (Barzel 1989). This, in turn, changed their incentives. The retails were willing to accept FCL's decision because of the critical situation that they and the system were in.

Concluding Discussion

With more and more firms involved in strategic alliances, there is a growing recognition of the need for an understanding of how alliances can be effectively managed to promote effective cooperation among business partners (Ireland et al. 2002; Culpan 2009; Kale and Singh 2009). While much of the published research considers the factors that may foster cooperation in

interfirm relationships, the literature is short on the actual procedures that firms use. This paper, based on a case study of the CRS, provides examples of the mechanisms that can be used to implement these theoretical solutions in a business setting. In particular, the paper presents practical ways for alliances – led by a focal firm – to alter partner firms' payoffs, to provide private rewards, to monitor behavior or its outcomes, to establish long term goals among partners, and to build high group identification within the alliance. While a few of the mechanisms identified in this study of the CRS (e.g., the patronage refund system) can be used only in cooperative alliances, most of them are applicable to other types of alliances as well.

A common feature of many of the mechanisms used in the CRS is the provision of a private economic benefit for the retails that cooperate. For instance, retail advisors, who play a monitoring role in the CRS, provide retails with sufficient improvements in operational efficiency (e.g., through market intelligence, dealing with problem managers, hiring new management) that the retails are prepared to accept the oversight that the advisors are also carrying out. Similarly, retails willingly go on study trips to the U.S., which have been shown to foster retails' identification with the CRS, because they are paid for by FCL. As a result, the successful solution of the cooperation problem in alliances requires not only that a dedicated strategic alliance function exists, as argued by Dyer et al. (2001), but also that this alliance management body has the ability to accumulate the resources needed to develop mechanisms that alter partners' incentives. Certainly, developing and implementing such alliance management strategies is advantageous only to the extent that the costs of doing so are lower than the benefits accruing from cooperation.

Obtaining the resources needed to develop and implement alliance management strategies requires the solution of a second-order cooperation problem - i.e., providing an incentive for alliance partners to contribute resources and enticing alliance partners to abide by the decisions made by the alliance management body (Ostrom 1990). This study shows that FCL has addressed these second-order dilemma problems by creating a number of resource generating opportunities. Through the patronage refund system, FCL retains part of the benefits that retail cooperatives collectively generate as the CRS. The resources that it retains can then be used to provide selective incentives and to build identity (indeed, Knoeber and Baumer (1983) have previously argued that the patronage refund system is a way of solving the dilemma that cooperative members face when it comes to investing in their organization). FCL also uses the scale of the CRS to attract resources from suppliers - i.e., suppliers value the marketing opportunities that the CRS offers and are willing to contribute marketing funds and to pay to participate in the Co-op Marketing Expo, which is also a significant identity building exercise for the CRS. Furthermore, FCL has found ways to have the retails voluntarily contribute resources. For instance, FCL organizes the Marketing Expo exclusively for the retails and the system suppliers. This exclusivity makes the Expo attractive to the retails, which are thus willing to pay to participate in it.

Another important finding is that successful alliance management mechanisms are deeply integrated into the partners' marketing and operational activities. In addition to exchanging the goods and services required in retail operations, these activities are also used to manage relationships to counter opportunistic behavior and to facilitate the development of a common perspective. The integration of alliance management mechanisms into day-to-day operations keeps the cost of managing the alliance to a minimum and is also more likely to generate retail acceptance.

Moreover, the integration of these mechanisms into the operational activities means that the costs and benefits of participating in activities that encourage cooperation are immediately apparent to local managers in straightforward and easy-to-understand financial terms. This financial impact creates an obvious incentive for managers to participate. In addition, the presence of a clear financial impact may give managers greater power in their relationship with boards. Because local boards are often the ones pushing for greater autonomy or more local control, giving managers greater power may be advantageous in promoting cooperation.

The results also suggest that firms need to use non-economic mechanisms alongside economic mechanisms to deter partner opportunism. The non-economic (behavioral) factors appear to be complementary to the economic ones in enhancing cooperation in interfirm relationships – i.e., fostering partner firms' identification with the group appears to have greater success when paired with economic incentives and vice-versa. The high failure rate of strategic alliances may suggest that business partners place too much emphasis on the economic mechanisms for alliance management and little or no emphasis on the non-economic ones. A more in-depth analysis of this relationship between the economic and non-economic mechanisms is a subject for further study. For instance, a stated preference methodology, such as conjoint analysis or discrete choice modeling, could be employed to examine retail cooperatives' heterogeneity with respect to the value they attach to the various programs that FCL uses to change retails' material incentives and to manage their identity.

Finally, the analysis in this paper also suggests that the use of single, stand-alone mechanisms to deal with cooperation problems is not common. Instead, it is expected that firms will use a number of mechanisms to tackle the problems, likely suggesting that these problems are both important to business success and difficult to address.

This study is not without limitations. First, due to the fact that it is a case study, statistical generalizations cannot be made based on the study's findings. Second, as in any case study based research, it is difficult to establish a cause and effect relationship. Third, due to the study's limited geographical scope, the insights from this study may not be generalizable and applicable in other areas with different economic and market conditions. Despite these limitations, however, the present study contributes towards a better understanding of the forms that opportunism may take in alliances and the business mechanisms that firms can use to manage partner opportunism.

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International Food and Agribusiness Management Review Volume 17 Issue 1, 2014

Farmers' Satisfaction with Fresh Fruit and Vegetable Marketing Spanish Cooperatives: An Explanation from Agency Theory

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Abstract

Agricultural cooperatives have specific characteristics. Coop members may have different roles (owners, buyers, sellers and controllers) and, consequently, these players may have different objectives. The various stakeholders may also have different objectives from the management of the cooperative. This makes agency theory a good framework for the analysis of farmers' satisfaction with their cooperative. Based on a sample of 277 members of fruit and vegetable marketing cooperatives in Spain, the results show that members' satisfaction with the cooperative exerts a positive influence on members' desire to continue as members of that cooperative. The results also confirm the positive influence of trust, information and control on satisfaction.

Keywords: Agricultural cooperative, satisfaction, information, control, trust

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Introduction

Cooperatives play an important role in the development of agriculture in many countries as suppliers of farm produce, marketers of agricultural commodities, and providers of services such as storage and transport (Ortmann and King 2007).

In the European Union (EU) there are around 40,000 cooperative companies, with about 600,000 workers and an aggregate turnover of more than 300,000 million euros per year (General Confederation of Agricultural Cooperatives in the European Union - Cogeca 2012a). Cooperatives account for over 50% of the supply of agricultural inputs and over 60% of collection, processing and marketing of agricultural products (Cogeca 2012b). Spain stands out in the European Union, with almost 10% (3,918) of cooperatives, which employ roughly 93,000 workers and have a turnover of more than 17,000 million euros (Cooperativas Agro-alimentarias 2011). These figures clearly indicate the importance of cooperatives in the EU and particularly in Spain.

In 2011, the fresh fruit and vegetable sector accounted for 19.6% of total agricultural production in the 27 countries of the EU. In fact, this sector was the largest in terms of output value. The importance of this sector is particularly evident in Spain. Fresh fruit and vegetables account for 33.1% of total Spanish agricultural production, which corresponds to 18.4% of all EU fresh fruit and vegetable production (European Commission 2012). Moreover, Spain is the EU country with the highest number of fresh fruit and vegetable cooperatives, with 945 (Cogeca 2012b). These cooperatives have a turnover of more than 5,000 million euros and provide 71.4% of the business volume in Spanish agricultural cooperatives (Cooperativas Agro-alimentarias 2011).

The study of the performance of agricultural cooperatives has attracted growing attention in recent years. This is due, on the one hand, to the previously mentioned economic importance of those firms and, on the other hand, to the significant role they play in rural development and attaining of the objectives of the Common Agricultural Policy (Guzmán et al. 2009). However, the evaluation of the performance of cooperatives is particularly controversial (Guzmán and Arcas 2008).

In contrast to investor-owned firms (IOFs) that are operated in the interests of investors, cooperatives are member-owned, member-controlled and operated for the benefit of producermembers (James and Sykuta 2005). Thus, many authors agree that the evaluation of the performance of cooperatives must not be limited to a simple analysis of traditional financial ratios (i.e. solvency, efficiency, liquidity and profitability) (Lerman and Parliament 1991; Pratt 1998; Hind 1998). Therefore, it must be borne in mind that cooperatives should give priority to maximizing the satisfaction of the needs of their members, by offering a list of services that can create a state of well-being for their associates, and that the criteria of success go beyond simply optimizing profitability (Michelsen 1994). Hence, members' satisfaction with their cooperative is being increasingly used by researchers as a measure of the success or performance of such organizations (Sayers et al. 1996; Hansen et al. 2002). Satisfaction influences the desire to continue as a cooperative member and thus the survival of the cooperative as a functioning organisation (Hernández-Espallardo et al. 2013). The aim of this paper is to examine the determinants of members' satisfaction with their cooperative. In addition, the paper also examines the effect of members' satisfaction on their desire to continue as cooperative members. There is very little previous literature that examines these issues (Hansen et al. 2002; Nilsson et al. 2009; Hernández-Espallardo et al. 2013). This, together with the fact that the present study employs agency theory as a framework, is the significant contribution of this manuscript. Agency theory is appropriate for the examination of the relationships in any firm and, therefore, in agricultural cooperatives (Ortmann and King 2007).

The rest of the paper is organized as follows. First, the theoretical framework and the hypotheses are presented. Then, the methodology and the methods of data selection are described. The next section contains the results of the study. Finally, conclusions are presented.

Theory and Hypotheses

The Concept of a Cooperative

Many definitions of cooperatives are available. However, one of the most frequently employed is that of the International Cooperative Alliance (ICA). This organization defines a cooperative as "an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise" (International Cooperative Alliance 2012). As a general rule, the running of these firms is guided by seven cooperative principles recognized by the ICA: voluntary and open membership; democratic member control; economic participation of members; autonomy and independence; provision of education, training and information; cooperation among cooperatives; and concern for the community (International Cooperative Alliance 2012).

In addition to these general principles, each country usually develops its own legislation about cooperatives. In the case of Spain, the relevant legislation is the Spanish Cooperative Law (BOE 1999). This law states, in Article 1.1, that, "A cooperative is a firm constituted by people who freely associate and voluntarily retire, to conduct business activities directed to satisfying the economic and social needs of its members, with democratic structure and functioning in accordance with the principles formulated by the ICA". Considering this definition and other precepts of the law, it can be concluded that both its capital and the number of members may vary over the life of the organization.

One characteristic of agricultural cooperatives is the peculiar relationship of the organization with its members, because these are simultaneously the owners, users (buyers and sellers), controllers, and beneficiaries (Nilsson 1996). From the above it follows that a cooperative is essentially a user-owned and user-controlled business that distributes benefits equitably on the basis of use or patronage (Barton 1989). The fact that partners maintain individual property holdings that are coordinated by the management of the cooperative through administrative controls means that cooperatives have both market-associated characteristics and company-associated characteristics. For this reason cooperatives have been considered to be a hybrid form of business governance (Ortmann and King 2007).

Cooperatives, especially large ones, can employ managers and other salaried staff, in order to implement the decisions of members (Chaves 2004). Cooperative members may participate in the day to day administration of the cooperative by becoming administrators, but there are other ways for members to influence decisions and exert control. One way to exert influence is through the Board of Directors. The Board is the top level of administration, supervises the managers and represents the interests of the cooperative. Another way to exert influence is through the General Assembly, which is the meeting of members, constituted in order to consider and to adopt agreements on those matters that, legally or statutorily, are within their competence. Decisions of the Assembly are binding on all members. The General Assembly is the equivalent to the shareholders' meeting in corporations, except that shareholders differ in terms of their contribution to the firm's capital, while cooperative members differ in the governance of the cooperative by taking part in non-statutory action (section meetings, commissions, etc.) (Barraud-Didier et al. 2012).

The principle of democratic governance is generally considered to be one of the most important characteristics of cooperatives. This principle implies that each member has one vote in the General Assembly. From the point of view of democratic governance, cooperative management rests on several premises: the members decide democratically at the General Assembly; the members participate actively in the General Assembly as well as in the election of representatives; elected representatives, including the Board of Directors, represent and manage the cooperative; and elected representatives are accountable to the membership. However, recent studies have highlighted a decline in the democratic life of cooperatives (Levi and Davis 2008; Siebert and Park 2010).

Agency Theory

According to Jensen and Meckling (1976), an agency relationship is, "A contract under which one or more persons (the principal/s) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent". That is, the principal (cooperative members) hires an agent (board members and managers) to carry out a task on the principal's behalf. When both parts of the relationship are utility maximizers, act rationally and form unbiased expectations of the impact of the agency relationship on their utility function, agents will try to reach their objectives, which may or may not coincide with those of their principals.

A divergence of objectives will lead to agency conflicts and agency costs. However, agency problems arise when, in addition to conflict of objectives between the principal and the agent, there is information asymmetry between them. That is, the agent typically has more information than the principal about the environment in which decisions are being made, leading to that information asymmetry. The limited access to information that the principal usually has allows the agent considerable discretion to adopt opportunistic behavior that does not always translate into a greater benefit for the principal.

When a conflict of objectives exists, but the principal has perfect information about the agent's performance, the loss of efficiency can be overcome by the principal including the actions that

the agent should perform in the contract, as well as checking if the agent has followed instructions, with the possibility of including penalties in case of breach of contract. Thus, the agency costs are the sum of (Jensen and Meckling 1976): a) the cost of monitoring: the principal will limit the autonomy of the agent by installing controls, maintaining checks, establishing budgetary limits, making direct supervision, using the payment and reward system to structure the agent's incentives, etc.; b) bonding costs: agents can voluntarily accept clauses in their contracts restricting their discretion and such restrictions may cause additional costs, for example costs associated with profitable investments that may be rejected, or direct costs associated with the formalization of the contract, and so on.; and c) residual loss.

Shareholders of large quoted firms usually have the same objective: maximizing the firm's market value. This objective conflicts with maximizing the managers' utility function. However, the picture is more complicated in cooperatives. Since, as previously stressed, the members of the cooperative may play different roles simultaneously (owners, buyers and sellers, controllers and beneficiaries) they may also have very diverse objectives (Hansmann 1996). Members usually delegate day-to-day decisions to managers, probably to avoid the costs arising from decision making in a collective process.

As a consequence, cooperatives face two problems. On the one hand, in most cooperatives the administration is delegated to managers or professional agents. On the other hand, the multiplicity of objectives that member have leads to a lack of definition in collective objectives, increasing the managers' discretion, making it more probable that they take decisions that benefit themselves to the detriment of members. In addition, the multiplicity of objectives makes it much more difficult to establish incentives and control mechanisms that minimize conflicts between members and managers (Tirole 2001).

Agency problems in agricultural cooperatives, arising from the diversity of objectives of cooperative members (principals), members of Board of Directors and professional managers (agents), are compounded by the existence of asymmetric information. This could lead agents to adopt opportunistic behavior that does not benefit the principals. Cooperative members must have information and control mechanisms to avoid agency problems.

Corporate governance examines the mechanisms that the organization can employ in order to provide incentives for the agents to persuade them to behave in the principal's interest, as well as to reduce the information gap and to provide the appropriate control mechanisms. Problems associated with the governance of cooperatives have not attracted the research interest that has been focused on capitalist firms and the field of interest has been rather slow to develop. Most studies on this subject agree that problems in cooperatives are more complicated due to the fact that there are more players than in capitalist firms and, in addition, some of them assume more than one role. In fact, although some studies suggest that there is no separation between ownership and control in cooperatives and that, consequently, conflict does not arise (Hansmann 1988), other studies, such as Spear (2004), put the emphasis in the limited extent to which cooperative members can influence the behavior of managers, to the point of concluding that in such companies the discretion of the managers is larger than in capitalist firms.

The literature usually classifies control mechanisms for Inc. corporations as either internal or external to the firm. These control mechanisms help reducing information asymmetry. Internal control mechanisms, which include the ownership structure of the firm, boards of directors, and compensation systems, are particularly important when markets, and hence external control mechanisms, are less well developed. An example is Spain, where markets are less developed than in Anglo-Saxon countries. Focusing on cooperatives, the market for corporate control, which is the main external control mechanism, does not work because residual rights in the cooperative cannot be transferred. Thus, in cooperatives, the only effective control mechanisms are the internal ones. For this reason, the classification of controls as internal or external is not usually employed in cooperatives (Coque 2008).

An alternative to that classification classifies corporate governance mechanisms for cooperatives into direct and indirect mechanisms (Coque 2008). The direct mechanisms are related to information and decision flows, including participation in the internal organization of the cooperative through the election of the positions in the General Assembly and in the other established democratic processes, and control, both ex-ante and ex-post, to prevent managers adversely affecting the interests of members. The indirect mechanisms are related to real and financial flows; for example, the extent to which members choose to use the services of the cooperative rather than alternative services offered by competitors. A recent paper by Pascucci et al. (2012) illustrates this matter by examining members of the cooperative who do not deliver to their cooperative, as well as non-members who do deliver to cooperatives.

Consequences and Antecedents of Satisfaction (Hypothesis)

Because the cooperative (as agent), is created to serve its members (as principal) and operate for their benefit (James and Sykuta 2005; Ortmann and King 2007), from the perspective of agency theory, members will be satisfied with their cooperative when the cooperative is perceived to act in their interests. The most obvious reason why farmers join cooperatives is to satisfy their economic goals. However, in addition to this goal, some members may also seek to satisfy social goals through their cooperative membership (Hansen et al. 2002). Economic objectives are related, among other things, to obtaining higher prices for the products, or receiving high quality services (Ortmann and King 2007). Social goals may include the desire to interact with other members and develop personal relationships (Hansen et al. 2002).

In a similar way, Nilsson et al. (2009) indicate that the members' degree of satisfaction with the cooperative may be related to the organization as well as to the business. Satisfaction with the organization might mean, for example, how satisfied members are with the information they receive and the treatment they are offered by the cooperative. However, satisfaction with the business is related to how satisfied the members are with the prices and services offered by the cooperative.

Given that members may play several roles in their relationship with the cooperative, and therefore have different interests or goals (Nilsson 1996), another generally accepted definition of satisfaction in business relationships provided by Anderson and Narus (1984) may be relevant: "A member's satisfaction with the cooperative is a positive affective state resulting from the appraisal of all aspects of the relationship with the cooperative".

