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Internet Adoption and Use of E-commerce Strategies by Agribusiness Firms in Alabama

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Abstract

Electronic commerce (e-commerce) is relatively new to the agricultural industry, and affects such aspects of the organization as its strategy, processes, customer relationships, information technology, and business culture. This paper analyzes the factors influencing agribusiness firms' desire or need to adopt the Internet and employ e-commerce strategies. The relationship between the factors driving the choice of distribution channel and Internet usage for e-commerce will empirically be estimated. This study will also assess how Internet adoption and the use of e-commerce strategies impact rural development and the overall sustainability paradigm.

Introduction

E-commerce involves business transactions carried out electronically between a company and other companies (B2B), companies and consumers (B2C), and the public sector and consumers (Stair and Reynolds, 2001). It is “the buying and selling of information, products, and services via computer networks” (Bloch, et al., 1996). This definition includes the support for any kind of business transactions over a digital infrastructure; and is consistent with Henderson (2001) who views e-commerce as the purchase of goods and services over a computer-based network. The Internet reduces transaction costs for business firms, and provides consumers with more choices, more control over purchasing decisions, and lower prices, in some cases. By automating purchasing functions, companies can eliminate mistakes and costs associated with data entry of paper invoices (Henderson, 2001). Further, the availability of information through automated systems also improves product flows, forecasting for product demand and input supply and overall business management.

Within agriculture, B2B sales are predicted to grow from \$34 billion in 2000 to \$124 billion in 2004 (Little, 2000). In 2004, agriculture is projected to be the fifth largest industry sector (following chemicals, computing, industry equipment, and energy), accounting for 8 percent of the total B2B online economy (Goldman Sachs, 1999). As agribusiness firms turn to the Internet for a new channel of business transactions, insight into its usage is important. Today, businesses view the movement of products and services through a supply-chain management lens. The supply-chain performs seven functions – i.e., *processing or manufacturing, negotiations, transaction, logistics, promotion, financing, and information* (Henderson, et al., 2000). As agribusiness firms engage in e-commerce, these functions guide its implementation.

Aldridge, et al. (1999) discusses the popularity of the Internet, the nature of business on the Net and various marketing strategies. They note that between the 1960’s and 1990’s, the Internet had grown explosively, linking users with the whole electronic world, and providing the means to interact with that world. This growth has been accompanied by an increase in the Internet user’s population. According to

Henry (1996), four percent of the population had Internet access in 1995; increasing to 19 percent in 1996 (Aldridge, et al., 1997). As a result of the growth in Internet user population, many businesses have been lured into planning for Internet marketing. A study by America Online in 1999 showed that e-commerce was the fastest growing online activity, and was responsible for driving overall adoption of the Internet.

Agribusiness firms, like all other firms, face the challenge of changing their business model and practices to account for the rapid growth of e-commerce. According to the U.S. Department of Agriculture (USDA), over 42 percent of online market activity in 1999 involved purchasing crop inputs, and online buying was related to farm size (USDA, 2000). Between 1997 and 1999, the number of farms having Internet access increased to 29 percent; in 1999 15 percent of US farms and ranches conducted e-commerce transactions. In a study by Chambers, et al. (2001), the impact of e-commerce on U.S. agriculture, both at the farm and agribusiness level, was investigated. However, the results were inconclusive based on the limited data, which were mostly gathered from magazines, newspapers and talking with industry people (Chambers, et al., 2001).

Numerous studies have explored computer adoption by farmers but few have explored Internet adoption and e-commerce usage. In particular, very little is known about the extent of Internet/e-commerce in Alabama's agribusiness firms. Overall, the effect of e-commerce on the agricultural sector and its implications for farmers and agribusiness firms remains a controversial issue. This study seeks to contribute to the debate and understanding of the adoption of the Internet and use of e-commerce strategies by agribusiness firms in Alabama.

