International Food and Agribusiness Management Review
Volume 10, Issue 1, 2007

An Empirical Analysis of the Determinants of Success of Food and Agribusiness E-Commerce Firms

Fernando Montealegre [a] , Sarahelen Thompson [b]Ⓘ, and James S. Eales [c]

[a] *Former Graduate Research Assistant, Department of AgriculturalEconomics, Purdue University, 403 W. State St., West Lafayette, Indiana 47907-2056, USA.*
[b] *Professor and Department Head, Department of AgriculturalEconomics,, Purdue University, 403 W. State St., West Lafayette, Indiana 47907-2056, USA.*
[c] *Professor, Department of Agricultural Economics,Purdue University, 403 W. State St., West Lafayette, Indiana 47907-2056, USA.*

Abstract

E-commerce's value creation in agricultural and food markets will only occur to the extent that e-commerce firms exist throughout the supply chain. The problem is that e-commerce firms throughout the agricultural and food supply chain have faced a serious challenge in staying in business. Many have been forced to exit the market, and only a few have survived to develop into functional web-based businesses. The objective of this research study is to identify characteristics that are associated with successful e-commerce firms throughout the agricultural and food supply chain. Relevant e-commerce and agricultural e-commerce literature suggests several characteristics that influence the success for agricultural and food e-commerce firms. A limited-dependent variable technique, logistic regression, is used to relate websites' characteristics to their probability of survival.

Keywords: e-commerce, food chains, survival probability, logistical regression

Ⓘ Corresponding author: Tel: + 765-494-4191
Email: sallyt@purdue.edu

Other contact information: James S. Eales: eales@purdue.edu

Introduction

Agriculture and the food supply chain in general possesses a history of quick adoption and assimilation of new technologies, especially cost reduction technologies. Agriculture was identified as one of the great promises of e-commerce; the high level of fragmentation present in the supply chain, large volumes traded, and homogeneous products only reinforced the expectations.

Internet technology has provided the possibility for cost reduction and demand enhancement along the food supply chain through the use of e-commerce. Automation has the capacity to substantially reduce transaction and procurement costs. E-commerce can improve firm efficiency by reducing inventory levels, transportation costs, and order and delivery time. E-commerce markets are expected to be more transparent and more perfectly competitive than physical markets, conditions which should attract more consumers and thus increase demand. The contribution of internet technology to food chains has the potential to release value that was previously locked by higher costs along the food chain.

Electronic markets for agricultural products have been around since long before the internet came into existence. Since the mid 1970s certain agricultural industries supported electronic trading mechanisms. Two especially successful pioneers in electronic trading in agriculture are the Egg Clearing House, a computerized egg exchange, and TELCOT, an electronic cotton trading mechanism established in 1975 to promote transparent cotton pricing (Wheatley, Buhr, and DiPietre, 2001).

Twenty years later, Farms.com was established as the first agricultural e-commerce website on the internet. The internet reduced the costs of running an electronic trading platform. The industry was optimistic that this new technology would reinforce perfect competition, decrease transaction costs, and bring opportunities to the marketplace by increasing market size and reach. Low entry cost and high expected returns resulted in the agricultural dot.com boom in the period from 1999 to 2001.

The quick and continuous sprouting of firms during this period resulted in a densely populated market. While the market population continued to increase, volumes traded remained low. The consequence was the saturation of the agricultural and food supply chain electronic markets. Forester Research diagnosed e-commerce market saturation in 2002, and predicted that of 1400 electronic marketplaces present at the time, only about 200 would remain in business through 2004.

E-commerce's value creation in agricultural and food markets will only occur to the extent that e-commerce firms exist throughout the supply chain. The problem is that e-commerce firms throughout the agricultural and food supply chain have faced a serious challenge in staying in business. Many have been forced to exit the

market, and only a few have survived to develop into functional web-based businesses, and even for these the future is uncertain.

Objectives

The objective of this study is to relate characteristics of e-commerce sites to their operational status at the time of the study. We have data on 128 e-commerce sites of which 71 were still operating at the time of our study and 57 no longer were. Using logistic regression, we will relate this condition to firm characteristics to be defined, below. The hope is that characteristics that differ between surviving and defunct firms will be revealed. Such differences should be of interest to firms in both agricultural and food supply chains.

