FACTORS AFFECTING ABSORPTIVE CAPACITY AMONG WESTERN CANADIAN GRAIN FARMS

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Abstract

Abstract: Previous research on agricultural innovation has focused on the role farm-level characteristics play in the rate of adoption. While existing studies have accounted for the effects of farm level characteristics such as gross sales and experience on adoption, recent research has begun to examine the role that other resources play in the adoption decision. The objective of this study is to examine the role that social capital, knowledge networks, and other structural and demographic factors play in the development of a firm's absorptive capacity in prairie agricultural system. Using a survey of producers in Saskatchewan, Alberta, and Manitoba, I develop two regression models of absorptive capacity. The results from this study indicate that the ability to assimilate and integrate information on products and processes depends on a producer's utilization of supplier and professional networks, as well as the number of days attending workshops and conferences. The paper concludes with a discussion of various ways farmers can build their absorptive capacity.

Keywords: Absorptive capacity, innovation, learning, social capital

1. Introduction

Producers of agricultural commodities often do not have much control over the prices they receive. Therefore, in order to improve performance they must be able to discover and implement new methods of production that allow them to produce at a lower cost. As many new technologies are developed outside the farm gate, the ability to quickly become aware of and implement new technologies may lead to temporary advantages. These advantages are only temporary as government institutions have been developed to foster innovation within agricultural systems (Klerkx, Aarts, and Leeuwis 2010). Government agencies developed these policy frameworks, as they perceived there was a resource gap in agricultural firms, specifically as it relates to adopting and exploiting innovations.

These public resources aim to equip agricultural firms with additional resources that may be necessary when there is uncertainty regarding the innovation process. However, these resources may not be as effective as hoped as there is still little understanding of the factors that contribute to the ability of firms to become aware of, assimilate, and exploit innovations on their own firms.

Cohen and Levinthal (1990) suggested that a firm's absorptive capacity, defined as their ability to recognize, assimilate, and apply new information, may help explain the success of innovative activities. Recently, research has shown that absorptive capacity is a key determinant of innovation success for agricultural firms (Tepic et al. 2012; Gellynck et al. 2014). Given the link between absorptive capacity and firm-level innovation, research on the factors that contribute to this valuable resource can provide much needed insight.

The purpose of this paper is to advance a model that explains which factors and behaviours contribute to an absorptive capacity within agricultural firms in Canada. Using data from a 2013 survey of grain farms located in Manitoba, Saskatchewan, and Alberta, this paper models the development of the potential and realized absorptive capacity of agricultural firms. The absorptive capacity of the firm i

modelled as a function of demographic (i.e. size, experience, age) and cultural variables (i.e. commitment to learning, social capital, networking).

The contributions of this work highlight some of the factors that are associated with high levels of absorptive capacity. While the research on the consequences of an absorptive capacity are valuable, there remains a need for further research on the determinants of an absorptive capacity to give farm and agribusiness managers greater insight on how they can also develop this important capability. As technology, market demands, and rival firms evolve, farm managers must also be able to innovate or risk being left behind (Barney 1991).

Using two OLS regression models, I find that farmers who question the status quo, have greater amounts of social capital and who utilize networks of suppliers and consultants are more likely to become aware of and be able to assimilate new information into their farm business. I also find that firms with greater amounts of social capital and who value continual learning are more likely to be able to transform and exploit this new knowledge.

The first section below presents a review of the previous literature. Following the literature review, the data and methods are presented. The paper concludes with the results of the model and some recommendations for practitioners.

2. Previous literature

Previous studies in the agricultural and management literature have begun to examine adoption as a function of the willingness of firms to learn, their ability to network with others in their community, and their ability to acquire, transform, and exploit new knowledge (Clark et al. 2007; Lindgaard Christensen et al. 2011; van Rijn, Bulte, and Adekunle 2012; Tepic et al. 2012). However, these studies do not examine the factors that lead to greater awareness and exploitation of new technologies. For example, farms of equal size and experience may have different levels of awareness or skills in assimilating new knowledge into current business models. As such, variables that account for differences in the awareness of technology and the individual implementation of information into the innovation process would further our understanding of the adoption process (Eckhardt & Shane, 2003; Wiklund & Shepherd, 2003).