Study Objectives

The overall objective of this study is to contribute to the understanding of the adoption of information technology and e-commerce use by Alabama agribusiness firms. More specifically, this study focuses on identifying the factors or reasons why agribusiness firms adopt the Internet and use e-commerce strategies. The study will also assess how the adoption of the Internet and use of e-commerce strategies would impact rural development and the overall sustainability paradigm in Alabama's non-

metro communities. It is hypothesized that multiple factors are associated with Internet adoption and use of e-commerce, and that both e-commerce use and Internet adoption promote economic development.

Data and Methodology

A survey instrument based on one by the Center for Agricultural Business at Purdue University (Henderson, et al., 2000) was developed and used to collect the data to examine the adoption and use of Internet/e-commerce strategies by agribusiness firms in Alabama. A master list of the agribusiness firms in Alabama was obtained from the Alabama Industrial Directory 1999-2000. Given the relatively small number of agribusiness firms in Alabama as given by the aforementioned source, the questionnaire was mailed to all 410 agribusiness firms listed in the Directory in February 2002. Of the 410 questionnaires mailed, a few of them were undeliverable for various reasons, but primarily because firms moved out of state and left no forwarding address or because the firm was no longer in existence. Sixteen (16) firms either retired or did not want to participate in surveys. When these discrepancies were corrected and accounted for, a total of 325 verifiable firms in Alabama remained. Thus, after two mailings and several follow ups, 95 usable responses were received, giving a response rate of 29.23 percent. The instrument solicited information as to whether or not the business had a web site, type of features available on the web site, manager's general opinion of e-commerce, actual or potential barriers to e-commerce for farmers, and factors affecting the implementation of e-commerce strategies by agricultural firms.

(i) *The Dependent Variable*

The development of the dependent variable follows the procedure by Henderson, et al. (2000) and Boehlje, et al. (2000). Manager responses to whether the firm had a web site, and the type of features included on the web page were used to categorize the agribusiness firms into three Internet usage categories: Non-User, Basic User and Power User. Firms without a web site were classified as Non-Users. Power User firms were differentiated from Basic Users based on the type of features found on the firm's web site (Table 1). Power Users were classified as those

having web sites containing one or more advanced feature (G to K in Table 1). These included online ordering, making payments online, and password protected areas. This level of Internet usage (INETTUSE) becomes an ordered discrete dependent variable, and is given a value of 0 if a Non-user, 1 if a Basic user, and 2 if a Power user.

Table 1: Features Found on Web sites

Features
A. Technical information about the products that you sell
B. Pricing information for the products that you sell
C. Background information about your company
D. A dealer directory (information on where your products are sold)
E. Links to industry trade associations
F. Links to other data/information sources (e.g. USDA, Universities)
G. Online ordering (but traditional means of payment)
H. Online ordering and payment
I. Online communities (I.e. chat rooms, bulletin boards, message centers, virtual coffee shop, etc.)
J. Areas with content customized to different audiences or individuals
K. A password protected area, only accessible to registered customers or suppliers

By collapsing Basic and Power users into a single group of Internet users, we have a situation that measures Internet adoption (INETDOPT). It is assumed that INETTUSE and INETDOPT are affected by the same factors - i.e. the characteristics of the firms and the supply chain functions.

(ii) *Independent Variables: Supply Chain Functions*

The agribusiness managers were asked to give their general opinion on Internet/e-commerce usage, possible barriers to farmer adoption of e-commerce, and reasons that would support rapid adoption of e-commerce and purchasing over the Internet by farmers. The opinion and perception responses were provided on a 5-point Likert scale, and were used to develop independent variable measures for the supply-chain model.

There were 10 general opinion questions that related to e-commerce (Table 2 in Appendix 1). A response of strong agreement is coded as 1, whereas a strong disagreement response is coded as 5. As can be seen in Table 2 (Appendix 1), each question was classified into a supply chain function.

The first opinion question (O1) where managers were asked if e-commerce would fundamentally change the way the agribusiness industry would conduct business was considered to be a logistic function. Strong agreement with this statement should indicate an increased probability of implementing an e-commerce strategy. The second opinion question (O2) asked whether e-commerce would reduce the role of local dealers is categorized as a transaction function. A strong disagreement with this statement should lead to higher willingness to adopt an e-commerce strategy, and is expected to have a positive relationship with both INETTUSE and INETDOPT.