Literature Review

E-commerce Definition & Classification

E-commerce can be defined as the conduct of business activities electronically via digital media (Vulkan, 2003). It encompasses electronic trading of goods and services, online delivery of digital content, electronic fund transfers, electronic share trading, commercial auctions, collaborative design and engineering, online sourcing, public procurement, direct consumer marketing and after sales service. E-commerce can further be divided into two categories: business to business and business to consumer. While the latter has had most of the media attention with the revolutionary idea of shopping directly from your computer, business to business e-commerce has already been identified as a market more than 10 times the size of business to consumer e-commerce (Timmers, 1999).

The idea of business-to-business e-commerce is by no means a revolution. Dating back to the 1980s there were companies exploring the use of information systems to allow suppliers, distribution channels and customers to interchange data and timely information, which in turn would result in better forecasts of demand and supply (Cash and Konsynski, 1985). Before the internet was commercialized the rise of electronic data interchange (EDI) systems allowed for electronic documents to be transferred in a standard machine-process format (Dai and Kauffman, 2001). With the introduction of the internet, these electronic processes that were once only practiced by large companies are now commonly available throughout the market. This facilitation has provided the growth of internet business-to-business e-commerce where large numbers of buyers and sellers are willing and able to adopt these new technologies given their low cost and advantages.

Agricultural e-commerce presents a difficulty when trying to categorize it according to the specified taxonomy, since a farm or any type of agricultural production is indeed a business, but simultaneously presents market power characteristics such

as price taking behavior most commonly attached to consumers. As a result of this difficulty, agricultural initiatives were classified into four categories: content providers, agribusinesss-to-grower, agribusiness-to-agribusiness, and commodity futures and derivatives markets (Wheatley, Buhr, and DiPietre).

Lucking-Reiley and Spulber (2001) evaluated productivity gains from business to business e-commerce in four different categories: automation of transactions, the potential economic advantages of intermediation, the organization of centralized exchanges, and the reorganization of firms. The automation of transactions will make it unnecessary to translate computer files into paper documents, thus reducing the cost of personnel and eliminating a source of human error. Cost of procurement will be reduced before, during, and after the transaction. Previous to the transaction taking place, the costs of search for suppliers and buyers, and price and product comparisons are considerably lowered through the use of e-commerce. During the transaction, communication costs will be drastically reduced by excluding cost and time of travel, physical space for meetings, and the processing of documents. After the transaction has taken place, communication costs to assure contractual performance or confirm delivery will also be diminished. Software that enables the transaction itself to trigger necessary updates of inventory and accounting records will not only yield cheaper information but also speed up the process. As evidence of the later point, MasterCard estimates the cost of processing purchase orders to have decreased from $125 to $40. In 2000 the Economist published the findings on the cost of financial transactions; according to Lehman Brothers: a teller costs $1.27, an ATM costs $0.27, and an online transaction $0.01.

E-commerce intermediaries can reduce search cost while consolidating markets, providing market information, and offering a variety of goods and services. In that manner a consumer could trade with an intermediary and thus get everything needed in a one-stop-shop, as opposed to the extended version without the intermediary where the consumer would have had to contact several different suppliers. Intermediaries can reduce search costs, certify product quality, reduce barriers to communications and provide guarantees for buyer and seller commitment (Spulber, 1999). Certifying product quality as well as providing guarantees of delivery and payment are especially important in e-commerce.

As information costs diminish, as is the case with e-commerce, several things will occur. Consumers will be allowed to make direct purchases from manufacturers. There is less need for firms to be vertically integrated, resulting in more firms with greater specialization and outsourcing. Business-to-business e-commerce improves the performance of the supply chain by reducing inventory levels, transportation costs, and order and delivery lead times. E-commerce will restructure the market place not only by reducing transaction costs but also by reducing market thinness and increasing liquidity (Thompson and Sonka, 1997). These changes will promote firms' reorganization and thus further productivity gains.