Factors affecting potential absorptive capacity

Firms choose to change production practices after they determine there is a need for change and they find suitable options for change. Assuming the farmer has identified a need for change, factors such as social interactions with other farmers and suppliers may influence the awareness of opportunities for change. For example, research has shown that firms with broader social networks and greater social capital are more likely to become innovators (Jara-Rojas, Bravo-Ureta, & Díaz, 2012; Maertens & Barrett, 2012; Ramirez, 2013; Sligo & Massey, 2007).

Awareness of new technologies and processes may also be influenced by extension based programs that aim to increase the dissemination of information surrounding new technologies (Dinar, Karagiannis, & Tzouvelekas, 2007; Klerkx et al., 2010; Ortiz, 2006). Additionally, innovation brokers need not be only extension personnel; they could also be other farmers, suppliers, and even paid consultants. Moreover, firms may become aware of new technologies or processes through attendance at workshops, seminars, and conferences (Knowler and Bradshaw 2007; Webb et al. 2010).

Factors affecting realized absorptive capacity

While awareness of and willingness to adopt innovations is important, the ability of the firm to assimilate new knowledge and to exploit this new knowledge are also important. The increasing utilization of technology in agriculture can make subsequent innovation implementations less complicated. As farms implement new technologies and develop their own systems to generate new

knowledge and gather information, they are better able to appropriate new technology into their operations (Cohen and Levinthal 1990). This has led to a growing research field in which innovation and innovative capacity has been explained by the capability of firms to assimilate and exploit new information into their own firms (Vinding 2006; Jansen, Bosch, and Volberda 2005; Tepic et al. 2012).

While building a firm's potential absorptive capacity allows it to develop the choice set for potential new technologies or processes to adopt, it is not sufficient for successful exploitation of these ideas. For example, a manager may be aware of a new technology and may be willing to adopt it, however their ability to assimilate and exploit this new process may limit the rate of adoption. Research has shown that producers who utilize extension services are able to improve performance and close productivity gaps (Dinar, Karagiannis, and Tzouvelekas 2007; Ortiz 2006). Research out of Australia has shown that farmers who utilized specialized consultants and attended workshops were more likely to adopt new technologies (D'Emden, Llewellyn, and Burton 2008).

3. Data and methods

In February and March of 2013, a market research firm administered a survey of agricultural producers across Alberta, Saskatchewan, and Manitoba. The market research firm solicited participants from both a proprietary database of farmers as well as telephone directories. Producers were contacted by email or telephone. In total, the firm sent a link to the survey to 2400 farmers in Alberta, 1600 farmers in Manitoba, and 450 farmers in Saskatchewan. Producers who participated in the survey had their name entered into a drawing for an iPad. A quota of 500 responses was set based on costs of administering the survey and budget availability. In total, 204 farmers from Alberta, 81 farmers from Manitoba, and 201 farmers from Saskatchewan participated in the survey. The analysis that follows uses only responses from 431 grain and mixed (grain and livestock) farms.

The questionnaire included questions on farm and farmer characteristics, as well as questions regarding type and degree of innovation, how farmers use social networks, how farmers acquire and utilize information, and the use of outside expertise in various areas of the farm business. Descriptive statistics of the variables are shown in Table 1.

Figure 1. Descriptive Statistics of Variables used in Model

Variable	N	Min	Max	Mean	Std. Deviation
Farming experience (years)	432	1	70	27.03	13.87
Farm Size (Hectares)	432	.40	10926.52	864.89	1139.48
Number of Employees	432	0	35	1.76	3.26
Number of formal networks	270	0	12	2.36	1.69
How many other farmers do you talk with (about your farm operation) on a regular basis?	383	0	200	8.29	17.73
How many other suppliers do you talk with (about your farm operation) on a regular basis?	392	0	100	4.20	8.98
How many other consultants/advisors do you talk with (about your farm operation) on a regular basis?	382	0	20	1.58	2.39

On average, how many days per year do you spend attending workshops and conferences?	200	0	50	5.20	5.70
Learning Orientation (Sum)	300	9.00	45.00	35.93	6.93
Social Capital (Sum)	358	8.00	40.00	27.17	5.96
In 2012, did you work on your farm for more than 40 hours per week (on average)?	432	.00	1.00	.57	.50
Did you complete a post-secondary degree?	432	.00	1.00	.468	.50
Potential Absorptive Capacity (Sum)	370	7.00	35.00	22.98	5.60
Realized Absorptive Capacity (Sum)	288	11.00	55.00	37.31	8.55

Variables

The ***absorptive capacity*** of the firm was measured using a multi-item measurement scale first developed by Flatten et al. (2011). The scale examines how firms acquire, assimilate, transform, and exploit information in order to become more innovative.