General opinion question (O3) asked managers whether e-commerce would improve their firm's ability to manage inventory levels. This is a logistic function and is expected to have a positive relationship with INETTUSE and INETDOPT. Strong agreement with the statement should lead to higher willingness to implement an e-commerce strategy. The general opinion questions (O4) and (O5) refers to e-commerce promoting sustainable economic development in rural Alabama and if its adoption would make the company economically viable and/or sustainable. These statements were classified as financial or economic functions, and are labeled GO4 and GO5 respectively. The general opinion questions (O4) and (O5) are expected to positively influence INETTUSE and INETDOPT. Thus, a strong agreement with the statements should lead to higher probabilities of Internet adoption and e-commerce use as a business strategy. The rest of the supply chain functions are similarly defined and constituted as shown in Tables 2, 3 and 4 in Appendix I.

(iii) Control Variables

Three control variables were included in the model: size, scope and the type of product marketed by the firm. The size (FIRMSIZE) of the company was determined from the survey using the firm's annual sales. This is a continuous variable with the midpoint of each sales category range used as a proxy for size. The global scope (FIRMSCOP) of the company was given a value of 1 if the company had an international scope and 0 otherwise. Both FIRMSIZE and FIRMSCOP variables are expected to have positive relationship with INETTUSE and INETDOPT. Finally, the product the firm sells (PRODSERV) was hypothesized to influence Internet adoption and e-commerce use by agribusiness firms. In this study, the products sold through e-commerce included machinery, tools and parts, seeds, feed, grain, financial and consulting services. PRODSERV was expected to have a positive relationship with both INETTUSE and INETDOPT.

Estimation and Empirical Results

As noted above, the choice and intensity of Internet adoption and e-commerce use by business firms is assumed to be influenced by management's perceptions of the functions of the supply-chain. The size of the firm, market scope and the product sold by the firm are also expected to influence INETTUSE and INETDOPT. In this paper, both INETTUSE and INETDOPT are qualitative in nature. The estimation of qualitative models by the traditional regression models produces biased estimates (Gujarati, 2002). Therefore, the specified equations in this study are estimated using discrete choice models such as logistic regression and probit analysis techniques.

The majority of respondents were in upper management positions, such as presidents/owners (45 percent), Managers (11 percent), and general managers (10 percent). Other management positions included production/operations/distribution/logistics (7 percent), chief financial officers (CFOs) and marketing managers (4 percent each). Table 5 shows that about 23 percent of the firms with respondents in a President/Chief Executive Officer (CEOs)/Owner position had a web site, and

about 8 percent of the firms with respondents in a Production/Operation/Distribution or Logistic manager management position had a web site.

Table 5: Type of manager whose company has a Web site

Category	Percent
President/CEO/Owner	23.33
Vice President/General Manager	6.67
Manager/Division President	6.67
CFO/Controller/Treasurer/Finance	4.44
Marketing (Manager, Director, Product)	4.44
Sales/Sales Management	2.22
Production/Operations/Distribution/Logistics	7.78
Human Resource Manager	2.22
Other	7.78

The primary interest of the agribusiness firms included farming/ranching, grain merchandising/processing, fertilizer, feed and seed. The majority of these companies were manufacturers, distributors or dealers; privately owned, and found regionally or nationally. Average sales of the companies ranged between 5 and 19 million dollars. The products marketed by the firms included machinery and tools and parts (7 percent each), grains and seeds (4 percent each), crop inputs (5 percent), and consulting services (4 percent). The main features found on a firms' web site were background information (53 percent), price information (11 percent), and technical information (40 percent).

Several opinions were given as possible barriers to farmer adoption of e-commerce (Table 3 in Appendix 1). The responses of managers showed a general consensus that there are minor barriers to farmer adoption of e-commerce. In general, privacy was a major barrier whereas access to the Internet, the ability to make product recommendations and find desired information conveniently on the Internet were considered to be minor barriers to adoption. Managers chose to remain neutral on the issues of security, trust and the ability to provide service to farmers after the sales transaction has occurred.