Business models determine the way business is carried out by firms. More formally a business model is architecture for product, service and information flows, including a description of the various business actors and their roles, a description of the potential benefits for the various actors, and a description of the source of revenue (Timmers, 1999). E-commerce has revolutionized and significantly increased business model possibilities for firms.

Auctions have long been used as an exchange mechanism to determine a market clearing price and let the consumer with the highest willingness to pay make the purchase, thus maximizing price. However, traditional auctions present a significant cost in the transportation of the physical goods to the auction, as well as the time spent by the bidders at the auction. Internet technology facilitates auctions by decreasing their cost since the product does not have to be transported other than to its final location. The asynchronous characteristic of e-auctions increases convenience as well as the size of the market. The internet has also extended the duration of an auction from a few hours in a traditional setting to a few days or weeks in a virtual setting. Extended duration leads to a greater number of bidders and thus another increase in the size of the market. Further convenience can be sought by search engines and hierarchies of categories that allow customers to find what they need (Lucking-Reiley, 2000).

E-auctions also present several disadvantages relative to a traditional auction mainly in the difficulty of bidders to inspect the product before purchase. Large textual descriptions, images, videos and email question and answer mechanisms have all been used to diminish this effect. The risk of fraud, while evident, has not stopped internet auctions from leading the e-commerce revolution.

There are other possibilities for foul in internet auctions besides fraud. Two that are extremely hard to enforce in e-auctions are shilling and bid shielding. Shilling occurs when the seller bids on his or her own good in an attempt to raise the price for the item. There is a chance that the seller will end up not selling the product. Through the internet it is especially hard to enforce a non-shilling policy since it would be very easily done and hardly traceable for the seller to get a new free email and come in under a fake name as a bidder. Bid shielding is when a bidder places a low bid and then gets someone else to post an outrageous bid that will discourage anyone else from bidding until the auction closes, then the highest bid is retired and the item goes to the low single previous bid (Lucking-Reiley, 2000). Given the technological innovation of the internet, market makers and e-commerce designers as well as scammers will have a chance to test their creativity and exploit the possible variations of e-commerce exchange mechanisms.

Exchanges are the other most popular exchange mechanism on the internet. This economic mechanism aggregates many buyers and sellers through centralized

clearing, another recognized productivity gain from e-commerce. At these exchanges buyers place bids and sellers place offers. The main benefits of online exchanges seem to come from the provision of liquidity to the market from large numbers of participants. Electronic exchanges tend to focus on a specific industry, and are seldom owned, controlled, or backed up by a large company or an industry consortium. In some instances one can find "third party" marketplaces that have partnerships or special contracts with large companies.

Internet based market mechanisms such as auctions and exchanges with automated protocols present the potential for a bias. The protocol can be such that its design will benefit sellers or buyers. For example, an English auction is by design meant to be biased toward the seller since the bidders must compete by raising each others' price to their maximum willingness to pay. Throughout the literature, neutrality is cited as an important feature for the long run survival of an exchange (Vulkan, 2003). If a certain market mechanism is oriented towards one side of the transactions, say the seller, it will become increasingly hard for the exchange to attract buyers. Buyers could possibly reach a better deal through private negotiations. It is crucial that a market mechanism provides value for both buyers and sellers to attract enough participants to provide liquidity (Kaplan and Showney, 2000).

In business-to-business e-commerce the choice for a firm between using auctions or exchanges will depend on the liquidity of each. If an exchange has enough participants buyers and sellers can expect competitive prices. A seller may prefer an auction since by design it is seller oriented. However, if liquidity is lacking, no sale may occur, or the price may be depressed relative to competitive levels, and a seller would prefer a more liquid exchange. Characteristics of the good and industry could also tip the balance toward either mechanism. For example second-hand goods or items where the price is uncertain are more endemic to auction mechanisms. Some industries have traditionally implemented auctions, for example the cattle industry. If an auction displays a high degree of competition then the seller bias is reinforced and bidders will drift into exchanges. As more and more business moves toward e-commerce transactions, increased competition at auctions is a possible progression. Due to this effect, exchanges may become the dominant trading mechanism for business-to-business transactions in the long run (Vulkan, 2003).