Satisfaction is not only a close proxy for concepts such as perceived effectiveness but also a predictor of future actions by the cooperative's members. A review of the literature reveals that there is consensus about the positive influence of satisfaction on the relationship and the desire, by active members, to continue that relationship or leave it. This desire to continue is considered one dimension of the commitment of members (Kumar et al. 1995; Kim and Frazier 1997; Barraud-Didier et al. 2012) and the end result of the process of interaction between the parties (Frazier 1983). Parties who are satisfied with a relationship will be more interested in maintaining it than in starting a new relationship, given the uncertainty that any new relationship may bring (Ramsey and Sohi 1997).

In the field of the supplier-distributor relationships, there are empirical studies, such as Biong (1993) and Ping (1993; 1994), that give support to the highlighted theoretical considerations. If the parties have their expectations fulfilled by the relationship they will want to keep that relationship, and will reject other interesting alternatives (Ping 1994).

Therefore, increasing a farmer's satisfaction with the cooperative leads the cooperative member to increase his or her intention to continue his or her membership, and this has implications for the survival and future success of the cooperative as an organization (Hernández-Espallardo et al. 2013). In line with this reasoning, we propose the following hypothesis:

Hypothesis 1: Increasing a farmer's satisfaction with the cooperative increases his/her intention to continue his/her membership of the cooperative.

Principal-agent problems in a cooperative are likely to give rise to member dissatisfaction (Ortmann and King 2007). According to the general formulation of the principal-agent model, if members are not able to monitor managers' behavior, then managers have an incentive to behave opportunistically by maximizing their own utility instead of that of the members (Russo et al. 2000).

Moreover, this problem is exacerbated by the presence of information asymmetry, a characteristic that clearly exists in the relationship between a farmer and the cooperative (Hernández-Espallardo et al. 2013). As explained above, the relationship between the member and the cooperative is often based on information asymmetry. The cooperative has information which the member does not. For example, the cooperative has information about market prices, and about clients' behaviour (Borgen 2001). In this sense, Garnevska et al. (2011) also note that communication between members and management is important for the successful development of cooperatives.

Nilsson et al. (2009) argue that to the extent that a cooperative becomes very large and develops very complex business operations, the members are no longer able to control the cooperative and they have difficulty keeping themselves informed about the business and assessing what is happening in the firm. This hinders the participation of the partners in the governance of the cooperative and they will probably become dissatisfied with it.

Therefore, from the point of view of agency theory, to the extent that partners have information about the cooperative and mechanisms of control (i.e. through the correct functioning of the General Assembly), they may prevent opportunistic behaviour of members of the Board of Directors and professional managers, so that their decisions will help them to achieve their objectives. Therefore, we propose the following hypothesis:

Hypothesis 2: The more information a member has about his/her agricultural cooperative, the more satisfied he/she will be with it.

Hypothesis 3: The more control a member has of his/her agricultural cooperative, the more satisfied he/she will be with it.

Trust is another mechanism identified in the literature on agricultural cooperatives than mitigates agency problems (Borgen 2001). Many studies confirm that trust is essential in a cooperative (James and Sycuta 2005; Nilsson et al. 2009; Österberg and Nilsson 2009; Nilsson et al. 2012), by reducing behavioural uncertainty (Theuvsen and Franz 2007), to the extent that it can act as a control mechanism that reduces the opportunistic behaviour of managers (Arcas-Lario and Hernández-Espallardo 2003).

In most definitions, the trust of a party in another person or organisation is a belief, feeling or expectation about the intentions and capabilities of that person or organisation to adopt behaviour that produces positive results for the first party (Ganesan 1994; Wilson and Möller 1995). Thus, in agricultural cooperatives, the trust of members in their cooperative may be defined as the members' belief that their cooperative will take decisions and adopt behaviour that will allow them to reach their goals.

Several papers confirm the positive influence of trust on satisfaction with inter-organizational relationships (Anderson and Narus 1990; Andaleeb 1996). This is also the case, but with less intensity, in agricultural cooperatives (Hansen et al. 2002). It is to be expected that members that trust their cooperative will perceive that the decisions of their cooperative will allow them to achieve their objectives. This will stimulate members to feel confident and satisfied with the cooperative.

Therefore we propose the following hypothesis:

Hypothesis 4: The more a member trusts his/her agricultural cooperative, the more satisfied he/she will be with it.





Figure 1. Model with the proposed hypothesis

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Methodology

Data Collection

We collected data from farmers who are members of fresh fruit and vegetable marketing cooperatives in the Spanish Region of Murcia. This region specialises in fruit and vegetables, which represents 65.4% of its total agricultural production and 9.4% of the total fresh fruit and vegetable production in Spain. Another characteristic of the Murcia fruit and vegetable sector is the existence of a large number of cooperatives. For these reasons the marketing cooperatives of fruit and vegetables based in Murcia may be considered an appropriate universe for the testing of the hypotheses presented above.

To identify the cooperatives and their members we had the collaboration of the Confederation of Agricultural Cooperatives of Murcia (FECOAM, the regional affiliate to Cooperatives Agroalimentarias). The data provided by FECOAM indicate that 45 of its associates belong to the fruit and vegetable sector. FECOAM represents 91% of all the fruit and vegetables cooperatives in Murcia, and they account for 31% of the production of fruit and vegetables in the region.

Due to the population's characteristics (the fact that their members are in most cases active workers and/or are older people) and the difficulty of obtaining information, personal surveys were used. To develop the questionnaire we previously carried out several interviews with key persons (cooperative members and directors). This allowed us to have a broad knowledge of the relationships to be analysed. Later, in order to develop the final version of the questionnaire, we conducted a number of pre-tests.

Geographical dispersion made it difficult to get in touch with cooperative members, so we took advantage of the celebration of the XIII Day of the Agricultural Member, organized by FECOAM. This event coincides with the Mediterranean Agricultural Fair, so the sampling was including a wide range of members. The presence of about 6,000 members and the procedure employed to select the sample (simple random sampling) guarantees the representativeness of the sample. A total of 334 completed questionnaires were obtained. 57 questionnaires that were not answered properly or lacked relevant information were removed from the sample. Thus, the final sample consisted of 277 questionnaires.

Some characteristics of the sample are presented in Table 1. Most members are men (91%) with a mean age of 60 years and an average of 18 years as cooperative members. Their level of education is low. 42% of members completed their studies with primary education, and 40% did not even complete that level of studies. About 15% of members completed secondary education, 9% in general education and 6% in vocational education. Only 2% of the cooperative members have a university degree. The fact that only 54% of the members' revenues come from agricultural activity highlights the fact that agriculture is a part time activity for many cooperative members. In addition, most of the members' agricultural activity, and thus of their agricultural revenues, come from their cooperative activity (a mean of 87% of their agricultural revenues). In relation to their participation in the governance of the cooperative, only 25% of the members have ever been members of the Board, roughly half of whom were board members at the time of the survey. Their average time as board members is 10 years.

Table 1	. Profile	of Coo	perative	Members
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Variable	Minimum	Maximum	Mean
Men-members (%)			91
Woman-members (%)			9
Age	23	87	60
Years as cooperative member	2	66	18
Level of studies (%):			
Less than primary education			40
Primary education			42
General secondary education			9
Vocational secondary education			6
University degree			2
Other			3
Percentage of income that comes from agricultural activity	2	100	54
Percentage of agricultural income that comes from cooperative activity	1	100	87
Percentage of members that have ever served as a Board member			25
Number of years as Board members	1	30	10
Percentage of members of the cooperative that are presently serving on			12
the Board			12

Measures

To measure the concepts, we used multiple indicator scales that were inspired by the literature (for references, please see Table 2). Because most of the scales have not previously been applied in the field of agricultural cooperatives, they were adapted during the pre-test phase. We used a 0 to 10 points Likert-type scale with "completely agree" and "completely disagree" as anchors. Table 2 shows the concepts, their measures, and descriptive statistics, as well as their theoretical source, once the scales had been refined.

To determine the quality of the scales employed, we tested whether they meet the criteria of reliability and convergent and discriminant validity. To test the reliability, we use the Cronbach's alpha (α), whose optimal figure depends on the purpose of the research (Churchill 1979). Thus, for the early stages of any research, 0.5 - 0.6 may be acceptable figures.

To deal with validity, we conducted a factor analysis with the items of each variable, removing those that did not load heavily onto the factor. Finally, discriminant validity is tested by performing a factor analysis with all items that meet the previous criteria of reliability and validity. In this way we can check that the items of other scales do not load on the same factor or dimension, to determine discriminant validity. Thus, so long as the items load onto the appropriate dimension and the analysis has significant goodness-of-fit measures, we may conclude that there is discriminant validity.
Table 2. Descriptive Statistics

Variable		Mean	Standard deviation	Minimum	Maximum
Co	ntinuity (Ping 1993; Biong 1994; Selnes 1998)				
1.	Your relation with the cooperative is a long-term partnershi	p 8.40	2.091	0	10
2.	You wish to continue as a cooperative member	8.91	1.588	0	10
Sa	tisfaction (Kumar et al. 1992; Hansen et al. 2002; Nilsson et	al. 2009)			
1.	You are very satisfied with your overall relationship with the cooperative	e 8.41	1.666	1	10
2.	You are very happy with the price paid by the cooperative for the products delivered	7.80	2.085	0	10
3.	The services that the cooperative provides you help you achieve your business goals	7.90	1.96	0	10
4.	You are very pleased with the running of the cooperative as a firm	8.28	1.780	0	10
Inf	formation (Heide and John 1992; Mohr and Sohi 1995)				
1.	The cooperative always explains decisions that may affect i members	ts 8.22	1.970	0	10
2.	You are well informed about the results of the cooperative	8.16	2.013	0	10
Co	ntrol				
1.	You attend all meetings of the General Assembly	7.68	2.788	0	10
2.	You frequently intervene in the General Assembly	5.76	3.397	0	10
3.	Your interventions in the General Assembly are taken into account	6.80	3.190	0	10
Trust (Ganesan 1994; Kumar et al. 1995)					
1.	When facing adverse situations, members have the help of the cooperative	7.60	2.654	0	10
2.	When the cooperative makes important decisions, it takes into account its members' interests	7.88	1.978	0	10

In Table 3 we present the different items employed to measure the variables, once the items that do not meet the selection criteria had been removed. In Table 3 we present, together with the mean of each item, the figures for the Cronbach's alpha (α), the KMO index for the factor analysis (with principal component extraction and varimax rotation) and the weight factors of each item on the variable on which it loads most strongly. The results indicate the quality of the scales employed.

Var	iable Item	α	F ₁	\mathbf{F}_2	F ₃	F ₄	F ₄	КМО
Con	tinuity (Ping 1993; Biong 1994; Selnes 1998)							
1.	Your relation with the cooperative is a long-term partnership	0.00	0.89					
2.	You wish to continue as a cooperative member	0.82	0.85					
Satis	faction (Kumar et al. 1992; Hansen et al. 2002; Nilsson et al. 2	2009)						0.88
1.	You are very satisfied with your overall relationship with the cooperative	0.00		0.80				
2.	You are very happy with the price paid by the cooperative for the products delivered	0.88		0.89				
3.	The services that the cooperative provide you help you achieve your business goals			0.73				
4.	You are very pleased with the running of the cooperative as a firm			0.80				
Info	rmation (Heide and John 1992; Mohr and Sohi, 1995)							
1.	The cooperative always explains decisions that may affect				0.82			
	its members	0.77			0.82			
2.	You are well informed about the results of the cooperative				0.61			
Con	trol							
1.	You attend all meetings of the General Assembly	0.00					0.74	
2.	You frequently intervene in the General Assembly	0.00					0.88	
3.	Your interventions in the General Assembly are							
	taken into account						0.83	
Trus	st (Ganesan 1994; Kumar et al. 1995)							
1.	When facing adverse situations, members have the							
	help of the cooperative	0.71	1					0.91
2.	When the cooperative makes important decisions,	ive makes important decisions,						
	it takes into account its members' interests							0.67

Table 3. Variable Measures

F1 = Factor loadings for continuity. F2 = Factor loadings for satisfaction. F3 = Factor loadings for information. F4 = Factor loadings for control. F5 = Factor loadings for trust.

Results

(1) CONTINUITY = $a_0 + a_1$ SATISFACTION + e,

where CONTINUITY measures the intention of a member to continue in the cooperative and SATISFACTION measures the satisfaction of a member with the cooperative.

(2) SATISFACTION = $b_0 + b_1$ INFORMATION + b_2 CONTROL + b_3 TRUST + e,

where INFORMATION measures the degree to which the member have information about the cooperative, CONTROL measures the degree to which the member exercises control over the cooperative, and TRUST measures the degree to which the member trusts the cooperative.

In the regression, the score for continuity and satisfaction multi-item scales were computed as the average of the scores of the items used to measure these concepts. The computed factor scores obtained from the factor analysis (to determine the goodness of the measurement scales) were used in the regression analysis to reduce the potential for multicollinearity among the predictor variables (INFORMATION, CONTROL, TRUST).

The results of the regressions are shown in Tables 4 and 5. Hypothesis 1 is supported. This follows from the positive and significant regression coefficient ($\beta = 0.550$, p < 0.001) between continuity as dependent variable and satisfaction as independent variable (Table 4). Therefore, it is confirmed that the more satisfied partners are with their cooperative, the more they want to continue as cooperative members.

Table 4. Ordina	ary Least Squares	regressions or	n the influence o	f satisfaction of	n continuity
		0			2

Variable	Coefficient β	t statistic
Constant	4.193	8.821***
Satisfaction	0.550	9.522***
Adjusted R^2	0.264	
F	90.677***	

Note. *** denotes statistical significance p < 1%.

Hypotheses 2 to 4 are also supported, as shown by the positive and significant signs of the regression coefficients between satisfaction as dependent variable and information ($\beta = 0.329$, p < 0.01), control ($\beta = 0.214$, p < 0.05) and trust ($\beta = 0.202$, p < 0.05) as independent variables (Table 5). Therefore, it is confirmed that the members' satisfaction with their cooperative increases as they have more information about it, control over it, and there is a climate of trust.

Table 5. Ordinary Least Squares regressions on the influence of information, control and trust on satisfaction

Variable	Coefficient β	t statistic
Constant	8.074	81.212***
Information	0.329	3.299***
Control	0.214	2.152**
Trust	0.202	2.024**
Adjusted R ²	0.062	
F	6.536***	

Note. ***, ** and * denote statistical significance p < 1%, 5% and 10%, respectively.

Conclusions and Implications

Cooperative members may play different roles simultaneously. On the one hand they are owners and thus they provide capital. However, depending on the characteristics of the cooperative, they may also be buyers, sellers, controllers and so on. As a consequence the members of a cooperative may have various reasons for belonging to the cooperative, as well as different objectives from each other, and not all of these objectives may be compatible. However, conflicts in the cooperative arise not only from the relationships between cooperative members, but also from the relationships between members and the management. Managers of IOFs usually have great discretion, due to the private information they have. But in a cooperative, due to the conflict of interests among members, their discretion is even greater.

Previous studies on agricultural cooperatives have shown the importance of the participation of members in the life of the cooperative and as well as the importance of members' trust in the managers of the cooperative (James and Sykuta 2005; Barraud-Didier et al. 2012). In addition, information and control are two key factors that may help reducing conflicts in any firm, and thus in a cooperative. This makes agency theory a good framework for the study of the relationships between agricultural cooperatives and their members, and that is the approach employed in this manuscript.

The results show that the members' satisfaction from belonging to a cooperative is an appropriate measure of the success of the member-cooperative relationship, as it supports the desire of members to continue in the cooperative and, thus, the survival of the cooperative. This finding is consistent with previous evidence in both distribution channels (Biong 1993; Ping 1993 and 1994) and agricultural cooperatives (Hernández-Espallardo et al. 2013), that found a positive and significant relationship between satisfaction and the interest in maintaining a relationship.

Furthermore, as suggested by agency theory, it is important that members have mechanisms in order to protect themselves from the opportunist behaviour of management, so that they can reach a higher level of satisfaction with the cooperative. Information, control and trust are shown to be good mechanisms for this purpose. As a consequence of these results, directors of cooperatives should take appropriate decisions to develop these aspects.

In order to satisfy cooperative members, it is important that they have as much as information as possible. In fact, Barraud-Didier et al. (2012) argue that, "If cooperatives communicate more and share information with their members, the latter will be more attached to the cooperative". Sharing information reduces information asymmetry and leads to greater satisfaction of members. Following this argument, it is important to improve all channels of communication with cooperative members to ensure that information flows quickly, especially channels related to information technology and communications, such as the use of web sites. By using these channels conflicts between the management and the members can be reduced.

Most cooperatives are traditionally organized (Nilsson et al. 2012). However, in order to be competitive, cooperatives have been growing in size. This increase in size also leads to obvious challenges. One of them has already been highlighted and it is that it produces greater information asymmetry. In addition, it also makes it more difficult to control managers. In fact Nilsson et al. (2009) and Nilsson et al. (2012) point out that, in general, cooperative members think that cooperatives are too large and complex, and they have difficulty understanding their operation. In addition, they do not believe that the cooperative can be remodeled to strengthen member control. However, some measures could be adopted. For example, in order to exert appropriate control over the management, it is important that the Board and the General Assembly function well. Cooperatives must prioritise the proper operation of the General Assembly, trying to secure high levels of attendance and participation of their members. To help

to reach this goal, it is important to provide members as much as information as possible and meetings should be held at convenient times and in accessible locations, and be managed by a wise and effective chair. In summary, as Russo et al. (2000) highlights, managers' power is inversely correlated to members' participation in the cooperative. Thus, the more active members are in the annual meetings and in the decision making of the cooperative, the less power the managers have, reducing agency conflicts.

The present study also highlights the importance of the trust that the cooperative inspires in its members. Trust is an indicator of social capital: "network resources that are not visible to the eye, but have an economic impact on these enterprises" (Nilsson et al. 2012). Thus, when two persons or groups trust each other it is easy to have more coordination and engage in collaboration. However, trusting is risky. Even when information asymmetry is reduced, if members are dissatisfied and uninvolved, trust could be negatively affected. This situation is difficult to reverse. The impact of opportunism and divergent objectives may be minimized in the presence of trust, as shown in this study by the positive influence of trust on the level of members' satisfaction. This positive relationship between trust and satisfaction is consistent with previous evidence (Anderson and Narus 1990; Andaleeb 1996; Hansen et al. 2002).