Individual items examine how firms collect information, the rate at which market signals are understood and interpreted, the means and degree to which information is stored and shared, and ultimately how innovative activities are performed and practices implemented. The ***learning orientation*** of the firm was measured using a multi-item measurement scale first developed by Sinkula, Baker, and Noordewier (1997). Items in this scale measure the firm's open-mindedness and its commitment to learning. This scale has been used to explain firm-level innovation in number of studies (e.g. Calantone et al., 2002; Keskin, 2006; Nasution, Mavondo, Matanda, & Ndubisi, 2011). The ***social capital*** of the firm was measured using a multi-item measurement scale developed by Molina-Morales and Martinez-Fernandez (2010). The 19-item scale measures social interaction, trust, shared vision, and involvement in local institutions. This scale has been used to examine the effect of social capital on innovativeness by a number of scholars (e.g. Gronum, Verreynne, & Kastelle, 2012; Molina-Morales, Martínez-Fernández, & Torlò, 2011). Appendix A presents the retained measurement items as well as reliability statistics.

Several structural control variables including farming experience, farm size in acres, and the number of employees were included in the model as these variables have been shown to be important predictors of innovation in previous studies (Gronum, Verreynne, and Kastelle 2012; Argote and Miron-Spektor 2011). I also include the size and range of the producer's network, measured as the number of other farmers, input suppliers, and consultants with whom the producer regularly converses regarding their farm business, the amount of hours spent working on the farm, and whether the producer has a college degree (Daberkow and McBride 2003).

Measurement items from Appendix A were used to develop summated scores used in the analysis. The summated scores for absorptive capacity scales were used as the dependent variable in ordinary least squares (OLS) regressions conducted to test the hypotheses presented earlier. Two models are tested to measure the factors that contribute to both potential and realized absorptive capacity. Absorptive capacity (potential and realized) is modelled in the following manner:

Absorptive Capacity = f (Age of farmer, Years farming experience, Size of farm(hectares), Number of formal networks, Network—farmers, Network— Suppliers, Network—Consultants, Days spent at workshops, Learning orientation, Social Capital, Hours worked on farm per week, Education)

4. Results

The models were tested using an OLS regression in SPSS 22.0. Where data were missing, I used mean substitution to replace the missing data point. In total, the potential absorptive capacity model was significant, with an F-statistic of 32.333 (Sig. = 0.000). The model explains 46 percent of the variation in potential absorptive capacity. The realized absorptive capacity model was also significant, with an F-statistic of 20.249 (Sig. = 0.000). That model explains 35 percent of the variation in realized absorptive capacity.

Potential Absorptive Capacity

From the results in Table 2, we see that the number of networks (both formal and informal) significantly contribute to the respondent's ability to become aware of and internalize new information. Interestingly, the results show a negative relationship between the number of farmers a respondent talks with regarding their farm business and the ability to acquire and assimilate new information. This seems to contradict the finding regarding networks, but in total, the effect is positive. It may be that farmers gain better information at networks, even if they are informal, than they would in a general discussion with another producer. This may be driven by the fact that producers wish to gain some valuable information from participating in the network, so they share valuable information in order to get other producers to do likewise, thereby increasing the value of the network for all parties.

The results also show the use of advisors and consultants has a positive and significant effect on the ability to become aware of new information. As consultants may become aware of new information faster, and see how other farmers are implementing this information, the information shared by consultants may carry more weight. Perhaps there is also a size effect here as managers of larger farms may be more inclined to hire a consultant and this in some way is accounting for managerial competency.

The results show that firms who view learning as an investment also have higher levels of absorptive capacity. For each one-unit increase in the firm's learning orientation, we would expect a 0.233 unit increase in the potential absorptive capacity of the firm. The results also show that firms with greater levels of social capital, exemplified by the use of external networks for information and ideas, also have higher levels of potential absorptive capacity.