Goldman Sachs Investment Research described ten success factors for an e-commerce firm: business model, market size, industry expertise, structural inertia, first mover advantage, branding and distribution, community features, technology, blending revenue streams, and management execution hustle (Carrere, 2001). As the first success factor business model is of primary importance. However there is no clear or definite answer for firms as to what business model will allow them to survive. Different business models may be suitable as time progresses.

Agriculture was identified by Goldman Sachs' research as one of the seven most business to business inclined industries (Carrere, 2001). The high level of fragmentation in the supply chain, large volumes traded and homogeneous products all incline agriculture towards e-commerce. The agricultural supply chain was described as full of imperfections that restrict efficiency. In this area e-commerce had great possibilities for improvements (Forbes.com).

Data & Methodology

Relevant e-commerce and agricultural e-commerce literature suggested a series of characteristics that will serve as determinants of success for agricultural and food chain e-commerce firms. The development of a model that relates these characteristics to the firms' probability of survival could yield valuable insight for developing e-commerce ventures and could be used to estimate the effect on the probability of survival of feasible changes in existing e-commerce firms.

Data

The variable of interest is the survival state of the e-commerce firms which takes a value of 1 if the business is still operating, and a zero if not.

The independent variables included in the model are: whether the site offers complementary e-commerce goods functioning as a one-stop-shop or specializes in a niche, is buyer/seller oriented or neutral, is sponsored by an industry consortium, market information provided by the site, degree of site automation, business model employed by the site, and e-market concentration. All variables except for market depth are dummy variables where a 1 indicates that the website displays the characteristic and a zero if it does not. Market depth as the only continuous variable takes the number of e-commerce ventures operating within the same market. In order to better accommodate the different business models and sites with multiple business models, three dummy variables will be included representing exchanges, auctions, and private negotiations respectively.

The values the specified variables will take are found or derived from two data sets in addition to the actual e-commerce websites used in the analysis, provided that the site is still in business. If not, data may be obtained from "The Museum of E-Failure" at www.disobey.com/ghostsites. The website was created to preserve the last image of e-commerce ventures gone sour before the record is lost.

The first data set is a listing of agricultural and food industry e-commerce sites compiled originally by Thompson and Nageotte (2001). The table consists of a time series data at four points in time: 1999, 2000, 2001, and 2003. Data are provided for over a hundred e-commerce websites and include information on their respective

business model, ease of registration, market power, and range of offerings for each of the four different points in time.

A secondary data set is obtained through searches of the Agri-marketing magazine's website, where news articles of specific websites provide substantial information, such as when the site started doing business or discontinued operations, its vision or business model, and volumes traded.

A limited-dependent variable technique, logistic regression, will be used to relate websites' characteristics to their probability of survival. The independent variables employed in the analysis are: Market Information, Degree of Automation, Neutrality, Industry Consortium, Private Negotiations, Auction, Exchange, One-stop-shop, and Market Depth. Each is discussed in turn. [1]

Providing valuable Market Information (MI) and customizable settings are widely used strategies to attract and more importantly retain e-commerce customers. A website that provides timely market information and customizable settings is usually preferred. Some business models include a "community" feature, which is defined as having emphasis on content and interaction with limited commerce options. Many web sites combine their community feature with facilitators, auctions, negotiated listings and or e-trade show features, all of which provide e-commerce options. Any website which is designated by Thompson and Nageotte to have a community feature receives a 1 for their MI and a zero otherwise.

Goldman and Sachs Investment Research also included technology as one of its ten success factors for an e-commerce firm. Assuming that the same technology is available to all firms, the extent to which firms accommodate in order to exploit the benefits of available technology will influence their probability of survival. Lucking-Reiley and Spulber identified automation as the first source of possible gains from e-commerce. Benefits will accrue in relation to the degree of automation within an e-commerce firm and its compatibility with other firms. Each of the websites was examined. Its Degree of Automation (DA) is set to one if it is judged to be more automated than an online catalogue shop and zero otherwise.