In order to build up trust, the cooperative can adopt altruistic or helpful behavior towards members, and show members that it is reliable and competent in its everyday actions, for example, through advice that it gives to members (technical, economic or strategic advice) and capital budgeting or marketing decisions (Barraud-Didier et al. 2012). Testimonials from members about their success within the cooperative and information that highlights the skills, competencies and accomplishments of the cooperative may also help to develop a climate of trust (Hansen et al. 2002). Therefore, it is important that cooperatives have the appropriate human and material resources to provide quality services to their members in order to help them to achieve their goals.

This study is subject to limitations inherent in this type of research. The most important limitation is the fact that the study focuses on a concrete geographical area: the Region of Murcia (Spain). Thus, it would be interesting to make similar analyses in other geographical areas and contexts to examine whether the results can be generalized more widely. However, restricting the study to a very concrete region, as well as to very concrete firms (fresh fruit and vegetable marketing cooperatives) has some advantages as it makes it possible to isolate the phenomena of interest for close examination in a way that would not be possible where there are other influences in more heterogeneous contexts.

Acknowledgements

We acknowledge financial support from Fundación CajaMurcia, Cátedra Cajamar de Cooperativismo Agroalimentario – Universidad Politécnica de Cartagena, Ministerio de Economía y Competitividadand FEDER (Project AGL2010-22335-C03-03).

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International Food and Agribusiness Management Review Volume 17 Issue 1, 2014

Keeping Your Secrets Public? Open Versus Closed Innovation Processes in the Hungarian Wine Sector

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Abstract

An effective innovation system is crucial for food companies to cope with competitive pressure. An important issue is whether to innovate by cooperating and sharing ideas or to innovate inhouse. Thus the question is how to arrange external ties without compromising unique knowledge and assets. This is particularly controversial in the wine sector, where innovative marketing strategies have to be combined with "exclusive" and "secret" recipes. We use primary data on the Hungarian wine industry to study factors affecting the adoption of an open innovation approach. We find that both regional and company-specific factors affect the openness of innovation processes.

Keywords: open innovation, dynamic capabilities, Hungary, wine

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Introduction

Assuring safe, affordable and healthy food under conditions of a rapidly growing global population, shifting dietary patterns, increased competition for land use and environmental concerns is one of the major challenge of the EU agri-food sector (Baregheh et al. 2012a). The European Union tackles these challenges by investing in research and innovation and by facilitating the integration of scientific knowledge and innovation into food chain operations. Research and Development (R&D) are among the main engines of innovation, productivity growth and structural change and hence are essential to guarantee continued competitiveness of the food industry (Boehlje et al. 2011; Capitanio et al. 2009; Capitanio et al. 2010; Garcia Martinez 2013). Nevertheless, compared to other leading industry branches, the agro-food processing industry is generally not considered as being very innovative (Pascucci et al. 2012; Bareghehet al. 2012b).

Recent surveys show that the European food industry is targeting 50% less of its investment in R&D than the non-food industry (European Commission 2009). Furthermore, the return on investment and margins of profit are generally low and can contribute to a lack of incentives to commit to R&D projects. Barriers to R&D initiatives include the costliness and inappropriateness of patenting in the case of food products or new food processing techniques. Moreover, the European agro-food industry is dominated by small and medium enterprises (SMEs) that often lack resources and qualified personnel to invest in research and innovation (European Commission 2009).

In this context a more open and collaborative interaction among food companies could be used to overcome those barriers and lead to higher rate of innovation. In fact, an open innovation approach emphasizes the use of inflows and outflows of knowledge to speed up the internal innovation process of a company, eventually enabling this company to expand its markets (Chesbrough 2006). Therefore, increasing innovation through collaborative and open innovation networks in the agri-food sector is becoming a major focus in the EU policy framework in recent years. Particularly sustaining cooperation among SMEs, and creating a favorable climate for sharing knowledge and developing capabilities is one of the main targets at EU level (Bareghehet al. 2012b; Garcia Martinez 2013).

How to best implement cooperation among companies for sharing knowledge, developing capabilities and fostering open innovation are generally well-accepted concepts but are still highly debated in the agri-food industry (Dries et al. 2013). SMEs operating in this industry have a core business that is often related to production and marketing of traditional food products which rely on locally and family grounded recipes and procedures. Therefore, for many food SMEs cooperation and open innovation create risks for appropriability of valuable resources for the companies even though cooperation and open innovation can be seen as an approach for overcoming organizational and financial limitations. Moreover, whether cooperation is established in the idea creation or in the commercialization phase of the innovation process may lead to entirely different issues in terms of appropriability risks.

This paper contributes to the existing literature by addressing the issue of open innovation in the different phases of the innovation process in SMEs operating in the agri-food sector. The issue is

particularly controversial in the wine sector, where innovative marketing strategies have to be combined with sometimes "exclusive" and "secret" recipes, which make the quality of the products unique. The Hungarian wine industry presents an interesting case for research on the issue of open innovation. Wine contributes significantly to the total turnover in the Hungarian agri-food agri-food industry. Wine typically offers opportunities for strong value creation and can be marketed as a premium processed agri-food product. However, in recent years the Hungarian wine industry has been left behind in worldwide trends on premium and super-premium wine markets (Wittwer 2007). The uniqueness of the empirical investigation is twofold: (i) our survey is one of the first particularly designed to investigate innovation and competitiveness of the Hungarian agri-food sector; (ii) the survey is one of the first particularly designed to investigate innovation and competitiveness of the Hungarian agri-food sector; (ii) the survey is one of the few in Hungary specifically focusing on open innovation issues in the agri-food sector. The research has been motivated by an increasing interest of Hungarian authorities for the wine sector due to its economic potentials. In many developing countries, especially in the so-called "New World of Wine countries" like Chile and South Africa, the wine sector has proved to be able to generate sustained economic wealth during the last 20 years (Anderson 2004).

Besides this increased interest, still one of the most critical questions to be answered by wine companies is how to arrange external ties (i.e. networks of collaboration) with other companies and research organizations - potentially leading to a successful innovation system - without compromising unique and highly specific assets. Therefore, understanding the main factors that lead wine companies to adopt an open, rather than a closed, innovation system is the main research question of this paper. We aim at "unbundling" the open innovation process and analyse whether the degree of openness of wine companies varies in the different stages of innovation and whether patterns of openness and common factors that can predict these patterns exist. More specifically, we analyze the relationship between dynamic capabilities, namely the adaptive and absorptive capabilities¹ of the firm, and open innovation in three important stages of the innovation process: idea creation, development and commercialization. We also control for company characteristics.

The literature on open innovation predicts a low degree of openness in low-tech companies (Dahlander and Gann 2010), including SMEs operating in the agri-food sector (Sarkar and Costa 2008). However, we find that open innovation is quite extensive in the Hungarian wine industry: 25-30% of companies generate, develop and commercialize the majority of new ideas in cooperation with other partners. As a second result, we find that the degree of openness decreases as a company moves through the consecutive stages of innovation. In other words, Hungarian wine companies are significantly more likely to use outside ideas in the idea generation and development stages than in the commercialization stage. This contradicts findings in the literature (Lee et al. 2010). However, conclusions from this earlier research focused on the importance of outbound activities in the later innovation stages, while our data only allow us to

¹ In the context of this paper *dynamic capabilities* are defined as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece at al. 1997, 516). *Absorptive capacity* is defined as the ability [of the company] for sense-making of external developments depending on the existing set of [internal] competences (Cohen and Levinthal 1990). Organizations have *adaptive capacity* "when learning takes place at a rate faster than the rate of change in the conditions that require dismantling old routines and creating new ones" (Staber and Sydow 2002, 410-411; Verona and Ravasi 2003).

look at the inbound open innovation processes (i.e. the 'buy' decision with respect to knowledge and technology transfer). This may explain our outcomes.

In our econometric approach we use a multivariate probit model to determine the factors that drive the degree of openness at different innovation stages. As dependent variable we use an indicator of the presence of openness at the three main stages in the innovation process, more specifically presence of idea generation, idea development and idea commercialization realized with outsiders (i.e. suppliers, buyers, etc.). The independent variables are derived from the literature and include indicators of (1) companies' dynamic capabilities, such as absorptive and adaptive capabilities, which are hypothesized to be a precondition to benefit from open innovation; (2) control variables such as companies' age, size and legal form.

Results show that there is a high, positive correlation between the degree of openness in different stages of the innovation process. This result leads us to conclude that companies are inclined to be open (or closed) throughout the whole innovation process. Drivers that stimulate openness in idea creation in a company may therefore also contribute to a positive attitude towards openness in idea development and commercialization and vice versa. Furthermore, the estimation provides evidence that larger wine companies have more open innovation processes. Other significant results are the positive impact of access to specialized regional suppliers and the negative impact of a company's age. The former seems to indicate that supplier-buyer relationships are crucial in stimulating knowledge and technology transfer. The latter shows that older wine companies rely more on in-house innovation processes.

The remainder of this article will focus on the role of external partners in stimulating innovations in the EU food sector. After introducing the concept of open innovation, in general and in food SMEs more specifically, we use a case-study of the Hungarian wine sector to explore the concept in more depth. In the last section policy and the managerial implications are thoroughly discussed.

Literature Review

The Open Innovation Paradigm

Adopting an open innovation process is the new mantra of the agri-food sector. To illustrate, Heinz, one of the largest multinational corporations (MNC) operating in the sector, recently refocused its R&D and innovation strategy on an open innovation platform, including all relevant phases of food production, thus from agriculture to health science². This has led the company to introduce "consumer-inspired" innovations such as sugar-free ketchup and salt-free soups. Unilever, another agri-food giant, re-shaped its Corporate Social Responsibility policy (Unilever Sustainable Living Plan) with a renewed innovation platform fully re-focused on an open innovation approach³. Unilever operates by continuously interacting with established as well potential stakeholders by posting a "wish list" of main challenges and calling for technical

² <u>http://www.heinz.com/our-food/innovation/research-development.aspx</u> [accessed November 27, 2013]

³ <u>http://www.unilever.com/innovation/collaborating-with-unilever/open-innovation/</u> [accessed November 13, 2013]

solutions for outsiders. This approach is extended to non-technical issues related to marketing, packaging and product development, including ideas form consumers. Another example is provided by Barilla group, one of the largest pasta-makers in Europe, which funded a branch-company, Academia Barilla, as an open (web-based) platform to collect traditional recipes from the Italian cuisine and to use them to produce world-class food products⁴. SMEs are also increasingly joining the club of open-innovators, especially through industrial and knowledge-based clusters⁵.

This trend can be seen as a reaction of food companies to their exposure to severe (and increasing) competitive pressures worldwide (Boehlje et al. 2011). Adopting an effective innovation process to successfully introduce and develop new products to the market has become one of the most important strategies for food companies (Garcia Martinez 2013; Karantininis et al. 2010). However, whether it is more effective to speed up the innovation process by sharing ideas and resources with other companies or to innovate in-house in a more closed system is still under debate in the academic domain (Sarkar and Costa 2008).

Chesbrough (2003) has been the first to introduce the concept of 'open innovation'. The idea of open innovation indicates that a company is increasingly using inflows and outflows of knowledge to speed up the internal innovation process, and expand the markets for external use of innovation (Chesbrough 2006; Gassmann et al. 2010). From a theoretical perspective, the open innovation literature has focused on different topics such as (i) the degree and type of openness (i.e. outbound or inbound), (ii) effectiveness, (iii) context and (iv) process (Huizingh 2011). In this respect a gap in the literature is an understanding of open innovation in the different stages of the innovation process, from the idea generation to the commercialization phase.

Moreover, if we look at the empirical studies on open innovation, most of them draw on evidence from high-tech industries such as equipment, computers, Information Communication Technology (ICT) or pharmaceuticals (e.g. Christensen et al. 2005; Dittrich and Duysters 2007; Fetterhoff and Voelkel 2006) and have a prevalent focus on large companies and multinational corporations (Chesbrough 2003; Chesbrough 2006). Empirical investigations on open innovation in SMEs operating in the agri-food sector are relatively scarce in literature (Dries et al. 2013; Enzing et al. 2011; Garcia Martinez 2013; Huston and Sakkab 2006; Sarkar and Costa 2008; Vanhaverbeke and Cloodt 2006). Archibugi et al. (1991) indicate that a more open system of innovation is particularly interesting for food companies, which normally rely even more on external resources than other industries (see also Enzing et al. 2011). Moreover, some specific features of the innovation pattern in food companies make that looking at only internal, closed innovation processes (i.e. the effort in R&D) is a misleading indicator of food companies' innovation capacity (Avermaete et al. 2004; Capitanio et al. 2010; Galizzi and Venturini 2008). On the other hand, a strong R&D department and access to well-trained and expert human resources is a necessary condition to adopt a more open innovation system (Wang and Ahmed 2007).

⁴ <u>http://www.academiabarilla.it/italian-food-academy/sede/default.aspx</u> [accessed November 11, 2013]

⁵ An example is FoodValley operating in the Netherlands (<u>http://www.youtube.com/watch?v=hEg0a2xCePo</u>)

Defining Open Innovation in the Agri-food Sector

What makes food companies substantially different from other manufacturing companies is their higher dependency on natural resources - not limited to e.g. fossil fuels - and their need for specific (often tacit and local) know-how in their production processes. Transforming an often heterogeneous and discontinuous flow of raw materials into standardized and marketable products is at the core of a food business. Therefore, more than being involved in groundbreaking and radically innovative projects, food companies (including multinational corporations) are more likely to be active in a very targeted process of stakeholder and technology adaptation (Enzing et al. 2011; Rama 2008). As a result, when scholars look at R&D activities in the agri-food sector they are often inclined to see food companies as conservative, slow-growing and mature businesses, where innovative activities are less likely to occur (Capitanio et al. 2010; Sakar and Costa 2008). On top of that it is rather difficult to assess the degree of openness of the innovation system adopted by a food company. To illustrate, if a winemaker is producing a world-class wine using and adapting a "local recipe" (which is often the case), this is not regarded as an open innovation approach, though it is fitting in the concept of "increasingly using inflows and outflows of knowledge to accelerate the internal innovation process, and expand the markets for external use of innovation" (Chesbrough 2006).

A review of the literature on open innovation in the agri-food sector performed by Sarkar and Costa (2008) clearly indicates two main shortcomings in this domain: on the one hand, little empirical evidence is available to thoroughly assess whether food companies are approaching open innovation in a different way than other manufacturing companies; on the other hand, most of the contributions in the literature use proxies to measure the presence and degree of open innovation, for example through the presence and number of external ties (see also Enzing et al. 2011). The literature also indicates potential differences of open innovation features in the different stages of innovation (i.e. idea generation, development and commercialization) (Sarkar and Costa 2008). The question is how to measure and assess open innovation in food companies.

Van de Vrande et al. (2009) measure open innovation by identifying technology exploration and exploitation practices. As pointed out by Huizingh (2011) using external ties as a proxy of openness is potentially misleading because it only captures one of the components of the concept, such as the inbound/outbound dynamics. Thus being engaged in a partnership with someone (i.e. a research organization) does not necessarily mean that you are internally making use of your partner's knowledge (*inbound innovation*), nor that you are using internal knowledge to exploit resources provided by your partner (*outbound innovation*). In effect it merely highlights the underpinning mechanisms and trends leading to an open innovation process (Gassman et al. 2010; Huizingh 2011). Parida et al. (2012) point out that inbound open innovation refers more to exploring and integrating external knowledge to develop and exploit technology. Outbound open innovation is the practice of exploiting technological capabilities, combining internal with also external paths of commercialization (Chesbrough 2003; Chesbrough and Crowther 2006).

In line with this literature review, we conceptualize open innovation as "the proportion of innovations generated in co-operation/collaboration with universities, research organizations, regional customers and/or suppliers, other agri-food companies, venture capitalists and

industry/cluster associations or business assistance centers (open innovation) as opposed to innovations entirely generated within the company (closed innovation)". We apply this definition to the different stages of innovation, namely the *idea generation* phase (discovering market opportunities or problems to be solved, envisioning areas for technical breakthrough, developing initial insights, basic and applied research), *idea development* phase (developing a deeper conception of products or services, building a model of a product or service, product or process testing) and *commercialization* phase (production, promotion, distribution, and sales of a product/service/technique). In line with Parida et al. (2012) this conceptualization emphasizes more an inbound than an outbound open innovation process. This is particularly relevant in the agri-food sector since inbound open innovation is prevailing in low-tech industries (Chesbrough and Crowther 2006). In low-tech industries, in fact, the exploration and exploitation of external knowledge is more likely to occur through networks of collaboration than through new ventures, spin-offs, or licensing-out (Parida et al. 2012). However, what is more difficult to understand is whether significant differences occur in the different stages of the open innovation process in low-tech industries. Lee et al. (2010) argue that high-tech companies can be more prone to use an open innovation process in the commercialization phase. While high-tech companies show superior capabilities in the phases of creation and development of new technologies, they might suffer from a lack of marketing capabilities when it comes to the phase of commercialization (Lee et al. 2010). Enzing et al. (2011) show that agri-food companies need to implement open innovation processes from idea creation to commercialization. In fact, while they are more likely to engage in large networks of collaboration with upstream partners to use and adapt technologies to innovate their processes (Capitanio et al. 2010), they engage with downstream partners (i.e. retailers) to overcome challenges in introducing new products to the market (Enzing et al. 2011). Based on this literature we formulate the following hypothesis:

Hypothesis 1: The degree of openness in the innovation process does not differ between the three different stages of the innovation process.