Table 2: Factors affecting development of Potential Absorptive Capacity

Dependant Variable: Potential Absorptive Capacity	B	Std. Error	t-stat	Sig.
(Constant)	-.500	1.403	-.357	.722
Number of formal or informal networks	.321**	.144	2.226	.027
Experience	.015	.014	1.081	.280
Number of other farmers you talk with (about your farm operation) on a regular basis	-.041***	.013	-3.160	.002
Number of suppliers you talk with (about your farm operation) on a regular basis	.037	.027	1.396	.163

Number of consultants/advisors you talk with (about your farm operation) on a regular basis	.257***	.091	2.807	.005
Days per year attending workshops and conferences	.096*	.052	1.838	.067
Work > 40 hrs per week	-.155	.391	-.397	.692
Completed degree	.352	.385	.913	.362
Farm size (hectares)	.000	.000	1.411	.159
Total Employees	-.015	.062	-.237	.812
Learning Orientation	.233***	.035	6.686	.000
Social Capital	.478***	.037	12.865	.000

*, **, ***, indicate significance at 0.10, 0.05, and 0.01 levels

R-squared: 0.481; Adjusted R-squared: 0.466; F-statistic: 32.333, Sig: 0.000

Realized Absorptive Capacity

Table 3 presents the results of the model analysing the drivers of realized absorptive capacity. Unlike the potential absorptive capacity model, belonging to formal or informal networks did not significantly increase the respondent's self-rating of their ability to transform and exploit new information. The size of the farm was also shown to be positive and significant; however, the coefficient was not large.

Results of the model indicate that consultants are important sources of information regarding the innovation implementation process. Each consultant or advisor that the farmer speaks with about their farm is associated with a 0.224 increases the perceived usefulness and exploitability of new information. Again, this may be somewhat related to the nature of the consultancy business as well as the ability of managers who hire consultants as they typically operate larger farms.

Table 3: Factors affecting development of Realized Absorptive Capacity

Dependant Variable: Realized Absorptive Capacity	B	Std. Error	t-stat	Sig.
(Constant)	8.940***	2.085	4.288	.000
Number of formal or informal networks	.198	.214	.924	.356
Experience	.008	.020	.380	.704
Number of other farmers you talk with (about your farm operation) on a regular basis	-.019	.019	-.971	.332
Number of suppliers you talk with (about your farm operation) on a regular basis	-.025	.040	-.619	.537

Number of consultants/advisors you talk with (about your farm operation) on a regular basis	.224***	.136	1.648	.100
Days per year attending workshops and conferences	.043	.077	.555	.579
Work > 40 hrs per week	.058	.580	.100	.921
Completed degree	-.356	.572	-.621	.535
Farm size (acres)	.000479***	.000	1.856	.064
Total Employees	-.140	.092	-1.513	.131
Learning Orientation	.374***	.052	7.216	.000
Social Capital	.512***	.055	9.286	.000

*, **, ***, indicate significance at 0.10, 0.05, and 0.01 levels

R-squared: 0.367; Adjusted R-squared: 0.349; F-statistic: 20.249, Sig: 0.000

The learning orientation and social capital of the firm are again positive and significant. This indicates a strong relationship between a manager's view of learning as an investment and open-mindedness and the operation's ability to transform and exploit new knowledge that it is able to acquire. Moreover, firms who actively engage suppliers in developing new activities on the farm are in a better position to exploit these new ideas for profit.

5. Discussion

The objective of this paper was to examine the factors that contribute to building the absorptive capacity of agricultural firms. Cohen and Levinthal (1990) defined absorptive capacity as the ability of firms to assimilate, integrate, and exploit information that is new to the firm. Within agricultural settings, recent studies have shown that firms with greater levels of absorptive capacity have more successful innovation outcomes (Tepic et al. 2012; Gellynck et al. 2014). Using a survey of grain farmers located in Western Canada, this study contributes to the literature by examining the factors that build this valuable resource. These results show that social interactions with other producers and suppliers, enhanced through greater social connectedness within the community, enhance the firm's ability to acquire, assimilate, and take advantage of new information.

Firms interested in becoming more innovative may look to these results for practical ways of improving the outcomes of these activities. It is important to note, that the results presented here can be thought of as 'flow' variables (Dierickx and Cool 1989) in the sense that they can be easily adjusted year to year. For example, the results show that belonging to a formal or informal network of producers and attending conferences and workshops improves the ability of Western Canadian farmers to source and integrate new information into their farm business. This may be more clearly illustrated by what was not significant, as age, experience, and the level of education of the respondent were not shown to affect absorptive capacity.

The results show that farmers who viewed learning as an investment and were more open- minded about their farm business have increased potential and realized absorptive capacity. In essence, those managers who continually question their assumptions and look for new ways of doing things are more likely to discover and implement these new processes. Moreover, producers who belong to formal or informal networks and who utilize consultants are also able to benefit. Perhaps not surprisingly,

attendance at conferences and workshops is shown to be a good source for acquiring information, but less important when it comes to implementing the innovation.