(i) *Adoption of Internet/E-commerce Strategies*

Internet/e-commerce adoption was estimated using the logistic regression model (logit model). In order to determine the rate of adoption, managers were asked whether the firm had a web site or not. If the manager responded that the firm has a web site, then that firm was classified as an adopter. The parameter estimates for the logistic regression model are shown in Table 6. The standard errors indicated that all variables except firm size were statistically significant at the 5 percent level.

The statistical significance of the FIRMSCOP variable indicates that a firm with an international scope is more likely to adopt Internet/e-commerce strategies than one with only a local scope. The likelihood of firms adopting these strategies was also increased if finance (FINAANCE) and transaction (TRANSACT) were the firm's major supply chain functions. The positive sign of the FINAANCE and TRANSACT variables suggests that managers who perceive that e-commerce will promote sustainable economic development in rural Alabama are more likely to adopt Internet/e-commerce strategies than those who disagree. This is also true with managers who perceive that purchasing over the Internet is more convenient than traditional means. The positive sign for the logistics variable suggests that the likelihood of a firm adopting Internet/e-commerce strategies increases if that firm's major supply chain function is distribution. The type of product marketed by the firm (PRODSERV) also has a significant positive influence on the adoption of Internet and e-commerce strategies. These results, especially FINAANCE, suggest that most of the firms agree that e-commerce would promote sustainable economic development in rural Alabama as well as make their firms economically viable and sustainable.

Table 6: Parameter Estimates of the Logit and Probit Models

Parameter	LOGIT		PROBIT	
	Estimate	Std Error	Estimate	Std Error
INTERCPT	-5.907	1.535	-3.409	0.679
INTERCP2	-	-	2.118	0.284
FIRMSCOP	3.299	0.832*	1.936	0.406*
FIRMSIZE	0.032	0.026	0.023	0.014**
PROMOOTE	0.789	0.666	0.292	0.322
INFORMAT	0.479	0.579	0.215	0.285
FINAANCE	1.777	0.725*	1.173	0.331*
LOGISTIC	1.090	0.599**	0.731	0.299**
TRANSACT	1.467	0.702*	0.569	0.343**
NEGOTIAT	0.511	0.726	0.619	0.383**
PRODSERV	1.887	0.953**	1.015	0.407*
Log Likelihood		39.103		-65.198

** Parameter significant at the 0.05 level.

* Parameter significant at the 0.10 level.

Definition of Explanatory Variables Used in the Models

Variable	Definition of Variable	Variable Type
FIRMSCOP	= 1 if firm distributes locally or state-wide; 0 otherwise	Dummy
FIRMSIZE	= Mid-point of the range of annual sales of the company (\$ Million)	Continuous
PROMOOTE	= 1 if respondents agreed with statements of RECOMMEND ² or SERVICE ² or NETCHOIC ³ or COMPARES ³ ; 0 otherwise.	Dummy
INFORMAT	= 1 if respondents agreed with statement GO6 ¹ or considered INFORMAT ² to be a barrier or INEASE ³ to be a supporting factor; 0 otherwise	Dummy
FINAANCE	= 1 if there was agreement with GO4 ¹ or GO5 ¹ ; 0 otherwise	Dummy
LOGISTIC	= 1 if there was agreement with GO1 ¹ or GO3 ¹ or GO10 ¹ ; 0 otherwise	Dummy
TRANSACT	= 1 if response was of agreement with GO2 ¹ or GO8 ¹ or considered SECURITY ² or PRIVACEE ² to be a barrier or CONVINET ³ to be a supporting factor; 0 otherwise	Dummy
NEGOTIAT	= 1 if response was in agreement to GO9 ¹ or considered INTRUUST ² not to be a barrier or considered INACCESS ² to be a supporting factor; 0 otherwise	Dummy
PRODSERV	= 1 if products sold are crop inputs or services (financial or otherwise); 0 otherwise.	Dummy

¹ Explained in Table 2. ² Explained in Table 3. ³ Explained in Table 4

(ii) *Use of Internet/E-commerce Strategies*

The estimated model parameters and variable definitions for the probit model (used to measure level of usage) are also presented in Table 6. The parameters are a combination of different opinion, barrier and factor statements (Tables 2, 3 and 4 respectively). The model shows that there is a positive and significant relationship between the dependent variable, INETTUSE, which depicts level of Internet/e-commerce strategy usage, and 7 of the independent variables.