The Role of Company Dynamic Capabilities

Factors that contribute to a company's openness, such as dynamic capabilities, must be seen as the main explanatory variables when analyzing open innovation (Dahlander and Gann 2010, Huizingh 2011). As mentioned earlier, the role of openness and connected capabilities is even more important in agri-food companies because they have even more intense interactions with both upstream and downstream partners than other types of companies (Enzing et al. 2011). Agri-food companies may develop some specific capabilities due to the peculiarities characterizing their innovation pattern. On the one hand, agri-food companies are mainly "market-pulled" businesses, therefore involved in incremental rather than radical food product innovations (Elzing et al. 2011; Galizzi and Venturini 2008; Grunert et al. 1997). In this respect, they benefit the most from the interaction with downstream partners, such as retailers and distributors, in order to make the introduction onto the market of new products successful. On the other hand, agri-food companies are "technology-pushed" (Capitanio et al. 2010). Therefore, they are mainly process-innovation oriented through adaptation of equipment and the use of new technologies developed by upstream (high-tech) industries to create new food products (Archibugi et al. 1991; Capitanio et al. 2010; Garcia Martinez and Burns 1999). In line with these statements, we use dynamic capabilities to explain differences in degree and patterns of open innovation in agri-food companies. Teece et al. (1997) extensively discusses the relationship between dynamic capabilities and innovation-based competition in different industries. In this framework dynamic capabilities are seen as a subset of competences and resources which allow the firm to create new products and processes, and respond to market changes (Teece at al. 1997). Wang and Ahmed (2007) highlight the presence of two main types of dynamic capabilities, namely the *absorptive capabilities*, as a way in which companies create and absorb, integrate and re-configure external knowledge from other organizations (Cohen and Levinthal 1990); and *adaptive capabilities*, as a way in which companies are able to explore and exploit external opportunities in the market (or the geographical context) (Staber and Sydow 2002). Based on these concepts we develop the following research hypotheses:

Hypothesis 2: Open innovation in the idea creation and development phase is more likely to occur in the presence of dynamic capabilities developed with upstream partners

Hypothesis 3: Open innovation in the commercialization phase is more likely to occur in the presence of dynamic capabilities developed with downstream partners

Data and Empirical Strategy

Study Area and Data Gathering

Wine production in Hungary has a long history which dates back to the Ancient Greeks.⁶ In the Middle Ages the region that corresponds to Hungary had been recognized as an area of special wine-making interest and Tokaji, the most internationally-known Hungarian wine, was first mentioned as early as the 15th Century. During the "Communist era" wine production was oriented towards high yields and reliability, while quality and diversity were sacrificed in order to achieve more homogenized wines (including Tokaji). Moreover the overall production was under public control, including vineyards ownership. Today Hungary is particularly known for producing fiery white wines, as well as their sweeter counterparts. The Hungarian wine sector has experienced important structural changes in the last two decades, due to major changes in the institutional and economic domain. Particularly the sector has moved from more centralized and state-owned companies, to highly fragmented small farm businesses⁷ (Sidlovits and Kator 2007). Since the fall of Communism wine-makers are recovering traditional recipes and are experimenting with new techniques that existed before collectivization. The Hungarian Wine Society describes the sector as characterized by "a time of innovation, rivalries and rediscovery attempts to define the Hungarian version of "international" grape varieties, and to recreate and rehabilitate their indigenous grapes". Vineyards are experimenting with new blends, new grape varieties in unfamiliar regions, and rediscovering lost varietals. A small number of large wine farms have received interest from Foreign Direct Investment but the majority of the sector is still constituted by domestically owned, micro and small businesses. To illustrate, before transition about 30 large state societies and 50 cooperatives controlled the Hungarian wine production. By

⁶ See <u>http://www.hungarianwinesociety.co.uk/about-hungarian-wines/ for further information.</u>

⁷ Average size of vine-growing exploitations is 0.3 ha

the late 2000s about 13,000 enterprises and 29 cooperatives were involved with wine-making activities (i.e. processing and marketing) (Sidlovits and Kator 2007).

The survey was carried out in 2006 in the 22 Hungarian wine regions (Török and Tóth 2013). Altogether 119 questionnaires were sent to managers of wine-making companies and 115 questionnaires⁸ were completed, representing an average of five questionnaires for each wine region. During the examined time period (2004-2006), the EU faced aggressive market penetration of new wine producing countries (Australia, Chile and South Africa) and implemented new wine reforms. The new EU framework is more market oriented and competitive, therefore for the Hungarian wine sector – with almost only SME companies – fostering, adapting and spreading innovation is more crucial than ever.

Table 1 reports the main variables. Panel A describes the open innovation variables. We identify open innovation in the Hungarian wine companies when at least 25% of the new ideas have been created / developed / commercialized together with partners outside the boundaries of the firm. Therefore the dependent variable assumes value 1 (presence of open innovation) when managers indicated that more than 25% of the new ideas have been created, developed and/or commercialized with outsiders⁹. All three measures are based on self-assessment of top-managers.

Panel B refers to variables related to dynamic capabilities. We proxy absorptive capacities through the presence of highly-educated workers¹⁰, the percentage of workers who are able to use English for business relations and the percentage of workers that have a familiarity with ICT. Furthermore, we include variables that are based on the assessment of top-managers about the firm's dependence on specific knowledge and the level of know-how specificity that is present in the company.

To proxy adaptive capabilities we use the intensity of information exchanges the company has with both upstream (suppliers) and downstream parties (buyers) and the reciprocity in sharing know-how with competitors. In the context of this research upstream parties include raw material suppliers (i.e. grapes) as well as service and technology suppliers.

As controls we use firm size, age and legal status (whether a wine company is a private partnership instead of a cooperative or other legal forms).

⁸ 119 questionnaires were filled in by the associates of the Council, which means an average of 5 per wine region. The wineries were questioned about their knowledge and information acquisition-, development- and marketing practice and opinion. A 7 point Lickert-scale evaluation scheme has been used.

⁹ The survey included a specific question on openness of idea generation, development and commercialization by means of 4 categories and namely ranging from 0% to 25%, 25% to 50%, 50% to 75% and from 75% to 100%. Therefore we interpreted as "non-open" all companies falling within the first quartile, while considering the companies as "open" otherwise. This is in line with previous empirical evidence on rate of openness in food companies (see Enzing et al. 2011, Garcia Martinez 2013).

¹⁰ Defined as dummy variable that is 1 if at least one employee has finished higher or university education and zero otherwise.

Table 1. Descriptive Statistics

Variables			Obs.	Mean	S.D.	Min.	Max
Panel A: Ope	en innovation variables						
Presence of or generation ph with outside	open innovation at idea nase (>25% ideas created rs)	OIgeneration	115	0.635	-	0	1
Presence of o development developed wi	open innovation at idea phase (>25% ideas ith outsiders)	OIdevelopmt	115	0.548	-	0	1
Presence of c commercializ coming from	open innovation at zation phase (>25% ideas outside)	OIcommerce	115	0.426	-	0	1
Panel B: Dyr	namic capabilities variables						
	Presence of high-skilled workers	educ_skill	92	0.304	0.280	0	1
	Percentage of English- speaking workers	eng_skill	115	20.643	25.380	0	100
Absorptive capabilities	Percentage of workers familiar with ICT	ICT_skill	115	44.757	37.235	0	100
	The firm is dependent on specific knowledge	spec_know_depend	114	5.518	1.465	1	7
	The firm owns specific know-how	own_spec_know	114	5.105	1.319	2	7
	The firm has intensive info exchanges with buyers	buy_info	114	5.193	1.211	1	7
Adaptive capabilities	The firm has intensive info exchanges with suppliers	supl_info	114	4.307	1.446	1	7
	Reciprocity in sharing know-how with competitors	rec_info	114	3.500	1.581	1	7
Panel C: Control variables							
	Number of workers	size	115	11.296	19.916	0	130
	Age of the firm	age	105	11.095	6.631	1	47
	Legal status (1 if private partnership)	legalform	115	0.574	0.497	0	1

We now describe our empirical strategy. We consider correlations between the measures of open innovation and dynamic capabilities of agri-food companies:

(1)
$$O_j = \alpha + \beta_1 D_j + \beta_2 C_j + \varepsilon_j$$
,

where O_j refers to our open innovation variables, such as the proportion of ideas entirely generated, developed or commercialized in collaboration with other partners of company j, with j=1,....92. D_j refers to a vector of company dynamic capabilities, and C_j refers to a vector of company control variables.

We use a multivariate probit model to determine the factors that drive the degree of openness at different innovation stages. The multivariate probit allows the binary dependent variables to be correlated. Since the cross-sectional nature of our data does not allow us to completely avoid issues of endogeneity, reverse causality and omitted variables problems, the results of the econometric estimations should be interpreted as correlations and not as causal relationships.

Results

As a first result we can see from table 1 that the degree of openness decreases as we move through the different stages of the innovation process. While open innovation occurs in 63% of the surveyed companies in the idea generation phase, this share has decreased to 55% and 43% in the development and commercialization phase respectively.

To test hypothesis 1 we perform pearson's chi-squared test to determine independence of the variables OIgeneration, OIdevelopment and OIcommerce. The test strongly rejects independence and hence confirms that the degree of openness is strongly correlated in the three different stages of the innovation process in Hungarian wine companies. In other words, we fail to reject hypothesis 1. Moreover, the positive correlation between the degree of openness in different stages of the innovation process also justifies the use of the multivariate probit model. We can conclude that companies are inclined to be open throughout the whole innovation process. Drivers that stimulate openness in idea creation in a company may therefore also contribute to a positive attitude towards openness in idea development and commercialization and vice versa.

In Table 2 we present our results on correlations between open innovation variables and dynamic capabilities in Hungarian wine companies. As a first general observation we point out that only a limited number of coefficients are significantly different from zero. A reason for this may be the small sample size – only 92 observations were retained in the regression model – combined with an extensive list of explanatory variables. Results should therefore be interpreted with caution.

The results in Table 2 are in line with hypothesis 2: open innovation in the idea generation phase is more likely to occur in the presence of intensive information exchanges with suppliers (upstream partners). Furthermore, we find evidence in line with hypothesis 3, namely that open innovation in the commercialization phase is stimulated by information flows between the wine companies and downstream buyers (i.e. retailers). This points to the relevance of other value chain actors in the innovation process in the wine industry but with an important distinction between the players that affect the first stages of the innovation process (idea generation) as compared to the later stages (commercialization).

	OI	gener	ation	OIdevelopment		OIco	mmerce
Variable	Coef.		Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Presence of high- skilled workers	0.1596		0.6401	0.0430	0.5624	0.7054	0.60613
Percentage of English- speaking workers	0.0189	*	0.0099	0.0029	0.0071	0.0068	0.00802
Percentage of workers familiar with ICT	0.0015		0.0065	0.0040	0.0052	-0.0059	0.00525
The firm is dependent on specific knowledge	-0.1465		0.1301	- 0.1208	0.1104	-0.0673	0.10143
The firm owns specific know-how	-0.2466	*	0.1432	- 0.0224	0.1245	-0.1256	0.12784
The firm has intense info exchanges with buyers	0.0322		0.1506	- 0.0536	0.1279	0.2499 4	* 0.14356
The firm has intense info exchanges with suppliers	0.3106	**	0.1231	0.0868	0.1055	0.1055 5	0.11103
Reciprocity in sharing know-how with competitors	-0.1224		0.1429	- 0.1077	0.1141	-0.1741 *	[*] 0.10474
Size	0.0184		0.0151	0.0211	* 0.0124	0.0103	0.008
Age	-0.0494	*	0.0287	- 0.0181	0.0236	-0.0519 *	** 0.02536
Legal form	-0.2764		0.3579	- 0.5377	* 0.3030	-0.4972	0.31389
Constant	1.3445		1.0627	1.0813	0.8964	0.205	0.94027
Corr_gener_dev	0.83902	** *	0.08653				
Corr_com_gener	0.66411	** *	0.12792				
Corr_dev_com	0.84704	** *	0.07919				

Table 2. Multivariate Probit Results

N. sample = 92 valid observations

* significant at 10% level, ** significant at 5% level, *** significant at 1% level

Other dynamic capabilities that play a role in explaining the degree of openness include the skill level of the labor force and the degree of in-house specific knowledge. In line with the literature, companies that adopt an open innovation process have access to a well-educated workforce. Furthermore, access to own specific know-how in the company is negatively correlated with the openness of the innovation process in the idea generation phase. This may point to a trade-off

between openness and own innovation capacity. As expected, reciprocity in information exchange with competitors is negatively correlated with open innovation in the commercialization phase.

Finally, the control variables show a significant effect of firm size (positive), firm age (negative) and legal form. The former indicate that larger and younger firms are more likely to have an open innovation process. Companies established as private partnerships, on the other hand, are less likely to engage in open innovation.

Discussion and Conclusions

Food companies, policy-makers and practitioners are increasingly looking at open innovation as a promising approach to support the competitiveness of the agri-food sector. However the transition to an open innovation system is not straightforward and requires specific resources and capabilities, as well as a supportive institutional environment. The current study shows that agrifood SMEs in the Hungarian wine industry are actively using "open sources" in their innovation processes, even more than commonly acknowledged in the literature and the policy debate. For example, even in a relatively closed sector, such as the wine sector in Hungary, the degree of openness of companies in all the different stages of the innovation process has been surprisingly high. Looking at the determinants of the openness of the innovation process, we find that the phases of "idea generation" and "commercialization" are more influenced by specific company's capabilities than the development phase. Openness in the idea generating phase occurs more in companies that have higher shares of English-speaking employees and that have more intense relationships with suppliers. This may point to the importance of the flows of new ideas that come from global trends and from dealing with foreign companies and stakeholders. This result gives support to internationalization strategies at both company and sector level. Furthermore, interactions with suppliers seem important at the idea generation stage. In agribusiness, suppliers form a key component to assure quality and effective sourcing for agri-food companies that want to develop new products and services. This finding supports managerial and policy strategies oriented towards the creation of business parks and rural clusters, where farmers, processors and tech-companies can establish joint ventures and networks to create new products and/or processing technologies. Commercializing new ideas is also affected by the companies' capabilities, specifically when it comes to the creation of productive interactions with buyers.

Unfortunately, our approach was also affected by some limitations. The dataset didn't allow us to incorporate differences in regional conditions that can support or constrain the opportunities that companies have to participate in open innovation networks. This is a component of great relevance for shaping policy interventions at national and regional level. Moreover, we know that innovative interactions are deeply affected by proximity and cooperation. This is indeed a challenging issue since it creates the need for change not only in business practices and strategies, but also in the type of policy support provided to agri-food stakeholders and namely a shift from company-based to network/cluster based types of policy support.

Acknowledgements

Data were collected as part of the OTKA K 84327 research project with the assistance of the National Council of Wine Regions, and the analysis was undertaken as part of COMPETE, a research project supported by the EU's Seventh Framework Programme (Contract No 312029).

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International Food and Agribusiness Management Review Volume 17 Issue 1, 2014

The Starting Block: A Case Study of an Incubator Kitchen

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Abstract

This case explores strategic challenges facing the director of a non-profit incubator kitchen as he works to improve the facility's long-term viability. Incubator kitchens are business incubators that serve food business start-ups by providing licensed kitchens. The case follows the director from the incubator's formation through establishment and expansion, exploring tensions in this transition. Case objectives are for students to 1) debate definitions of success and value in entrepreneurial businesses, 2) evaluate the incubator's history and performance, 3) address its challenges, and 4) develop a sustainable business strategy for a business incubator. Intended audiences are advanced undergraduate and graduate courses and extension specialists.

Keywords: business incubator, incubator kitchen, entrepreneurship, networking, SME food business

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IFAMA Agribusiness Case 17.1 A

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Introduction

Ron Steiner eagerly leads visitors on an impromptu tour of the Starting Block, the incubator kitchen that he founded in rural Michigan. There is the smell of fresh baked goods, the sparkling production area and a display of products made by clients. He never tires of expounding his entrepreneurial philosophy, and he never stops grinning. He pauses at a poster of Yoda, the wise Jedi hero of the "Star Wars" movies, and recites:

"Do or do not... There is no 'try."

A prospective client walks in, someone with a salsa he'd like to start selling. Or cookies, or a pâté. Steiner rushes to greet him. The excitement of these encounters makes Steiner's day. But recently he has been wondering what comes next for the Starting Block. How can he balance opportunity, passion, and skill to improve the facility's long-term sustainability? This case examines the Starting Block's inception, growth, and current situation. It considers the Starting Block's geographic location and the economic situation to which it has responded; the skills of Steiner and his staff and the strategies they employ; the facility's operations and the services that it offers; the culture that has been created; and challenges that the Starting Block faces.

The Starting Block

The Starting Block is an incubator kitchen in Hart, population 1,900, in the rolling orcharddotted countryside of the state of Michigan located in the north central US. An incubator kitchen is a business incubator that includes a licensed commercial kitchen facility rented to clients to develop food businesses, an arrangement that saves clients the cost of building their own kitchens. The Starting Block opened in 2006 and is incorporated as a non-profit organization, employing three part-time staff people. The facility measures 10,900 square feet. Approximately half contains rented office space and meeting rooms. The other half includes a shared-use commercial kitchen of approximately 2,500 square feet, a catering kitchen of approximately 600 square feet, and warehouse and storage space. The facility serves approximately 30 clients who produce a range of products including jams, granola, cookies, spice mixes, and chutneys. Client businesses are private enterprises operated independently of the Starting Block. Staff provides entrepreneurial education.

When the facility opened, no other kitchen incubators existed on the western side of Michigan. The area is a major growing region for a large variety of temperate-climate fruits and vegetables. A long history of specialty food processing existed in the area, but recent entrepreneurial activity had been limited by the absence of access to a licensed commercial kitchen facility. Exhibit 1 (see Appendix) provides background on the Starting Block's service area.

Beginnings

When Steiner retired as custom computer and electronic component marketing entrepreneur and moved from California to Michigan, he found a region rich in entrepreneurial opportunities. The state's economy had been in decline for years, and even its diverse and vibrant agricultural areas

were affected. Restless in retirement, he turned to economic development and was hired as Director of the local Oceana County Economic Development Corporation in 1998. His initial impulse was to respond to the area's economic needs with high-tech businesses. "I was disabused of that very early on," he recalls, and tells of his first meeting with one of the region's large food processors. "I said that I'm hoping that I can have some of my Silicon Valley contacts visit Oceana County and maybe put a microprocessor plant here or something. And he said, 'That's interesting. Well, you are new here.' We go and look out his office window, and he says, 'What do you see there?' Beautiful orchards. To me when I first moved here it looked like the Sonoma Valley. It's beautiful."

The processor continued, "We grow and process food out here. That's our economic engine."