The information from consultants is shown to be much more valuable from an absorptive capacity standpoint than the average farmer, both in terms of potential and realized absorptive capacity. This may be because a consultant is able to observe these changes in production agriculture across a range of farms (and in more depth) than could many individual farmers. Moreover, consultants are likely to share only information about successful innovations in order to preserve their brand as a knowledge broker.

Using these results, farmers can see how straightforward changes on their farm can lead to an increase in their ability to gather, assimilate, and exploit new information. Future research in this area could examine factors within formal and informal networks that lead to greater levels of absorptive capacity.

6. Acknowledgements

The author would like to thank the Structure and Performance of Agriculture and Agri- products Industries for funding this research.

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Appendix A

Reliability estimates and descriptive statistics of multi-item measurement scales[a]

Parameter	Descriptive Statistics		
	Mean	Standard Deviation	Corrected Item-to-Total Correlation
Learning Orientation (Alpha = 0.897)			
Our ability to learn is the key to our competitive advantage.	4.03	1.042	.757
The values of our farm include learning as key to improvement.	4.12	.973	.707
Employee learning is an investment, not an expense.	3.98	1.010	.665
Learning is seen as a key commodity necessary to guarantee survival.	3.99	1.047	.694
Once we quit learning, we endanger our future.	4.14	1.049	.636
We are not afraid to reflect critically on the shared assumptions we have about the way we do business.	3.71	1.060	.560
Our farm places a high value on open-mindedness.	4.12	.989	.619
We encourage employees to think outside of the box.	3.92	1.107	.657
Original ideas are highly valued on our farm.	3.91	1.083	.651
Social Capital (Alpha = 0.837)			
A common academic background of the employees of neighbouring farms and businesses allows social interactions to take place.	3.29	1.166	.686
I have an informal network among customers, suppliers and competitors.	2.68	1.216	.458
I consider that other companies feel a special duty to stand behind me in times of trouble, so I consider it only fair that my farming operation should also give support to other companies.	3.39	1.091	.583
I consider that our farm's future is related to other firms in the area.	3.47	1.054	.537

My farm has received considerable information about products and markets from local institutions.	3.40	1.056	.683
Establishing networks with suppliers and customers has had a significant impact on developing new ideas for our farm	3.25	1.026	.675
Establishing networks with suppliers and customers has had a significant impact on the acquisition of important resources	3.02	1.113	.606
Establishing networks with suppliers and customers has had a significant impact on the development of new activities on our farm	3.38	1.023	.646
Potential Absorptive Capacity (Alpha = 0.855)			
People on our farm have frequent interactions with business partners to acquire new knowledge.	3.26	1.173	.667
We collect industry information through informal means (e.g. lunch with industry friends, talks with trade partners).	3.35	1.122	.540
We quickly recognize how changes in regulations affect our farm.	3.48	1.055	.555
We quickly recognize changes in technical possibilities.	3.36	1.067	.675
New opportunities to serve our business partners are quickly understood.	3.23	1.038	.644
Our farm allocates a lot of time to deliberating with advisors in order to quickly recognize market changes.	2.95	1.148	.592
We quickly analyse and interpret changing market demands.	3.34	1.055	.662
Realized Absorptive Capacity (Alpha = 0.912)			
Our farm regularly considers the consequences of changing market demands in terms of new products and services.	3.51	1.005	.685
Employees on our farm record and store newly acquired knowledge for future reference.	3.14	1.148	.662
Our farm quickly recognizes the usefulness of new external knowledge to existing knowledge.	3.54	.980	.737
Each month we discuss with advisors how changes in the market can be used to make changes to our farm business.	2.86	1.226	.630
We allocate a lot of time to the application of external information to our farm business.	3.03	1.070	.699
It is clearly known how activities within our farm should be performed.	3.80	.972	.617
Our farm has a clear division of roles and responsibilities.	3.67	1.068	.565
We constantly consider how to better exploit knowledge.	3.47	1.078	.717
We convert external information directly into new business applications to be used on our farm.	3.13	1.036	.647
Employees have a common language regarding our farm's products and services.	3.57	1.115	.667
Application of external information to our farm contributes to our profitability.	3.60	1.004	.685

a. Only retained items displayed