Goldman and Sachs Investment Research included business model as another of its ten success factors for an e-commerce firm. The choice of business model by the firm will surely influence its probability of survival. However, the optimal business model for an agricultural e-commerce firm ultimately depends on the characteristics of the product and the market in which the firm operates. There is no clear way to generalize a formula for whether a firm would be better off by utilizing auctions,

[1] A reviewer quite correctly pointed out that our list of firm characteristics is not exhaustive and could include things like firm logistics and the payment system employed. We acknowledge our data's short comings and note such for future research.

exchange mechanisms, or private negotiation (Carrere, 2001). Nevertheless, the development of e-commerce has allowed for the creation of many variations of more traditional business models, which suggests that business models can be molded to better exploit the benefits of e-commerce as a means to trade. According to Vulkan's predictions, as e-commerce markets develop, exchange mechanisms will be preferred to auctions, which will in turn be preferred to private negotiations. Many firms operate in more than one of these business models simultaneously, or have switched business models over time. The business model variables, Private Negotiations, Auction, Exchange, are set to 1 as appropriate according to the Thompson and Nageotte data (They are called Negotiated Listing, Auction, and Mall/"eTradeshow" in their data).

Market orientation or bias, is an important decision for a firm, physical or electronic. A firm can be buyer oriented, seller oriented, or neutral. E-commerce intermediaries exist in all ranges of market orientation, yet neutrality is accentuated for online business models. In the literature, Vulkan and Carrere both independently discuss that in the long run only sites that can attract both buyers and sellers will manage to survive. Since a seller oriented e-commerce firm is expected to have a harder time attracting buyers than a buyer oriented firm, and vice versa, neutral firms are expected to have an advantage and a better chance of survival. Neutrality is 1 if the site is so designated by Thompson and Nageotte and zero if it is deemed to be seller or buyer oriented.

The increased ease of communication diffusion through the use of the Internet has allowed for the establishment of industry consortiums throughout e-commerce markets. These consortiums directly support e-commerce ventures; Covisint in the automobile industry and Rooster in the agricultural industry are examples of such ventures. Although the demise of Rooster.com is contradictory, the support of an industry consortium is expected to have a significantly beneficial effect for the supported website's probability of survival. Industry Consortium is assigned a 1 if a search using search engines at *Agri-marketing* magazine's website revealed such support or if the firm was a business venture of an existing physical firm that held substantial market share.

Goldman and Sachs Investment Research included market size as one of its ten success factors for an e-commerce firm. Market size and market depth can ultimately determine if a website is to remain in business. The ease of entry to e-commerce markets has resulted in the crowding of firms that attempt to perform the same or very similar functions. Through the movement of business practices online, the capabilities of these firms are greatly enhanced. The results are markets that can be satisfied by only a few firms, further complicating the situation. Forester Research forecasted a market shakeout of 86% of all e-commerce marketplaces by 2004. The crowding effect displays progressive nature, meaning that at very low e-market concentrations, market size might simply be insufficient

to support operating firms. Furthermore every additional firm entering the market has a greater marginal contribution to the crowding effect than the previous and thus further decreases the probability of the website's survival. Market Depth is computed by totalling the Range of Offerings for a firm and then dividing this by the total number of firms which also participated in the products offered by the firm.

Throughout the literature of e-commerce design, the idea of a one-stop-shop is discussed as an important characteristic of successful e-commerce websites. Lucking-Reiley and Spulber (2001) discuss the potential economic advantages of intermediation as a source of productivity gains from e-commerce. They focus the initial discussion on the benefits to consumers, who can enjoy the conveniences of one-stop-shops with the asynchronous characteristics of e-business. Offering complementary e-commerce goods will increase the amount and regularity of consumers, both desirable outcomes for e-commerce firms. Survival probability will be expected to increase if the website becomes a one-stop-shop by adding complementary goods. For example, a livestock and meat e-commerce firm would benefit from also offering embryos, livestock medications or feed. So that a website that offers seed and fertilizer will have a better probability of survival than a website offering only seed. One-stop-shop is assigned a 1 for sites that are judged to offer a large number of complementary products and a zero otherwise.