Forming the Organization

Steiner defines an entrepreneur as someone who can spot unmet needs in society, who is "alert enough and is listening and looking around—always thinking of what better way there might be of doing something." He turned his attention to possibilities for innovation in food and agriculture, taking a second job with Michigan State University Extension (MSUE) and joining statewide efforts to respond to challenges in the agricultural sector. Michigan Food and Farming Systems (MIFFS), a non-profit organization, had formed in 1998 to develop partnerships to foster more sustainable food and farming for Michigan. With Dr. Chris Peterson of the Michigan State University (MSU) Department of Agricultural Economics, MIFFS co-founded the Michigan Partnership for Product Agriculture (MPPA) in 2001. MPPA was a broad-based group that aimed to give agriculture a more prominent role in statewide economic development and to create a network of resources for entrepreneurs. Along with Peterson and MIFFS, MPPA members also included US Department of Agriculture (USDA), Michigan Department of Agriculture (MDA), and Michigan Farm Bureau personnel and high-level MSU officials.

The notion of "value-added" agriculture (not just growing things but creating higher value goods through specialty processing) had attracted substantial attention in Michigan over recent years, and the group considered incubator kitchens as one means of pursuing value-added possibilities. Incubator kitchens had been established in rural areas of a number of other states. Fortuitously, the USDA representative to the MPPA suggested that the USDA Rural Development's Rural Business Enterprise Grants might be a source of start-up funding. MIFFS applied and received two identical grants in 2004, each for \$283,700, to develop two incubator kitchens in Michigan's more distressed agricultural areas. Steiner—by that time serving on the MIFFS Council—offered to move the project forward in western Michigan, one of the areas.

"By then I was captured by the idea," he says. "I said, I can do it, and I think I know how." Both he and Elaine Brown, MIFFS Executive Director, agreed that the actual management of an incubator kitchen was outside of MIFFS' programmatic focus. The MIFFS Council gave Steiner a high degree of autonomy in locating a facility, selecting equipment, and securing additional financing. "I had formed two companies before," he explains. "That's the easy part. The next stop after the MIFFS meeting was down to the Treasury Department in Lansing. I already had a name in mind, and incorporated the Starting Block. It cost me \$20." He and Brown emphasized the importance of trust and flexibility in these early stages of the project. Brown described their relationship: "He had been on the MIFFS Council, he'd been a MIFFS member, and we knew his capabilities. He came from a business background. Getting to know him, he's got these big ideas, and he's done these very creative things. So my role was to make sure those creative things were consistent with the requirements of the grant. We wanted someone to take the incubator kitchen and make it successful, and we couldn't do it from afar."

Collaboration is an important part of Steiner's business philosophy, "the willingness to partner with people and not thinking you can do it all by yourself." Thus, as he moved forward in establishing the Starting Block—recruiting its board of directors, securing financing, hiring staff, and developing the facility—he formed and leaned heavily on a network of old and new contacts both inside and outside of the area. The USDA grant's language called for an incubator kitchen with a regional focus, and Steiner was determined to cultivate a collective buy-in to the project among community leaders in surrounding western Michigan counties. The board thus includes members representing each of the six counties in the region¹ and a range of professional affiliations: a community college president, to represent the incubator's educational objectives; a farm cooperative director; an African-American active in urban areas that suffer from a lack of supermarkets and other fresh food sources; local government officials; a certified public accountant; and a grower association director.

The USDA grant did not provide all of the initial funding needed, and it did not cover operating expenses. With a broadly representative board in place, Steiner next approached each of the county commissions in the region for start-up funding, asking them for 20 cents per capita for one year. The effort raised about \$30,000 total from six counties. MSU's Project GREEEN² also contributed significant funds. He then contacted state and federal economic development organizations: the US Department of Commerce Economic Development Association (EDA) and the Michigan Economic Development Corporation (MEDC). Finally, needing a local partner to accept grants from these organizations, he contacted Stan Rickard, City Manager of Hart.

Speaking appreciatively of Steiner's networking abilities, Rickard recalls, "The city got involved because of two grant opportunities that Ron scoured the countryside for, as Ron does." Part of the funding was needed to finance what is now the Starting Block's building, which was for sale at the time. "We were acquaintances," Rickard explains, "but this is when we really started to work side-by-side to purchase the building. Both of the agencies, EDA and the MEDC, were very helpful, but it was a very cumbersome grant application process. It took a long time, a lot of paperwork. But," he adds, "we've worked on grants here." Rickard applied for the economic development funding to buy the building, and the Starting Block now leases it from the city at a low rate. Rickard also credits the building's former owner for believing in the project and having patience during the grant process. A number of other offers were on the table, but the owner wanted to help the incubator. "So God bless them, they held the building for us until we could get the grant approved."

¹ Steiner broadened the geographic range from the four counties initially included in the market area of the feasibility study. See Exhibit 1.

² GREEEN: Generating Research and Extension to meet Economic and Environmental Needs

Steiner now turned to staffing the facility. As in his relationship with MIFFS, trust and flexibility were central to these choices. Jim Henley and his wife, Jane Dosemagen, had run a restaurant in Hart and had been among those surveyed for the Starting Block's feasibility study. Henley also knew Steiner's wife from the nearby Pentwater Yacht Club, where he was kitchen manager. The couple wanted to stay in Michigan but found the economic climate difficult. In fact, when Steiner phoned to recruit them as staff, they were in the process of returning to Minnesota, where they had lived for 25 years and retained a residence. As Dosemagen tells it, "I was already actually back in Minnesota with the kids and Jim was still here. He worked at the yacht club for the summer. Then Ron had this idea, and we knew Ron from the restaurant. He knew us and knew enough about us that he thought we might work out well with this project with him. So he wasn't twisting any arms, but...." Dosemagen asked for a job description. Steiner had not developed one, and in fact admits that he does not believe in them. Nevertheless, Dosemagen was convinced. "Ron had the vision, and we trusted that. We'll work with Ron, Ron is a good person, Ron knows what he's doing."

Dosemagen and Henley possessed the broad range of skills needed to develop and manage a facility. The three of them eventually renovated the building, swinging sledgehammers and hauling wheelbarrows of cement block outside. Steiner acknowledges wryly that Dosemagen may not have accepted an offer with those tasks in the job description. But he holds himself to the same standard of flexibility. Since the couple needed health benefits that the Starting Block would not be able to provide, they agreed on an arrangement that has allowed Henley to hold another job that does, managing food service for a local school district. Steiner's human resource philosophy: "Find and hire 10s. One 10 is worth three to four 5s. Don't just hire cheap, but find the right people and be flexible—agility not only as a business, but also not having any fixed idea."

Equipping the Kitchen

Before making any major decisions about the facility, he took Dosemagen and Henley to visit the Appalachian Center for Economic Networks (ACEnet) in Athens, Ohio. ACEnet established one of the first incubator kitchens in the US and offers day-long replication seminars for others interested in its success. "Best \$500 we ever spent, before we took a hammer or a paintbrush here," Steiner says. Among the advice they received was to buy equipment used, not new. Asked whether it might make more sense to buy new equipment that is less likely to need repairing, Steiner replies simply, "Hire people who can fix it themselves." Indeed, stories of equipment repair abound among Starting Block clients. Gene Van Koevering, a graduate who produces Uncle Gene's Backwoods Pretzels, recalls an experience with the tumbler that he and his business partner used. "It was going too fast to start up with. Ron was—we were all—on our knees, digging around, playing around with gears and pulleys and stuff. And that was fun. They were so accommodating, it was unbelievable. And we got it to work in exactly the way we wanted it."

Steiner also subscribes to the belief that some kitchen equipment should not be purchased until a client has indicated a specific need for it. The feasibility study had specified the equipment that an incubator kitchen would be expected to need (Exhibit 2, see Appendix), but Steiner is adamant that there is no cookbook formula for equipping a kitchen. Henley drew on his

professional experience in commercial kitchens to identify and locate essential appliances—a convection oven, self-contained steam kettles, Hobart mixers, and reach-in refrigerators and freezers. Beyond the purchase of these basic appliances, other equipment decisions have been made in collaboration with clients. For Steiner, this "decision not to make a decision right away" is part of a larger philosophy. "Don't think you've got to have everything in place right away," he advises. The Starting Block offers to buy or lease equipment that clients need, and then gives them the option to take the item along when they graduate. When Van Koevering and his partner moved on to another facility, the only equipment they needed was the tumbler. "We had the opportunity to come up here [to the new facility]," he says, "and they were kind enough to say, 'Hey, if you want this tumbler, we'll sell it to you.' So we made a deal on a tumbler and bought that."

With basic kitchen equipment in place, obtaining an MDA license was the last hurdle before opening for business. A food establishment may not commence production operations before an MDA food safety inspector has evaluated the facility and issued a license. In some cases, this involves more than one evaluation visit as producers make required changes to bring the establishment into compliance. These changes may involve surface coatings of floors, walls, and ceilings; plumbing; and other items that may require considerable time or additional expense. Establishments, like the Starting Block, that have invested in used equipment may find that the equipment does not meet MDA standards. Starting Block staff found that one of the challenges of the licensing process was that not all MDA personnel were familiar with incubator kitchens. Dosemagen feels that the MDA was generally supportive of the project, but adds that it is very important to keep asking questions—and observes that the answers to questions can change over time as new regulations are implemented or as interpretations change. In some ways, licensing is an ongoing process. A kitchen license does not automatically cover all food products; kitchens are licensed only for specific products. The Starting Block continues to work to broaden the range of products that can be processed in its kitchen and has now become both a USDA and FDA processing facility.

The Starting Block began serving clients in 2006. Steiner marvels that although the feasibility study estimated a total cost of \$1.2 million, the three managed to start for one-third of that. Steiner, Dosemagen, and Henley thus pooled their interests and talents to develop a commercial kitchen on a shoestring budget. Key to this has been extensive networking at each step and a collective skill set that includes building renovation, equipment repair, institutional food service management, fundraising, administration, and entrepreneurial education.

Current Operations

Approximately 30 clients use the Starting Block's kitchen, coming from the immediate area and as far as 200 miles. Products include jams, salsas, chutneys, and other spreads; granola, cookies, and other baked goods; and snack foods, such as specialty nut mixes. Many of these products originated in family traditions or had long been popular with friends and colleagues. For many of the clients, the current economic downturn provided the final incentive to turn product ideas into marketable goods that could generate supplemental income.

Four clients have graduated, moving on to their own facilities and even building their own licensed kitchens. Vicki Fuller, for example, started the Maple Island Pie Company at the Starting Block and eventually added a commercial kitchen onto her house. Van Koevering's business grew to the point that he and his partner hired a copacker, and his Uncle Gene's Backwoods Pretzels were recently approved by Cracker Barrel Restaurants and Old Country Stores for national distribution.

Describing the mix of resources and the operational atmosphere of the Starting Block is no easy task. Operations are chaotic and have morphed to meet expanding client needs. Four elements make up Starting Block processes and procedures: (1) training clients, (2) providing basic services, (3) expanding services based on demonstrated client need while diversifying income streams for the incubator, and (4) creating an atmosphere that makes it all work.

Training Clients

Potential clients approach incubator kitchens for several reasons. First, Michigan law requires that most food products offered for sale be produced in a licensed facility. Second, incubator kitchens enable clients to produce at a greater scale than is typically possible when using restaurant kitchen space or other provisional facilities. Third, many small entrepreneurs have limited business experience and seek the expertise and guidance provided by incubator kitchen personnel.

When clients first contact the Starting Block, they meet with Steiner, Dosemagen, or Henley. Steiner is irrepressibly enthusiastic when talking about people's dreams—about the passion they bring to things that they love to do and want to share with others. However, he cautions, "You don't want to string them along." He first sends them away with homework, "low-cost, skunkworks market research," as he puts it. He advises clients to ask friends and family for honest feedback, suggestions on improving the product and, most importantly, whether they would pay money for it. Some clients have also been connected with a financial advisor provided by a community college. Henley agrees that marketing is one of the biggest challenges that clients face. He asks them to do concrete cost calculations, compare their costs with retail prices, and decide whether their products are feasible. If clients request independent taste testing, they are referred to the MSU Department of Food Science and Human Nutrition's Food Sensory Laboratory.

Some have found that friends and family do not provide the candid assessment that a realistic market analysis needs. Van Koevering tells of problems selling one of his pretzel products. "We realize that we've got one that's not a winner. And I would have much rather known that a year ago. But it took time. And quite honestly, we taste-tested with people we knew. If you and I get along, you're going to tell me you like my pretzels whether you like them or not. But you have to be honest." He suggests that the Starting Block coordinate blind taste tests at venues such as food shows.

Once clients decide to move ahead, they are required to contact the MDA themselves, obtain their own food licenses, and develop their own labels. The Starting Block provides clients with a checklist detailing whom to contact and in what order. As Henley reasons, "It doesn't make any sense for us to do it for them. They've got to know where to go. It's their license, they're the ones who are going to meet the inspector, so they have to know what they're talking about." For their own part, clients generally agree that the licensing and label review process is difficult and time-consuming. Some received conflicting information from different MDA personnel, resulting in a more protracted (and sometimes more expensive) process than they felt was reasonable. Some expedited the process by contacting the MDA persistently during the process and visiting the regional office in person.

Once a client is ready to use the Starting Block's kitchen, he or she is given a kitchen orientation. This includes a video covering preparatory and clean-up processes. Depending on how familiar clients are with commercial equipment, staff may also work with them the first time they use the kitchen, and they are always available to help if needed. Fran Russell had been producing her nut mix, "The Nuts," in a restaurant kitchen when she moved to the Starting Block. She speaks appreciatively of the orientation process as well as the kitchen. "They make sure everything is done by the book—they read you all the rules. They're aware of it and they make sure that you're aware of it, but they're fun people. I thought it was an amazing facility, physically. They have an amazing array of equipment, the kitchen is kept impeccably clean, and I love that the kitchen layout is flexible. So much of the equipment is on wheels, so you're not tied into using a configuration that's pre-set for you. You can set up the kitchen to work for you and your production needs."

Incubator kitchens and other multiple-use facilities pose risks of allergen cross-contamination. It can be difficult for clients to know exactly what ingredients other clients are using. Starting Block clients work with their MDA inspector to manage allergenic ingredients properly and to meet labeling requirements. Labels include the statement that the products have been produced in a facility that uses tree nuts, milk, and other major food allergens.

Providing Basic Services

The Starting Block offers two basic services: access to physical facilities that the client would not otherwise have, and business education and development services.

Physical Facilities. In addition to the commercial kitchen itself, clients need office space and warehouse/storage space. The Starting Block offers all three for a fee. The challenge in setting facility fees is that most small entrepreneurs have very limited financial resources. A balance has to be struck between fees that will finance the Starting Block's operation and be affordable for the entrepreneurs. To determine fees, staff researched other incubator kitchens across the Midwest and the US. They took into account the for-profit or non-profit status of the kitchens, urban vs. rural locations, and ambient economic conditions. In the end, they "went down the middle," in Steiner's words. After several years' experience, he now reflects that their rates may be too low. The facility has begun instituting incremental rate increases. Rental fees at the Starting Block include:

1. *Commercial Kitchen*. Clients reserve kitchen time on a wall calendar near staff offices. Fees range between \$10 and \$15 per hour depending on level of kitchen use and equipment required. Equipment includes commercial ovens, freezers, ranges, mixers, kettles, industrial food processors, and a filling machine.

- 2. *Office Rental.* Like other business incubators, the Starting Block rents office space to food as well as non-food businesses. Amenities include wireless internet access, local phone service, use of the conference room, and office support. A 90-square-foot office rents for \$110 per month, and a 225-square-foot office for \$275 per month.
- 3. *Warehouse and Storage*. The Starting Block rents dry pallet storage for \$10 or \$15 per month depending on whether it is secured. Refrigerator and freezer space is available for \$1.50 per cubic foot per month and \$75 per pallet per month. Staff also accepts deliveries. This saves clients, especially those who live at a distance from Hart, the trouble of bringing quantities of supplies and ingredients from home. Simone Scarpace receives bulk shipments of natural pectin from a California supplier for her Wee Bee Jammin' products. The pectin is sent straight to the facility, as are her jars. "I get a couple pallets of my jars delivered here every other month, so somebody who knows how to handle a forklift and get it off the truck needs to be here. It's usually Jim or Ron who do that. But I haven't really had any problem—I just let them know when it's coming. They just tell me that I owe them some jam." Since some carriers charge more for deliveries to private residences than for business deliveries, this also reduces delivery costs for some clients.

Clients sign a contract that spells out their payment terms and other obligations. Rental fees are not billed up front. Clients whose accounts remain in arrears beyond a specified term are prohibited from using the kitchen until they have paid. Steiner reports that this measure has been necessary just twice since the facility opened.

Business Education and Development Services. The Starting Block also offers individual guidance in small business management and networking, and classes in entrepreneurship, small business management, and marketing.

A critical partner in providing these services is the Michigan State University Product Center, which has been instrumental in the Starting Block's development. The two organizations maintain close ties. The Product Center assists entrepreneurs and businesses in the development of food and agricultural products and ventures. Staff, including a corps of Innovation Counselors, provides guidance in market identification, product research, and other developmental decisions. For some, the Product Center provided the initial contact with the Starting Block, and the Center continues to work with clients as their businesses grow. Sue Keegstra, whose family's cherry topping was produced at the Starting Block, recalls that their business grew to the point of attracting a distributor. She contacted Matt Birbeck, Supply Chain Specialist and Counselor Liaison at the Product Center, who has provided assistance since Keegstra's business was formed. "Well," Keegstra says, "I've never met with a distributor before, so Matt came to my home, and the distributor came, and Matt did the wheeling and dealing. I just sort of sat there and watched. And Matt was just fantastic."

Expanding Services

Food entrepreneurs require a variety of services that expand as their businesses grow. In addition to providing education and physical facilities, the Starting Block works to respond to client needs and expand opportunities.

Distribution. Distribution is a main challenge for many of the Starting Block's clients. Many

make their own deliveries, driving hundreds of miles to drop product off and, in some cases, to pick it up again after the product expiration date. It is among the services that they would welcome at the Starting Block.

Lynn Smith began as a client making fruit salsas, and she had also partnered with other food businesses. Some of them folded because of the challenges of making market contacts and deliveries. Steiner encouraged Smith to develop a distributorship based at the facility. A partnership with another distributor had failed in early in 2009, but Steiner persisted with the idea. She laughs about it. "Ron would say, 'We need a distributor.' And I would say, 'I don't have any money, Ron. I'm sorry, I am not your girl!'" At issue was buying a truck. "For probably about six months, he kept saying, 'You've got to do this,' and he was looking for a truck for me. Everybody was looking for a truck." One day Smith happened to phone her car dealer, who had a utility truck for sale. He agreed to let her use it and pay only mileage. He transferred the title to her company, with the agreement that if the business was successful, at the end of two years she would buy it. If not, she would return it. "What a great business move!" Smith exclaims. "He makes very little, but he could get his truck sold, and if I add a fleet, I will do business with him."