The FIRMSCOP variable is statistically significant at the 5 percent level, implying that the probability of the level of Internet/e-commerce usage increases as the firm increases its scope. Empirical results also reveal that more users agree that e-commerce will promote sustainable economic development in rural Alabama as well as within their firms. This is reflected in the variable FINAANCE, which is positive and statistically significant at the 5 percent level. The perception of increased sustainability is likely to lead to higher usage of Internet/e-commerce strategies by agribusiness firms in Alabama.

The positive sign for the FIRMSIZE variable suggests that size of the firm is one of the major factors that drive Internet/e-commerce usage. This implies that the larger the firm, the more the likelihood that the firm will use e-commerce as a business strategy. Results from the survey show that firms with annual sales of at least \$40 million are likely to use Internet/e-commerce strategies and to have advanced features on their web site. Intuitively, it is possible to expect progressive small firms to also use more of these strategies in order to have a competitive advantage with the larger firms as well as to keep their customers from gravitating to where they might find convenience. However, this element is not captured in this study. This study only suggests that firm size matters, implying that as the size of the firm increases, the likelihood of the firm adopting the Internet or employing e-commerce as a business strategy increases. This finding is consistent with previous studies (Henderson, et al. 2000 and USDA, 2000) which found that larger firms were more likely to implement Internet/e-commerce strategies.

Conclusions

Although many agribusiness firms in Alabama have adopted e-commerce strategies, there is a high perception (24 percent) that farmers are unwilling to buy products over the Internet. Managers also believe that the issue of privacy plays a vital role in whether the farmer will purchase products over the Internet. The results show that 41 percent of the firms that have adopted the Internet perceive the issue of privacy as a barrier to adoption of e-commerce by the farmers, whereas only 15 percent of those that have not adopted e-commerce strategies consider the privacy issue to be a barrier.

Distribution (logistics) is a major function in the supply chain. Managers must be able to move their products from one location to the next with ease. This is one major concern among both those who have adopted and those who have not adopted Internet/e-commerce strategies. Thirty percent of those who have adopted e-commerce agree that distribution issues would limit the sale of their industry's products over the Internet.

Functions of the supply chain do influence significantly the likelihood of Internet/e-commerce adoption and the level of usage by Agribusiness firms in Alabama. Firms are more likely to adopt and use Internet/e-commerce strategies if product comparisons and recommendations can be made on the Internet; if there is the ability to improve inventory management and increase sales through improvements in distribution and logistics systems. Both the logistic and probit models suggest that the negotiation and finance functions in the supply chain are important and significantly influence Internet adoption and intensity of usage of e-commerce strategies. Scope and size of the firm are also important variables in Internet adoption and e-commerce usage. Large agribusiness firms with an international scope are more likely to adopt or use Internet/e-commerce strategies than those whose scope is largely local. This could reflect the need to reach a more geographically diverse and/or wider customer base.

The positive relationship between the dependent variables (Internet adoption and e-commerce use) and the product variable (PRODSERV) indicates that firms selling products such as seeds, feeds, grains and crop inputs, and services, such as consulting services, crop services and financial services, are more likely to adopt the Internet and use e-commerce strategies than those selling machinery, tools and

parts. This is understandable because most people buying high-priced items would probably like to be able to examine, see and feel what they are buying.

The findings of the logistic and probit models are consistent with previous literature, which found that functions of the supply chain, the scope of the firm and the type of product marketed by the firm enhanced the adoption of the Internet and use of e-commerce strategies. Little (2000) found that more farmers were turning to the Internet to reduce production costs and increase sales. With such a technology, farmers would be able to search for the inputs that they need and do price comparisons.