Table 1 lists the descriptive statistics for each explanatory variable. The mean and standard deviation of each variable are presented first. With the exception of market depth, a breakdown of the variables is provided at three different levels: first, how many of the total observations displayed the characteristic (e.g., market information), followed by how many observations are associated with successful e-commerce ventures, and how many are associated with e-commerce ventures that have exited the market. Market depth as the only continuous variable gives means for those who survived and exited.

Table 1. Descriptive Statistics of the Data Set

Explanatory Variable	Mean	Std. Dev.	Total (N)	Survived	Exited
			128	71	57
Market Information	0.672	0.471	85	53	32
Degree of Automation	0.398	0.491	51	26	25
Neutrality	0.648	0.479	82	40	42
Industry Consortium	0.169	0.377	21	13	8
Private Negotiations	0.594	0.493	76	44	32
Auction	0.180	0.385	22	14	8
Exchange	0.484	0.502	61	29	32
One-stop-shop	0.5	0.502	64	39	25
Market Depth	22.14	6.04	22.14	21.63	22.75

The Model

Initial efforts to develop an empirical model suggested statistical survival analysis. However, "Survival analysis is used to analyze data in which the time until the event is of interest … If one wished to study the occurrence of some event in a population of subjects where the time until the occurrence of the event was unimportant, the event could be analyzed as a binary outcome using the logistic regression model."(Harrell, 2001). Since we are interested in survival probability of agricultural e-commerce firms, logistic regression will be used.

To achieve further insight and test statistical significance, several variations of the original model were executed. This results in a total of four models. Model one is the original empirical model consisting of 128 observations. Model two is the same model but the data for e-commerce providers is excluded, with a total of 115 observations remaining. Model three will use data only for agricultural e-commerce ventures and model four will be based on food service e-commerce ventures. Each model is estimated using SAS.

The Results

Table 2 lists the coefficient estimates, their standard errors, and the Wald statistics testing the hypothesis that each coefficient equals 0 for Model 1. Market information, auction, and exchanges are the significant variables, while neutrality and market depth approach significance.

Table 2: Parameter Estimates and Statistics for the Explanatory Variables

Explanatory Variable	Parameter Estimate	Standard Error	Wald	Variance Inflation	Odds Ratio
Intercept	1.27	1.1	1.34	-	-
Market Information	1.02	0.42	5.90*	1.05	2.78
Degree of Automation	-0.09	0.42	0.05	1.14	0.91
Neutrality	-0.52	0.43	1.53	1.09	0.59
Industry Consortium	0.34	0.54	0.41	1.05	1.41
Market Depth	-0.05	0.04	1.89	1.05	0.95
Private Negotiations	-0.21	0.57	0.13	2.01	0.81
Auction	1.18	0.61	3.78*	1.36	3.25
Exchange	-1.14	0.57	3.99*	2.02	0.32
One-stop-shop	0.38	0.42	0.81	1.18	1.46
R^2 = 0.19					
Chi-Square Statistic for the overall significance of the regression =19.60 (0.02)					
*Statistically significant at $\alpha = 0.1$					

The R^2 reported is due to Allison (1999). The Chi-square statistic for the overall significance of the regression tests the hypothesis that all variable coefficients are simultaneously zero. The value in parentheses is the P-value for the relevant Chi-square statistic.

Market information behaves as expected, exhibiting a positive contribution to the overall probability of survival. The model indicates that the provision of information via the Internet is valuable.

The impact of Neutrality is negative. This contradicts our expectations that in the long run only those e-commerce sites that manage to attract both buyers and sellers will manage to remain in business. Perhaps because our data can be qualified as "short term" the model is unable to capture long-term results. Or, perhaps the neutrality hypothesis is erroneous.

Market depth, the only continuous variable in the model, has a negative effect. The more firms operating within each e-commerce market, the lower the probability of survival for the e-commerce venture. The ongoing e-commerce market shakeout continues to reduce e-commerce offerings to sustainable levels.