"So all of a sudden," she continues, "I've got a truck. . "Then people started coming out of the woodwork because we had a truck." Smith considered the types of products that were available from other Starting Block clients, such as granola and cookies. She saw an opportunity to market to school districts in the region, and within two weeks had orders from five districts.

Drum Dryer Processing. Dave Johnson runs the drum drying business started by his father in Fremont, about 20 miles from Hart. Drum drying is a technology used in food processing and other industries. Food products are made into slurries, which are dried between two heated, rotating drums. The technology provides a means of removing water from a product, reducing transport costs and making possible new forms of the product. Wanting to reach a greater variety of food producers, large and small, Johnson contacted Steiner about establishing a pilot plant at the Starting Block. He installed a drum dryer to enable kitchen clients and others to develop and test new food products. He hopes to broaden the services that the facility provides to entrepreneurs and create new opportunities to add value to regional agricultural products.

Food Product Testing. Food processors must abide by a range of quality and safety standards required by government regulations and increasingly by private-sector food buyers. Most Starting Block clients submit their products for testing of some kind, such as for pH, shelf life, or nutritional analysis. For this, Steiner refers them to MSU and to Summit Laboratory, one of the region's few food testing laboratories, and at that time 75 miles away in Grand Rapids. In the interest of serving clients better as well as providing a new service to the many fruit and vegetable processors in western Michigan, Steiner persuaded Summit Laboratory President Tom Krueger to establish a branch of his facility at the Starting Block. "I need to be able to justify it," Krueger recalls telling Steiner initially. "There had to be that market that would support my decision to set up a laboratory there." Krueger was delighted when Steiner offered to contact the region's major processors and spend a day taking him to meet with each of them. "And we did. You know, Ron Steiner knows everybody up there in Oceana County. We went up there in April [2009] and we visited with all of them, and it was unanimous. That not only was there this huge
demand for reliable, convenient, quick testing of their product, but also for training as well." Summit Laboratory opened its Starting Block branch in July 2009. Krueger hired a staff person from the area and has been pleased with the response from the processors. He is also pleased to be able to help the region economically. "I'm going to buy my supplies locally, I'm going to buy equipment locally. I'm going to hire electricians, I'm going to hire plumbers, I am going to hire people to work here. I'm going to get my lunches here in Hart." Krueger contacted Oceana's *Herald Journal*, which responded by interviewing him and publishing a story on the new branch. He has had limited interaction with Starting Block clients, partly because many of them are not there during business hours. "They have very unusual hours, because they're kind of squeezing it in along with the rest of their life's doings," he observes. They continue to call on Summit for product testing, and the laboratory's presence saves them shipping costs. Clients are pleased that the lab is there. Says TenBrink, "I think it's fantastic that they have an on-site lab now. Had that been there when we first started-we shopped all over for a lab to do that." Krueger plans to offer trainings. He observes that the clients' training needs differ from those of the larger manufacturers. "The manufacturers require training in things like GMPs [Good Manufacturing Practices] and HACCP [Hazard Analysis and Critical Control Points], whereas the people who are developing their own product in the kitchen require training such as ServSafe, which is just safe food handling practices. They need to know how to be able to prepare their product in a way that is not going to cross-contaminate it and that is not going to cross-contaminate other areas of the kitchen or products in the kitchen."

Copacking. A number of Starting Block clients have expressed an interest in working with copackers. Copackers process food products for others, leaving food entrepreneurs more time for product development, marketing, and other tasks. Henley notes that there is a relative shortage of copackers who do small batches. The Starting Block thus undertook a copacking project in the fall of 2009, bottling Herkner's Homemade Cherry Topping for Sue Keegstra and her sisters, Lynda Herkner and Judy Harmon. This has been the facility's only copacking experience to date, and it illustrates some of the challenges of commercial-scale expansion.

The project began with a batch of 600 jars, and all agree that it was a learning experience from the beginning. As Steiner says, gesturing, "We usually start down here [in terms of quantity], and they started way up here." First, the original recipe needed to be scaled up by six times. According to Dosemagen, they now know that the copacking process is normally done gradually, requiring testing for both process and quality. The jars produced in the early batches turned out not to have an even consistency, a problem that may have been due to insufficiently automated equipment. The topping is made in a large cooking pot and then poured into a filler. The operator pushes a pedal to release a specific amount of product into each jar, one by one. The filler at the Starting Block did not have an automatic stirrer. As a result, over the time required to fill all of the jars, the cherries settled, and some jars had too much sauce and some had too many cherries. The problem was resolved when Steiner stood on a ladder to stir while Henley filled jars—an entire day.

Keegstra marvels at how quickly their business then took off, which led to another challenge. "Quite rapidly, we realized that we were outgrowing the Starting Block, because they just could not make it fast enough for us. We started selling lickety-split right away. I mean, we just found markets." Staff found that expanding a copacking operation can be a slow process. Copackers normally approach this carefully, in stages, and, Dosemagen emphasizes, with no promises. "You can't just make a lot of cases the first day," she observes in retrospect. "Depending on the type of product, copackers can take at least six months to review, scale up, and test the recipe, then bottle and package the product so it is of high quality and up to the client's satisfaction." After a month or so, Herkner's moved operations to a copacker with greater capacity, one near Traverse City and closer to two of the sisters. However, Keegstra remains appreciative of the Starting Block and its staff and of what they have helped accomplish. "It's an awesome place to start. We learned a lot from them."

The experience has reinforced the Starting Block's identity as an incubator kitchen. "We're here to assist," Henley says. "We'd like to do copacking to raise funds for the Starting Block, but with limited staff at this time, it is too big of a time commitment. We recommend that clients hire and create local jobs, keeping our role as advisors." Should others express interest in copacking, they would begin in the same way as other clients, making their own products and adapting their own recipes. "There are always glitches when you're starting out," Dosemagen remarks. Indeed, clients describe such learning experiences—ingredients running short, supplies arriving dirty, labels fitting wrong. "That's why it's better for people to come and make their product first, see what it's like, see what they need, and face some of the glitches themselves. Then they know what it entails to make their product." Then, if production increased to the point that clients needed assistance, clients would hire their own help. Starting Block staff would provide these workers with the same technical assistance provided to all clients. Such an approach would address many of the issues encountered in this copacking experience, in which several stages of development were condensed into a single, very demanding project.

Creating the Atmosphere

The physical facilities and services (basic and advanced) are critical to an incubator's success, but creating an entrepreneurial atmosphere appears to be the final ingredient of the Starting Block's operational processes. Two elements drive the atmosphere—the culture and the leadership.

A Culture of Collaboration. The learning process along which the Starting Block moves clients does not follow a precise, prescribed course. Steiner's approach is to not offer help unless clients request it. Instead, the Starting Block staff has aimed to create a dynamic environment that fosters spontaneous conversations and innovation. Vaughn White bakes Uncle Vaughn's Cookies at the facility and tells of an episode in which Henley and Steiner had borrowed an automated cookie machine in order to speed up his baking process. The three of them tried to figure the machine out and to get it to produce cookies according to White's standards. "And we failed completely," White says. "Ron actually got on the phone with the company and we had a conference call about why this wasn't working. Essentially I had to change my recipe, and I wasn't willing to do that." But in the process, Henley hit on a different solution. "Really, you know, frozen dough would be good," White remembers him saying. "We have a heat sealer." That led White to develop and build a new baking implement, an idea he considers so innovative that he is guarded about sharing the details.

Others agree that the atmosphere is conducive to sharing, networking, and collective problem solving. "It's very friendly, it's an environment where we're all comrades," says Randy TenBrink, who produces Randy's Granola. "Even though we're customers of theirs, we collaborate on ideas almost on a daily basis. There have been mistakes plenty—inventory management, deadlines, delivery mistakes, packaging mistakes—that contribute to our business's quality assurance program. But I don't sit down and say, 'I want to talk about quality assurance with you.' I'll be walking down the hall and say, 'I've been doing *this*, but I'm thinking of doing *this*, what do you think?' They're collaborators." Van Koevering puts it this way: "We all feel pretty comfortable. I would liken it to me going to a gym where they're all buff. I wouldn't be very comfortable there. But I'll go on the TV show where they all lose weight. The Starting Block is kind of that way, where you feel comfortable going in, because we're all kind of in the same thing."

Even Rickard, who is Hart City Manager and does not use the Starting Block, appreciates the atmosphere. He tells of one visit: "Just to walk in and see what's happening there—it's exciting to see these young kids out there. Seeing these young people, new ideas, trying a new product. Here are people trying to get this drum dryer going. And then Randy [TenBrink] was all excited." TenBrink does not use the drum dryer but was enthusiastic about it. "He showed me-'Do you know how it works? It comes in here, and it goes out there, and it goes up over the ceiling!' He was as excited about the drum dryer as these other guys were. It's just contagious." Starting Block staff also refers clients to other producers and businesses in the area. Dosemagen continues to email event announcements and marketing suggestions to clients even after they have stopped using the facility. Keegstra has learned of key opportunities in this way, such as the MSU Product Center's annual Making It in Michigan event, and the twice-annual Select Michigan farmers' market at the Capitol in Lansing. She also credits Henley with referring them to a couple that has proven to be one of their biggest resources, both as a supplier and as a source of advice. "Probably that is the biggest thing the Starting Block did for us, was to connect us with them." Steiner connected Fuller with one of the region's largest producers. She wants to use Michigan fruit where possible, and Steiner made the initial contact with the grower.

Some clients express interest in more coordinated networking. Smith, the distributor based at the Starting Block, suggests holding groups that meet and brainstorm on ideas, although she acknowledges that this can be hard to schedule. TenBrink agrees that everyone is busy. "It would be nice to have a monthly meeting. It would be a meeting to encourage each other, share progress stories, leads, any kinds of marketing tips that we'd come across. But we're all so busy."

Entrepreneurial Leadership. Steiner has established and managed the Starting Block by following the same advice he gives clients: Move forward without having all the certainty. Be comfortable with ambiguity. Business decisions should be client-driven. Benchmark. And don't think you can do it all yourself.

Many agree that his commitment, energy, and optimism have made the project possible. Some colleagues speculate on the prospects for a Starting Block without Steiner should he decide to retire. "Ron is a sharp guy. He knows a lot of people, and he's an ambitious guy," Krueger says. "But when he's done with that place, they'd better get somebody who's pretty ambitious to

replace him." Brown, of MIFFS, feels that he has developed a team equal to that eventual challenge. "I think he's got two good people. There's no doubt in my mind that you've got some risk takers there who are working with him. In terms of running it on the whole, they could. They understand what the commitments are in terms of funding, and he's probably helped them develop the relationships they need to build and move forward. But the odds of getting someone to come in from the outside and be able to do that—probably not so good."

Challenges

Client Wish Lists

The Starting Block cannot meet all client needs as client businesses grow. As clients resolve some operational bottlenecks, others emerge. For TenBrink, for example, the physical labor of making granola was a bottleneck until staff adjusted the kitchen's drum mixer. "It increased our production like crazy," he says. "The next bottleneck now is the actual packaging." Without automated equipment, he fills bags one at a time. Scarpace also discusses packaging needs; she would take advantage of more assistance with time-consuming aspects such as attaching shrink bands and labels, and cutting out the burlap bonnets that decorate her jars. Staff is planning to upgrade. "We've also found that we need better packaging equipment and more automated equipment," agrees Dosemagen. Clients also express interest in Universal Product Code (UPC) and other coding software, which is expensive for small businesses.

Some clients voice a need for more assistance than the trainings that are offered. TenBrink speaks for many when he says, "I've done a lot of things over the years, but I've never been a businessperson." Suggested topics include taxes, liability, advice on accounting software and procedures, even simply learning more about the culture and language of business. Others would like to learn more about marketing. Many appreciated a meeting that Steiner arranged for clients with representatives of a major grocery chain, and they would like to participate in more such sessions. White suggests that staff also conduct follow-up calls with clients. "They're always there for you if you have a question, but I think if they could maybe even just call and connect. Say, 'How are you doing? I haven't seen you around lately, how's your business?' I think that might be helpful. Because I think it encourages you to progress."

Many clients started their businesses on shoestrings. Smith notes the barrier that start-up costs present, and wonders whether the Starting Block could collaborate with a financial institution to make small loans available. "Because," she says, "usually, it's a matter of \$1,000 or \$2,000 to get this great idea off the ground. But you're working a 40-hour job and the paycheck's spent at the end of the week, and you don't have it. So that idea never gets off the ground."

Financing

Ongoing funding is a challenge. According to Steiner, the kitchen is not likely to cover more than 30 to 40 percent of the facility's cash flow even when fully booked. Although the Starting Block is incorporated as a non-profit organization, he is determined not to rely on grants, arguing that this is a common mistake made by other incubator kitchens. He is working to create income

streams that make it self-sustaining. A need for entrepreneurial education in the region provides one opportunity; Steiner notes the relative lack of business counseling available in the area. He plans to offer a business start-up course tailored to displaced workers, a 10-week course condensed into 3 weeks. In the meantime, the Starting Block periodically offers classes on topics such as low-cost marketing, accounting software use, and food safety, for a fee. Steiner also teaches entrepreneurial education classes at neighboring community colleges and forwards his instructor fees to the Starting Block.

Steiner does not draw a salary from the Starting Block but instead has retained his half-time job as an MSUE regional entrepreneurship educator. As he explains it, "All extension agents have to have at least two educational initiatives. I said, Okay, my initiative is to establish and administer a regional kitchen incubator." This arrangement has been crucial as the facility establishes itself. However, it is a luxury that few incubator kitchens enjoy, and constant threats to MSUE's budget could compel the Starting Block to find other funding sources during what are very lean years for non-profit organizations. The facility's financial health is of importance to clients whose businesses depend on it. As White says, "If they don't sustain, we fold"—a loss that would have cascading effects throughout the businesses that White supports in his community.

A recent fiscal year funds flow statement is provided in Exhibit 3. The facility is running at about 50 percent capacity.

Equipment and Safety

Steiner makes a strong case for purchasing used rather than new equipment, and many clients have been pleased with his and Henley's ingenuity in repairing equipment and adjusting it to meet their needs. However, a few of them mention persistent problems with one item, an automated filling machine that has dispensed uneven quantities in spite of repeated attempts to correct the problem.

Commercial equipment enables producers to increase production, as TenBrink and others have experienced. Johnson, who installed the drum dryer, feels that this gives rise to a new set of challenges and that clients may not be sufficiently aware of them. Large equipment and the quantities made with it can introduce safety problems. For example, when equipment breaks, pieces of it can find their way into food products. He emphasizes that clients need to be made aware of these risks and of the consequences for both clients and the Starting Block should a public food safety problem arise.

Location

The Starting Block originated with a vision of providing value-added opportunities to western Michigan farmers, and it is located in that part of the state in order to be closer to them. But although a number of the facility's clients source ingredients from local growers, many of them do not represent the rural Michigan constituency that the Starting Block had intended to benefit. At the same time, many of the clients' products sell well in urban niche markets, the closest of which is 60 miles away.

Clients and others weigh the advantages and disadvantages of the Starting Block's location. Many feel that one of the chief advantages is the safe and collegial atmosphere of the facility. "You trust people," Dosemagen observes. "So far, it's pretty much an open door. They have a key to come in here. We're in an area here that is just really safe, and that's been a really nice thing. Other places—I'm sure in bigger cities—you can't have the trust factor that we have. We were going to build cages in the dry storage, and everybody would have their locked space, but so far nobody cares." Russell agrees. "Everyone is respectful of the belongings of others." She is from an urban area and marvels, "I feel totally comfortable just coming and going. The building and parking area are well lighted and feel very secure."

However, the location can make it harder to attract entrepreneurs and increase kitchen rental income. It can also be hard to attract the attention of distributors and retailers. Even the workshops that Steiner hopes to develop into an income stream are not always well attended. Krueger recounts arriving at the Starting Block the day that a class on the food industry had been scheduled, and seeing a sign on the door that it had been canceled due to lack of registration. He sees the low population density of the region as a challenge to the facility's long-term success.

Competition

When the Starting Block began, it was the only kitchen incubator in western Michigan. The increased demand for locally grown and processed foods had recently become a national phenomenon, and Michigan consumers appeared to have growing interest in local foods. Since then, new kitchen incubators have been established in nearby cities, including Grand Rapids and Kalamazoo. The trend towards local foods would seem to be an opportunity, but the prospect of competition seems a challenge.

What's Next?

Like many entrepreneurs, Steiner does not believe in formal plans. He has developed and managed the Starting Block without a business plan, relying instead on an innate ability to identify markets, partners, and opportunities, and a knack for building a business identity and culture. He has been creative in meeting financing, physical plant, and other needs. Steiner's management philosophy accommodates and even embraces ambiguity, and many colleagues emphasize the benefits that have accrued from this flexibility.

However, Steiner is now faced with strategic decisions about how to maintain the viability of the Starting Block, maximizing its strengths while mitigating concomitant risks. He is 1) considering in what ways the Starting Block is and is not successful; 2) assessing which strategies have been effective and are appropriate for the business's transition to its next stage of growth; 3) reevaluating the Starting Block's target client audience, the role that it plays in its clients' lives, and its value proposition for them; 4) defining clients' key success factors, critical risks, and strategies for their start-up and growth; and 5) determining the qualities that should be fostered in entrepreneurs.

Late in the evening, Steiner finishes some paperwork and pushes back from his desk. The Starting Block is quiet except for the sounds of a client working in the kitchen across the hall. Steiner reflects happily on the accomplishments of the past several years and on the legacy that

he has created in his adopted state, at an age at which many have left business life far behind. He pauses at the door to consider some of the suggestions his staff has made for improving the Starting Block's long-term sustainability. He will return early in the morning.

Acknowledgements

We thank Ron Steiner, Jane Dosemagen, and Jim Henley of the Starting Block, and the clients, community partners, and others who participated in this research. The study was made possible in part by the University Distinguished Fellowship that supported the lead author's doctoral program at Michigan State University, during which this research was conducted. We gratefully acknowledge the suggestions and comments of anonymous reviewers and the Managing Editor that improved the case.