Important issues in the adoption of Internet and usage of e-commerce lie within (1) the logistics function: how is the firm going to distribute its product and manage its inventory; (2) the transaction function: is it convenient for the farmer to buy products over the Internet and how secure and private are the transactions making farmers willing to purchase their products online; (3) the negotiation function: can they develop personal relationships with the farmers over the Internet and can the farmers trust them; (4) the finance or economic function: will e-commerce make the company economically viable and sustainable as well as promote economic development in rural Alabama; (5) scope of the firm: is the firm located nationally, regionally or internationally. These issues are considered to be more important to agribusiness firms in Alabama.

From the responses, managers perceive that if the Internet were implemented in rural Alabama as well as within firms it would empower rural communities and enable them to contribute to the development process. The Internet would give rural communities access to knowledge, technology and service, which would contribute to expanding and energizing agriculture. Employment opportunities would be created, encouraging the educated and informed to return to rural Alabama. The adoption of the Internet and use of e-commerce strategies would enable farmers to promote their products, interact with each other, suppliers, customers, and intermediaries. In consensus with Richardson (1997), the Internet can provide new communication channels for rural communities in Alabama and agricultural organizations thus supporting sustainability and enhancing economic development.

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Appendix I

Table 2: General Opinions about E-commerce

Question and Statement	Variables	Supply Chain Function	Expected Sign
O1. E-commerce will fundamentally change the way we do business in our industry in the next five years.	GO1	Logistic	+
O2. E-commerce will reduce the role of local dealers in our industry in the next five years.	GO2	Transaction	+
O3. E-commerce will improve my company's ability to manage inventory levels in the next five years.	GO3	Logistic	+
O4. E-commerce will promote sustainable economic development in rural Alabama.	GO4	Financial	+
O5. E-commerce adoption will make my company economically viable and sustainable.	GO5	Financial	+
O6. Information about increasingly complex products is difficult to provide over the Internet.	GO6	Information	-
O7. Internet offers excellent business possibilities and opportunities for farmers and agribusiness firms.	GO7	Promotion	+
O8. Farmers are unwilling to buy products on the Internet	GO8	Transaction	-
O9. Personal relationships with customers are difficult to be developed over the Internet.	GO9	Negotiation	-
O10. Distribution (logistics) issues will limit sale of my industry's products over the Internet.	GO10	Logistics	-

Level of agreement with the previous statements were indicated on a 5-point Likert scale where 1 = Strongly Agree, 2 = Somewhat Agree, 3 = Agree, 4 = Somewhat Disagree, and 5 = Strongly Disagree.

Table 3: Barriers to E-commerce Adoption by Farmers

Question and Statement	Variables	Supply Chain Function	Expected Sign
B1. Farmers do not have Internet access.	INACCESS	Negotiation	-
B2. Farmers lack the required trust to make Internet purchases.	INTRUUST	Negotiation	-
B3. The Internet offers limited ability to provide product recommendations to farmers.	RECOMEND	Promotion	-
B4. The Internet offers limited ability to provide after sales service to farmers.	SERVIICE	Promotion	-
B5. Farmers are unable to find desired information conveniently on the Internet.	INFORMAT	Information	-
B6. Farmers question the security of e-commerce.	SECURITY	Transaction	-
B7. Farmers question the privacy of e-commerce.	PRIVACEE	Transaction	-

Level of agreement with the previous statements were indicated on a 5-point Likert scale where 1 = Not a Barrier, and 5 = Major Barrier.

Table 4: Factors Supporting Rapid Adoption of E-commerce by Farmers

Question and Statement	Variables	Supply Chain Function	Expected Sign
F1. Information can be obtained more easily off the Internet.	INETEASE	Information	+
F2. More product choices will be available over the Internet.	NETCHOIC	Promotion	+
F3. Buying over the Internet is more convenient than traditional channels.	CONVINET	Transaction	+
F4. It is easier to make product comparisons over the Internet.	COMPARES	Promotion	+

Level of agreement with the previous statements were indicated on a 5-point Likert scale where 1 =Not a Factor, and 5 = Major Factor.