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Appendix

Exhibit 1

Basic Description of Location and Agricultural Production of Market Area

Excerpted from the initial USDA project's feasibility analysis for an incubator kitchen in western Michigan (Molnar 2005, 1-8).

Area Boundaries

The primary focus of the study consists of the Ocean County Region in Michigan.





Motivation and Goal of Study

Agriculture plays a significant role in the Oceana County Region. One of the most alarming agricultural issues in the area is the inability of small, family-operated farms to remain profitable and stay in business in the long term. Raw crop farming is profitable, but only if sold in considerable quantities and at a low price in a market where large farm corporations already dominate. One method to increase profitability for small farms is through the selling of value-added and processed farm products. These products can sell for a higher price compared to raw farm products, which means higher profit margins for small farms and farmers. . . . However, it may be that this is not enough to solve the escalating problems of small farms, as well as the declining employment in the manufacturing industry.

Agriculture of Oceana County

Forty percent of the land in Oceana is used for agricultural purposes. According to the 2002 Census of Agriculture, Oceana County contained 648 farms, roughly the same number as 1997. However, the land in farms and the average size of farms decreased by 4 percent over this five year period. . . . Despite decreasing sizes of farms, the market value of production on the farms has increased by 14%, from \$78,875 in 1997 to \$90,096 in 2002, per farm. Crops accounted for 68% of the value, and livestock accounted for 32%. The predominant crops grown were fruits and vegetables, which made up 82% of the crop market value. Asparagus and tart cherries are two crops that are grown in large quantities within the county, contributing \$10,403,000 and \$8,581,000 to the county's total market value of \$58,382,000 respectively. Within the state of Michigan, Oceana ranks first in vegetable production and asparagus production, and also ranks second for tart cherry production. Asparagus and tart cherry growth both rank second in the nation.

Agriculture of Mason County

According to the 2002 Census of Agriculture, there were 478 farms in Mason County, a slight increase from five years prior. However, the land in farms and size of farms decreased by 4 and 5% respectively. . . . Like Oceana County, Mason County has experienced an increase in market value of production for its crops over the past five years. This increase was from \$24,343,000 to \$24,955,000, and increase of 2%. About two thirds of the market value came from crop products, the other third from livestock. Fruits and vegetables dominate the crops, accounting for \$9,947,000 of the \$16,546,000 total. . . . Mason County ranks second in the state for asparagus production and fifth for tart cherries and snap beans.

Agriculture of Newaygo County

Newaygo County has seen a 15% increase in the number of farms from 1997 to 2002, according to the Census of Agriculture. Originally, at 787, farms increased in number to 902. Land in farms increased slightly from 131,779 to 135,422 acres, but overall, the average size of a farm decreased by 10%... Market value of production in Newaygo County increased rapidly from 1997-2002. During these five years, the value increased by 23%, translating to an average 7% increase by farm. Unlike Oceana and Mason Counties, Newaygo County's market value comes

more from livestock than crops. Crops accounted for only 33% of the total \$60,868,000 market value, and livestock accounted for the other 67%.

Agriculture of Muskegon County

Muskegon County had 545 farms in 2002, representing an 11% increase from five years prior. Overall farmland decreased 4% to 73,918 acres, dropping the average acreage per farm to 136 acres, the smallest size of the four counties surveyed. . . . The market value of production in Muskegon County was \$46,301,000 in 2002, up very slightly from 1997. Overall though, average production decreased by farm, due to the increase in farm number. Crops represented 64% of this value. Fruits and vegetables are popular in the county, but nursery products and sod also contributed heavily to the total market value, making up nearly 25% of it at \$10,369,000. Statewide, Muskegon County ranks fifth in blueberry production.

Entrepreneurs Key Findings

A mail survey went out to 600 local entrepreneurs which resulted in 116 valid responses. One of the key findings was in relation to venture type.

Туре	Responses	Percent	Туре	Responses	Percent 3.4	
Restaurant	59	50.8	Farm Market	4		
Farmer	28	24.1	Meat Sales	2	1.7	
Caterer	20	17.2 Bar		2	1.7	
Value-Added Processing	19	16.4	Cart/Street Vendor	1	1	
Bakery	18	15.5	Delicatessen	1	1	
Specialty/Gourmet	14	12.1	Direct Retail	1	1	
Supermarket	7	6	Fish Smoking	1	1	
Bed and Breakfast	6	5.2	Pet Food	1	1	
Home-Based	-Based 6 5.2		Wholesale	1	1	

Question 7. What type of business venture are you presently involved in, or do you plan to launch? (*check all that apply*)

Exhibit 2

Kitchen Equipment Costs Projected in Original Feasibility Analysis (Molnar 2005, 57-59)

Name	Cost	Name	Cost
Janitor's sink	\$374.90	Double Stack Conventional Oven	\$7,790.10
Walk in Cooler/Freezer	\$17,297.15	40 Gallon Tilt Kettle and Filler	\$8,000.55
Cooler Condenser	\$4,488.45	40 Gallon Stationary Kettle and Filler	\$4,993.30
Freezer Condenser	\$6,467.60	Gas Fryer	\$3,872.05
Storage Shelving	\$638.25	Walk in Cooler/Freezer	\$7,307.10
Work Tables	\$2,856.60	Refrigeration System	\$5,957.00
Hand Sink	\$347.30	Freezer Shelving	\$982.10
Prep Table w/ Sink	\$4,363.10	Cooler Shelving	\$1,125.85
Food Processors	\$6,656.20	Class I Hood	\$3,542.00
20qt Mixers	\$4,273.40	Class II Steam Vent Hood	\$1,967.65
Slicers, Univex	\$2,130.95	Dishwasher	\$2,696.75
Roll In Refrigerator	\$12,916.80	21/22 Qt. Mixer	\$2,639.25
Roll In Freezer	\$8,186.85	Mixer Cart	\$419.75
Reach In Freezer	\$5,931.70	63Qt. Mixer	\$8,510.00
Reach In Fridge	\$7,259.95	Hand Wash Sink	\$162.15
Double Convection Ovens	\$18,842.75	Work Tables	\$2,248.25
Double Steamer Ovens	\$21,256.60	Vegetable Sink w/ Faucet	\$667.00
Exhaust Hood	\$20,125.00	Work Tables	\$1,624.95
Trunnion Kettles	\$21,625.75	Pot Rack	\$212.75
Tilting Braising Pans	\$16,878.55	Pot Sink w/ Faucet	\$914.25
Floor Through Drains w/ Grates	\$1,089.05	Clean Dish Table	\$535.90
Work Table L	\$1,089.05	Soiled Dish Table w/ Pre-Rinse	\$917.70
4 Burner Ranges w/ Oven	\$5,773.00	Bun Racks	\$664.70
Gas Griddle w/oven	\$6,289.35	Scale 40lb	\$563.50
Gas Deep Fryers	\$9,987.75	Portion Scale 5lb	\$67.85
Hot top range w/oven	\$5,974.25	Slicer	\$1,941.20
6 burner ranges w/oven	\$5,773.00	Juicer	\$1,777.90
Disposer	\$1,440.95	Attachment Set, Varimixer	\$621.00
Ice Machine	\$2,096.45	Receiving Cart	\$624.45
Gas Range	\$1,568.60	Garbage Cans	\$96.60
Electric Tilting Braising Pan	\$5,263.55	Aluminum Baking Sheets	\$225.40
Rinse/Fill Faucet for Braising Pan	\$219.65	Flash Freezer	\$14,500.00
		Total	\$317,651.50

Exhibit 3

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Income	
Grants	\$ 208,670.73
Education Fees	\$ 2,940.00
Office rental	\$ 6,123.00
Warehouse rental	\$ 4,947.25
Kitchen rental	\$ 17,746.95
Other	\$ 3,089.01
TOTAL INCOME	\$ 243,516.94
Expense	
Contract labor	\$ 4,566.25
Educational materials	\$ 13,074.50
Equipment	\$ 7,069.16
Insurance	\$ 5,698.75
Payroll expense*	\$ 34,386.53
Professional fees	\$ 1,285.15
Repairs	\$ 1,300.80
Supplies	\$ 5,266.49
Utilities	\$ 13,555.97
Other	\$ 1,795.83
TOTAL EXPENSE	\$ 87,999.43
Net Funds Flow	\$ 155,517.51

*Steiner does not draw a paycheck from the Starting Block.

Exhibit 4

Participating Businesses

Vicki Fuller, Maple Island Pie Company

Fuller is one of the Starting Block's graduates. The business began with a decision to leave an office job and simply do what she loves, which is bake pies, and the local MDA inspector put her in touch with the Starting Block. Her first impression was of the distance from her house. She remembers her daughter commenting during the first 30-mile trip, "I don't know, Mom, this is an awful long ways to travel just to bake." But the assistance that she received made it an important move. Staff provided a financial advisor, a community college instructor who helped Fuller determine pricing. They also helped her increase batch size. Steiner connected her with local fruit growers, and production leapt after he introduced her to the representatives of a local community foundation who were touring the facility while she was baking. When she decided to develop her own kitchen, the Starting Block assisted her with that project as well.

Dave Johnson, Drum Drying Resources

Eager to establish a pilot drum dryer plant in addition to his main production facility, Johnson approached Steiner with the idea and installed a small drum dryer at the Starting Block in 2009. The pilot plant gives producers an opportunity to experiment with products using larger-scale industrial production technologies, and renting space at the Starting Block saves Johnson the cost of building a separate facility. Although Johnson appreciates the enthusiasm with which clients develop businesses, he believes that they need to be better prepared to meet the challenges of increasing scale. Large equipment creates new quality and safety issues. "And they need to be educated for that. It's easy to make it in the Starting Block with family. But the next step could scare you." He hopes to be part of that developmental process and to assist with innovations.

Sue Keegstra, Herkner's Homemade Cherry Topping

Keegstra and her sisters, Lynda Herkner and Judy Harmon, grew up on a cherry orchard on Michigan's Old Mission Peninsula. When they decided to fulfill their parents' dream of bottling a popular cherry topping, they recognized that they would not be able to produce at a commercial scale without help. Matt Birbeck of MSU's Product Center guided them through the process of forming a business, and he referred them to the Starting Block for copacking. "We didn't have a lot of money to get started," Keegstra recalls. Sales increased rapidly. Henley put them in touch with a jar supplier, who put them in touch with a distributor who was so impressed with the topping that he offered to make it his primary distribution product. Although they soon moved to a larger copacker, she stresses that the Starting Block has been of tremendous help. The sisters have continued to enjoy the networking connections with other clients.

Tom Krueger, Summit Laboratory

Summit provides analytic and microbiology lab testing, and it opened a branch at the Starting Block in 2009. Krueger thus sees kitchen clients from a broad food industry perspective. He remarks on the considerable motivation that clients display when they travel the distances they do to develop products. Although the Starting Block is located in a commercial fruit production area, many clients do not live in that area, nor are their markets nearby. Krueger hopes that Summit's presence there can help to make it a resource for a greater variety of food businesses.

He sees twin challenges in increasing kitchen use. One is producer drive. "People really have to have the motivation to want to take their famous family recipe and try to get it on the shelf at Meijer [a major regional supermarket chain]." The other is market incentive. "The stores have to create the demand. They have to create the market. They have to say, 'Hey, all this stuff was grown locally, and here are the advantages to you and to Michigan as a whole for you buying these products.' If they can create the market—the demand for those products—then the incentive will be there. Then it motivates people more to use places like the Starting Block, and it helps complete that cycle."

Fran Russell, "The Nuts"

"The Nuts" are a mix of pecans, cashews, and almonds in a sweet, salty, spicy coating. Russell uses Michigan honey and beet sugar, and, while not grown in Michigan, all of the nuts used come from a Michigan distributor. "The Nuts' is a recipe I've been making and tweaking for years, and it's always what I'd put out at parties." When her design business started changing in 2008, she decided to try marketing "The Nuts" and contacted the MSU Product Center. With help from Birbeck, she obtained a food license and started producing the mix in a cramped local restaurant kitchen, then moved to the Starting Block in 2009. Although Hart is a two-hour drive from her home, she feels that the efficiency of a well-equipped production kitchen has more than compensated. Among her favorite accessories is a large bowl that fits nearly all 75 pounds of the baked nuts, which are packaged into 4- to 11-ounce boxes. Production labor is one bottleneck, but she was able to hire local labor from the Hart area for the most recent baking and packaging day.

Simone Scarpace, Wee Bee Jammin'

Scarpace has been gathering wild berries and making jam with her family for years, and her products are now sold in specialty shops throughout Michigan. "We love the Upper Peninsula, we love being outdoors. So there's just a passion for all of this," she says. A friend who knew that she was interested in marketing the jams mentioned the Starting Block, and she began using the kitchen in 2008. Demand grew fast, pushing the limits of the fruit supply that her family could pick fresh in season. A light bulb went off, she says, when Henley suggested buying frozen fruit from Michigan farms. About the Starting Block, she says, "It's a blessing, really, I just find that it was too good to be true." In particular, the networking with other clients and the support from the staff make the hour-long drive from her home worth it, "just talking to people and picking their brains a little bit and getting ideas and learning what they've learned, and about their mistakes."

Lynn Smith, MI Foods

Smith has used the Starting Block facilities and services since 2007, and she credits its supportive atmosphere. "I went through several businesses that failed, and with every failure there's an opportunity. Ron has really been crucial in focusing—'There's an opportunity. There's got to be.' And there was, and it was just a matter of picking up the pieces and figuring it out. I couldn't have done it without the Starting Block." She is driven by a vision of making nutritious and locally produced food available to school districts. Her distributorship helps fill a marketing need among small producers who cannot supply the quantities demanded by larger distributors. In addition to products made by Starting Block clients, she has added other products based on the

schools' needs and turned to others she knew from networking. A Big Apple Bagel shop is custom-producing the smaller size of bagel served in school cafeterias.

Randy TenBrink, Randy's Granola

TenBrink started developing a granola recipe in 2005 and eventually was selling it to friends and coworkers. He began looking for a commercial kitchen. "I made hundreds of calls—VFWs, American Legions, day care centers—but no one would do it," he says. Although TenBrink lives only 60 miles from Hart, he was not aware of the Starting Block. He queried on Facebook and learned of incubator kitchens, and a Google search led him to the facility. "They've helped us with production—streamlining the production, storage, providing a place for the product to be picked up." He appreciates the staff's jack-of-all-trades capabilities. "Anytime we need something, some piece of equipment that needs to be put together, or a 220 power line needs to be run somewhere, it's just a question of asking and it's done." The business has grown. Like many other clients, he makes a point of sourcing ingredients through Michigan companies.

Gene Van Koevering, Uncle Gene's Backwoods Pretzels

Van Koevering's business is a Starting Block graduate. He and partners have started a number of businesses over the years, and their flavored mini-pretzel is a current project. "We started this little snack food business in November 2006 with one product, a result of a recipe that I'd been using for six or seven years." A friend had seen a Starting Block workshop advertised and alerted Van Koevering. The facility allowed them to begin processing and packaging the pretzels without investing in equipment. They used the kitchen for eight months before sales exceeded their production abilities. They now contract with another pretzel business, one that is helping the group transition to a larger scale. Van Koevering speaks appreciatively of their experience at the Starting Block. "It was a good facility—plenty of room, a good storage area. And they were very accommodating folks. And the accessibility to it—we all got a key, and then you'd go in any time of the day or night, and you'd just sign in and put your hours down."

Vaughn White, Uncle Vaughn's Cookies

"I'm a do-er," White says of himself, "I'm always doing something." He had been making dozens of cookies for school and community events every year using his grandmother's popular recipe when he asked his wife what she thought it would take to sell them. "She kind of rolled her eyes, and she knew she was in trouble." White credits his family and the Starting Block with making his business possible. The facility's flexible hours enable him to work around his job as a school administrator, and he sometimes bakes at 5:00 a.m. during the school year. He is at home in the Starting Block's collegial atmosphere, where staff and other clients have prompted innovations. As production increases, he hopes to make use of additional kitchen equipment, such as a larger mixer. Such an increase, however, requires scaling up his recipe, which can be an expensive experiment. "If the dough doesn't turn out right, I don't feel right selling it." White emphasizes the importance of values as he builds his business: avoiding debt, donating a portion of profits, and supporting local producers and retailers.





International Food and Agribusiness Management Review Volume 17 Issue 1, 2014

Cooperative Innovation: The Case of Team Marketing Alliance, LLC

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Abstract

With rising volatility in agriculture, farmers increasingly need to manage volatility and elevated risk. This case illustrates the experience of four Kansas cooperatives that combined their efforts to develop risk management services for their members through a jointly owned LLC, Team Marketing Alliance (TMA). TMA's unique approach to risk management helps producers mitigate output price risk, lock in input purchases and ensure revenue coverage through crop insurance. This case can be successfully used in undergraduate and graduate courses, and in extension seminars focused on agribusiness strategy, risk management, and farmer cooperatives.

Keywords: Farmer cooperatives, risk management, agribusiness strategy

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IFAMA Agribusiness Case 17.1 B

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Cooperative Innovation: The Case of Team Marketing Alliance, LLC

We used to do our own grain marketing, but with the amount of volatility today, it just became a task that took a lot of supervision. TMA is able to fill our need for a risk manager that is constantly informed on current market development, future outlook, and, most importantly, is a partner we trust.

-Kansas grain farmer, customer of Team Marketing Alliance, LLC

Introduction

Volatility in agricultural commodity markets has surged. Before 2008, commodity price movements were fairly calm. However since 2008, commodity prices have swung to historically high levels and have also experienced sharp drops—all of which has occurred in a short amount of time. These steep changes were especially acute in 2008, when the price of corn shot up from \$5 to nearly \$8 per bushel in June, and then plummeted to below \$4 per bushel by December, 2008. Many other steep price swings in other commodities and crop inputs were also experienced, which were largely driven by anticipated changes in carry-over stocks due to supply and demand shocks tied to extreme weather events and the U.S. and global economic and financial crisis.

Volatility persists in commodity markets and is not likely to go away anytime soon because of numerous developments including the globalization of the agri-food system, exceptionally low interest rates and extreme weather events. As a result, farmers must continue to manage this volatility. But, do they have the tools and knowledge necessary to do so?

Risk analysis and risk management are now receiving growing attention from participants at every stage of the agri-food supply chain. This is particularly true for farmers of various sizes who now must add yet another skill to their repertoire—risk management. While certainly some farmers have an excellent grasp of how to manage their operation's risk, there are likely plenty who need help in this area of rising importance.

Some farmer cooperatives have recognized the rising demand for these risk management services. The ability of cooperatives to mitigate farmers' risks becomes an increasingly important aspect of their overall value proposition to their farmer-owners. Consequently, progressive cooperatives are in continuous search for new and unique ways to assist producers in decision making through offering beneficial tools and services in risk analysis and risk management.

This case study illustrates the experience of a group of Kansas cooperatives who joined their efforts in developing risk management tools and services for their members through a company they wholly own together, Team Marketing Alliance, LLC (TMA). TMA helps farmer-members mitigate output price risk, lock in input purchases and ensure revenue coverage through crop insurance.

The primary objectives of this case study are: i) to discuss the evolution of TMA from creation to its current status today, ii) to examine the benefits to farmers and to the four co-ops that wholly own TMA, and iii) to identify and discuss strategic issues facing TMA. The case is based on the information from interviews and personal interactions with TMA management, farmer-members of cooperatives as well as TMA reports and presentations.

Background and Overview of TMA

In the mid-1990s managers of four cooperatives in central Kansas joined around the concept of centralized grain marketing for gaining efficiencies through economies of scope and scale. At the start, the cooperatives found that the concept of marketing grain as a team proved beneficial to partner co-ops. Through sharing labor and knowledge in working together, these cooperatives enjoyed increased selling power, operational efficiencies, diversification of territory, increased patron opportunities due to larger size, risk management programs, and patronage. With the success and growth of this concept, a separate company, wholly owned by the four cooperatives, was formed called Team Marketing Alliance, LLC (TMA). This structure has been commonly referred to as a "marketing agency-in-common" (Reynolds 1994).

For these cooperatives, TMA is exclusively utilized as a consolidated grain marketing division for these four local cooperatives handling all merchandising, logistics, accounting and e-commerce through its office. Today, TMA is wholly owned by four central Kansas cooperatives: Farmers Cooperative Elevator Co, Halstead, KS., Cooperative Grain and Supply, Hillsboro, KS., Mid-Kansas Cooperative (majority owner), Moundridge, KS., and Farmers Cooperative, Nickerson, KS. Together, these cooperatives own 52 country elevator facilities for the handling of bulk grain and one ethanol plant. Farm-marketing programs are initiated by a team of origination specialists on TMA's staff who all strive to fulfill TMA's mission statement: *"To provide a grain marketing service that links the Producer to the End User giving the greatest value to both parties."*

All profits earned by TMA during the year are passed back to the four local cooperatives at yearend on the basis of use. During the year, a put thru charge is paid to each elevator for bushels handled along with storage. These profits are then distributed back to the cooperative patronmembers per each cooperative's patronage allocation and equity redemption program.

The long-run strategic direction for TMA is set by its Board of Directors (Exhibit 1). There are four board members who are the CEOs of the local cooperatives that own TMA. In addition, there are four associate board member who are assigned from each cooperative's Board of Directors. Even though Mid-Kansas Cooperative is the majority owner of TMA, the CEO of Mid-Kansas Cooperative cannot unilaterally decide TMA's future growth or strategic direction. On all voting issues, the majority owner must have the support of at least one minority owner vote. Conversely, the minority owners cannot vote together against the majority owner.

Below the Board of Directors, are TMA's 20 employees which include: a Chief Operating Officer, a grain marketing manager, four grain marketing specialists, four crop Insurance specialists, a crop insurance processor, a person in charge of logistics and transportation, six support and accounting staff, and two TMA employees at Kansas Ethanol. Responsibilities and

activities of employees include: marketing and hedging of grain inventories, providing warehouse licensing for elevators, providing financing for grain receivables and inventories, providing uniform patron grain contracts and programs, arranging logistics and transportation for local elevators, overseeing training for grain grading and customer programs, providing grain origination assistance and programs, and maintaining separate accounting and financial statements.





The geographic footprint of TMA covers ten counties in central Kansas (Exhibit 2). In 2012 TMA insured over 260,000 acres, received gross crop insurance premiums of 10 million dollars, and contracted over 9 million bushels of fee based contracts. TMA's warehouse licensing and close relationships with farmers in central Kansas allow them to manage the inbound logistics of grain origination effectively.

While TMA has done a fair job managing outbound logistics, their expanding geographic footprint has put pressure on TMA's ability to manage these logistics effectively and efficiently. The primary reason is because TMA relies solely on trucking as a means of transporting grain. In addition to the logistical challenges of coordinating over one hundred truck fleet, the reliance

on truck transportation limited TMA's marketing options. To address this problem, one of TMA's owners, Mid-Kansas Cooperative, has partnered with CHS Inc. to provide the equity capital to build and operate a high-speed shuttle loading facility which upon completion will load 110-car trains bound for export facilities. This facility will be operated as its own LLC, and this newly created LLC will become the fifth member of TMA.

Exhibit 2. TMA Locations



TMA's Approach to Creating Value in a Turbulent Time

TMA creates value for their member-farmers through a unique risk management tool. With heightened volatility in the agricultural marketplace, farmers need ways to manage many types of risks. TMA's unique approach to risk management helps farmers' control their production risks by locking profits. More specifically, the value proposition for farmers is through a profit based, risk management approach that can utilize contracts to lock in (1) input purchases; (2) grain sales; and (3) crop insurance.

The best way to illustrate TMA's approach to risk management is through their profit matrix. An advantage of the profit matrix is that it is a straightforward way to show a producer what type of profit per acre they can lock in based on their input, grain and crop insurance decisions. While different types of crops can be shown in the profit matrix, for explanation purposes a hypothetical wheat farm profit matrix is used (Exhibit 3).

Team Marketir Alliance	Team Marketing Alliance											
		3 14		1						1		
Crop HRW Wheat 💌	Load Values	Description	2013 Whe	eat Matrix					Dis	splay Percenta	age	
Your Share of Acres	11	Em Weighted	Avg APH Yiel	Ы	45		Harvest Fut	ires	-	7 45		
Fatilizar	82.00	Step 1 Fm Weighted	Avg Expected	d Yield	45		Harvest Bas	is	Step 2		-0.15	
Chemicals	20.00			(CDID)	45	-	,					
Fertilizer / Chemical Application	12.00	County Expected Yield (GRP/GRIP)			45	Step 3	Bushels per acre - Cash Forward Con			acts 3	6.00	
Seed	16.00				8.78		• Weighted A	verage Cash	Price 8.25			
Custom Rates	75.00	GRP Projected Price			5.68		Bushels per acre - Minimum Price			ntracts 0		
Irrigation	0.00	The of Care barrense DD			-		Weighted Average Minir			num Cash Price 0.00		
Crop Insurance	14.00	Type of Crop Insurance RP			Bushel Gt	el Gte Per/Acre Long Ontion Strike Pr			e 0.00			
Hail Insurance	0.00	% Protection 100 • %				36.0 Short Option Strike			ce (0.00			
Number of Months with Interest	9			25	50	70	00	100	100	140	150	
Interest Percentage	5.00 %	Enrolled in Acre:	% OT APH Farm Yield	20	22	22	30	45	59	62	001	
Land Cost	65.00	Cash Price (Bation)	9.00	e0	23	52	41	45	\$200	03	00	
Fixed direct \$/acre payment	0.00	Cash Price	8 70	\$7 \$9	\$7	06 32	\$40 \$44	\$00	\$200	\$240	\$203	
Misc Cost	0.00	Cash Price	8.42	\$17	\$15	\$14	\$43	\$81	\$195	\$233	\$271	
Total Costs	291.69	Cash Price	8.14	\$27	\$25	\$24	\$42	\$79	\$188	\$225	\$262	
	~	Cash Price	7.86	\$37	\$35	\$34	\$41	\$76	\$182	\$218	\$253	
Print Copy Charts		Cash Price	7.58	\$47	\$ 45	\$44	\$42	\$74	\$176	\$210	\$244	
Compliments of		Cash Price (Now)	7.30	\$57	\$ 55	\$54	\$53	\$71	\$170	\$202	\$235	
Diversified		Cash Price	7.21	\$60	\$58	\$ 57	\$56	\$70	\$168	\$200	\$232	
Services		Cash Price	7.12	\$ 63	\$62	\$60	\$59	\$69	\$166	\$198	\$230	
~~		Cash Price	7.03	\$67	\$65	\$64	\$62	\$69	\$163	\$195	\$227	
(660) 584-8888		Cash Price	6.94	\$70	\$68	\$67	\$65	\$68	\$161	\$193	\$224	
		Cash Price	6.85	\$/3	\$/1	\$/0	\$69	\$68	\$159	\$190	\$221	
		Cash Price	6.67	\$/6	\$/5	\$/3	\$72	\$71	\$157	\$188	\$218	
		Cash Price	6.58	\$60	\$70	\$77	\$75	\$75	\$153	\$160	\$213	
		Cash Price (Low)	6.50	\$86	\$84	\$83	\$81	\$81	\$155	\$181	\$210	
		Weighted Avg Cash P	x Breakeven	\$25.93	\$12.96	\$9.26	\$7.20	\$6.48	\$4.99	\$4.63	\$4.32	
Agent					•							

Exhibit 3. Screenshot of TMA's Profit Matrix

The profit matrix has two axis of information that determine the realized profit per acre, which is reported in the middle of the matrix. The vertical axis shows various cash price levels. Across the top horizontal axis are varying levels of farm yields. In addition, the farm yield as a percentage of the farm's APH (actual production history) is shown at the top (so in the case of this hypothetical farm, 45 bushels per acre of wheat is 100% of the farm's APH). Finally, because the

farmer's cost is known, the cash price needed to breakeven can be presented along the bottom row. For example, at 68 bushels per acre, the farmer needs a wheat price of \$4.32 to breakeven. The breakeven prices along with the profits per acre reported in the matrix are all dependent upon the specific profit based decisions made by a farmer. These decisions create a tailored profit matrix for a farmer. Of course, there are many different decisions that could be made that would result in very different profit per acre figures. To keep things tractable for the purposes of this case study, the hypothetical wheat farmer is used again. So, the illustrated example (Exhibit 3) reflects three key decisions: (1) reporting and locking in input costs; (2) locking in revenues through grain contracts; and (3) minimum revenues from production through crop insurance.

The first decision pertains to input costs and purchase commitments. Step 1 pertains to the upper left-hand corner of the illustrated example (Exhibit 3) which shows the cost per acre figures that a farmer must provide from their own records. In addition, the farmer may be able to lock-in input prices and input quantities purchased through contracts with their local grain, oilseed and farm supply cooperative. For example, Mid-Kansas Cooperative offers 12-month fertilizer contracts to their farmer-members, which allows their farmer-members to lock in fertilizer prices. With regards to the other input costs, all of the price risks are assumed to be incurred by the farmer.

After entering their input cost information, next is to market their grain. Step 2, in the upper right hand section of the example (Exhibit 3) shows multiple ways in which farmers can market their grain through TMA. These options include hedging, using the options market, minimum price contracts or forward contracts. One advantage for farmers using futures to hedge or lock in grain prices is that the farmer does not pay for any margin calls as TMA handles all margin calls.

The final and third step is to determine their crop insurance coverage. Numerous crop insurance options, such as crop revenue coverage to multiple production insurance policy to catastrophic risk protection, are available to the farmer. It is up to the farmer to decide how much they are willing to spend for the insurance, and how much coverage and protection that they need. In Exhibit 3, the hypothetical wheat farmer's APH is 45 bushels per acre and the wheat farmer decides to purchase an 80 percent revenue protection policy, which insures 36 bushels per acre. With this amount of the wheat crop insured, 36 bushels per acre is also the amount of grain that a farmer would market in Step 2.

Following all of these steps helps the farmer realize the value of TMA's profit based risk management approach. Being able to lock in profits is clearly valuable in today's volatile times, but there is another advantage of TMA's risk management approach. Producers have to process a lot of information when making farm level decisions and the profit matrix allows producers, along with TMA's guidance, to coherently synthesize this information and make the most profitable decisions possible. Ultimately, this value is illustrated in the profit matrix because it synthesizes all of these decisions in a profit per acre number.

These profits per acre numbers vary because of the impact of varying yields and prices. For example, in the illustrated example (Exhibit 3), if the hypothetical wheat farmer produced their APH of 45 bushels per acre and the cash price at harvest ended up being the current cash price of \$7.30 per bushel, then the realized profit per acre would equal \$71. Now, holding yields

constant, if cash prices were to rise, then profits per acre would rise. Conversely, if cash prices were to fall, profits per acre would fall to a minimum of \$68 per acre at a price of \$6.85 per bushel. Below that per bushel price, crop insurance payments would flow to the farmer and actually raise their profits.

Knowing where profits could potentially fall is valuable, but having information on the likelihood of these profits per acre numbers would also be valuable. To provide this additional information to the farmer, TMA tracks and shares historical profits so that producers can see where current profits are relative to the past. To make it more tractable for a producer, this historical information is shown in a graph that illustrates the probability of a particular profit per acre opportunity (Exhibit 4). For example, if a hypothetical wheat farmer had the opportunity to lock in \$94 per acre of profit, there would be about a 15 percent chance that profits may go higher. In effect, this figure is a cumulative distribution function or CDF graph. Using this historical information and figure is another way TMA provides value to their producers.

Exhibit 4. Cumulative Distribution Function (CDF) Graph of Historical Profits: Dryland Wheat Example



Other cooperatives do provide similar risk management services to their farmer-owners. Examples of cooperatives helping their members through unique programs include Key Cooperative in Iowa with their AgroMetrix program and Harvest Land Cooperative in Minnesota who link crop input purchasing decisions with grain marketing decisions. While these as well as other cooperatives approach to risk management is different than TMA, the motivation is still the same, providing valuable information to farmers.

Value Proposition for Producers of Varying Size¹

Approximately 40 to 50 percent of TMA's current customer base utilizes some aspects of its risk management approach. The proportion of customers utilizing all three steps to lock in profit per acre is ranging between 10 to 15 percent. Approximately 85 percent of current customers utilize TMA's marketing services including new crop Hedge-to-Arrive (HTA) contracts, cash grain contracts, options, and various over-the-counter contracts.

While there are many value propositions TMA brings to producers, there are also some important realized value differences for producers. Namely, producers of differing sizes do receive and perceive a set of different values. For purposes here, producers are segmented by total number of acres tied to TMA's risk management approach of purchasing inputs, selling grain and purchasing crop insurance. In particular, medium to large sized producers (1,000 acres to 5,000 acres) and very large producers (5,000 acres or more) can extract similar values as discussed above as well as some different benefits. Namely, medium to large sized producers primarily gain value from TMA's ability to absorb margin calls and marketing knowledge. Out of top 200 accounts, 70 percent use TMA's grain marketing services. Very large producers could easily hire their own risk management employee, but utilizing TMA's expertise effectively puts a risk management employee, and even full staff, on the farm without all of the human resource issues that are associated with managing an employee and/or staff. Finally, all producers gain from economies of scale in the purchasing and selling of products as well as TMA's exceptional customer service.

The medium-to-large size farm operators clearly state they receive value from TMA's ability to absorb financing costs as well as their marketing knowledge. One medium-to-large size farm operator stated, "Having to pay for margin calls with my own funds has somewhat been a deterrent for me implementing my own hedging strategy. However, with TMA as a partner, they are willing to cover those margin calls for me because it will ultimately benefit my farm's profitability." The farmer also stated that TMA being much larger than his farm in terms of grain available to market helps lower the interest rate of using debt to finance these margin calls.

Another medium-to-large size farm operator and a new member of TMA stated that marketing knowledge was what attracted him to TMA. "Working with a TMA field marketer at my kitchen table is what sold me on using TMA's risk management services. Their knowledge and profit matrix tool clearly shows the value risk management can bring to my operation." The farmer also stated that while he has a personal relationship with one TMA field marketer, he knows that the entire staff of TMA share insights and discuss agricultural market developments. "In many ways, working with TMA is like employing a risk management division for my farm," stated this new customer of TMA.

In fact, having access to a "risk management division" is an advantage for very large farmers, too. While very large farmers might have the scale and resources to hire their own risk managers,

¹ Within the scope of this case the value to farmers is assessed based on perceptions of farmers who use TMA services. The financial information of TMA clients is not publicly available.

some have stated they will not when they could use TMA's risk management expertise. One very large farmer, which is also a fairly new customer, stated, "We used to do our own grain marketing, but with the amount of volatility today, it just became a task that took a lot of supervision. TMA is able to fill our need for a risk manager that is constantly informed on current market development, future outlook, and, most importantly, is a partner we trust." In many ways, this very large farmer feels that TMA is like a person on his farm's payroll, but with less work to manage.

Finally, two benefits were noted by all farmers regardless of size. First was TMA's holistic approach to risk management. That is, the approach of coupling the grain marketing, insurance and input purchase decision together really helps mitigate market volatility and locks in profits. The second benefit is TMA's commitment to exceptional customer service. One farmer stated, "TMA goes above and beyond the call of duty because that will ensure their future just as much as it will ensure mine. Bottom line, they need me just as much as I need them."

Challenges and Forward Looking Strategic Issues

Through its progressive and comprehensive producer risk management programs, TMA was able to enhance the value to the members of four partner cooperatives. With elevated volatility in agricultural marketplace, risk management services are much needed and demanded by producers. TMA's unique approach to locking in profits combined with exceptional one-on-one client service helped the company to develop a strong relationship with farmers. The company is known widely throughout central Kansas and is well respected for the value it offers to its clients.

While TMA has enjoyed much business success to this point, there are a number of strategic issues that they must address. Below are a set of strategic issues that have been identified:

Strategic Issue #1:

In central Kansas, TMA was the first to employ a profit based risk management approach for their farmers. The question then becomes: how to leverage the momentum from the first-mover advantage, gained through the profit matrix approach to risk management, and to develop long-term sustainable competitive advantage?

Strategic Issue #2:

While TMA is not a cooperative, they operate on a cooperative basis because they are wholly owned by four cooperatives. So, how will TMA continue to grow but maintain the benefits of cooperative structure?

Strategic Issue #3:

There is a growing number of younger more business minded farmers who are characterized as being well-educated and willing to adopt new technology and risk management practices. How

will TMA extend the value proposition to make it appealing to new demographic of farmers while continuing to serve the needs of traditional clients?

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The IFAMR (ISSN #: 1559-2448)