The next three explanatory variables represent a site's business model. There is no clearly optimal business model for e-commerce firms. The results suggest that while private negotiation has a negative effect, the effect is insignificant. A site with an auction model increases its chances of survival significantly, while those with an exchange model decrease the probability of survival significantly. Vulkan predicted that once e-commerce markets fully develop exchange mechanisms would be preferred to auctions, which will in turn be preferred to private negotiations. Model results show that auctions are preferred to private negotiations, but both are preferred over exchanges. One interpretation of these results is that at present, exchange mechanisms still have a long way to go; this in turn suggests that the e-commerce markets are far from being fully developed.

Interpreting the Coefficients

Variable effects are discussed in the previous section. The variable coefficients themselves are difficult to interpret. In an ordinary least squares regression, coefficients are marginal effects. Logistic regression coefficients however, tell us the change in the log-odds associated with a 1-unit increase in the explanatory variable. Results are easier to interpret if they are converted to odds ratios. This is done by taking the antilogs of the coefficient estimates.

Market information has an odds ratio of 2.78, which means that the predicted odds of survival for e-commerce ventures providing substantial market information is 2.78 times the odds for those that do not.

Neutrality has an odds ratio of 0.59, which means that the predicted odds of survival for neutral e-commerce ventures (no bias) is 0.59 times the odds for those that are biased (buyer or seller). In other words, neutrality reduces the odds of success. The rest of the coefficients can be interpreted in the same manner.

Market depth, the only continuous variable, has an odds ratio of 0.95. Which means that the predicted odds of survival for e-commerce ventures that operate in markets one firm deeper is 0.95 times the odds for those that operate in one firm thinner markets. Firms have a greater chance of success in thinner markets.

Model Interpretations

From the model as a whole we obtain several insights. First, evidently e-commerce markets in general, but especially those associated with agriculture, are at an early stage of development. This results in a model that fits reasonably well given historical data, but produces several unintuitive relationships. Of the significant or near-significant variables in the model three, Market Information, Market Depth, and Auction, have the anticipated signs, while two, Neutrality and Exchange, do not. Whether this is due to lack of maturity in e-commerce in agriculture and food businesses or because of different workings of the markets, themselves, remains to be seen.

Secondly, it became apparent during this project that, against predictions, agriculture might not be well suited for e-commerce. The level of automation possible is relatively limited. Classified ads, or catalog shopping was already available and making them electronic contributes little value added. Inventory and record keeping in agricultural settings differs greatly from those in, say, the retail industry, limiting the degree of automation and reinforcing that agricultural e-commerce differs substantially from B2B e-commerce.

Agricultural margins have been historically thin, which raises an interesting concern: is e-commerce increasing the size of the pie or increasing the number of slices in the pie? Truth seems to be that it does both; thus, we have contradicting effects. On one side, cost reducing automation, increased transparency, and market reach are expected to increase market size. However, e-commerce firms compete directly with established firms, splitting the pie into a greater number of slices. This phenomenon is enhanced by the low entry costs associated with e-commerce startups, which has resulted in a large number of e-commerce ventures. On the other side, geographical considerations, given the bulk and relatively low value of most agricultural inputs and products, limits the size of e-commerce markets. Logistical costs prevent a farmer in Indiana from buying fertilizer from Arkansas.

The thin margins experienced in agriculture have constrained the degree to which e-commerce can increase market size. Price transparency seems to be unaffordable, or at the least undesired, by already established firms. Market reach is limited by bulkiness and geographical distance. Thus, the increase in pie size, if occurring, is certainly not of large proportions. The predatory effects of e-commerce firms on established firms may then be considered as having a greater effect. Thus, the positive effect on market size is surpassed by the predatory effects of the large number of new e-commerce ventures. At least for agricultural markets, these contradicting effects result in an overall negative effect on the market, possibly explaining why agricultural e-commerce ventures are having such a hard time staying afloat.

Modifications of the Empirical Model and Data Set

The original data set is comprised of 128 observations which can be grouped into three groups: agricultural, food service, and e-commerce provider ventures. The e-commerce provider ventures (such as Transora.com, now known as 1snync.org) differ greatly in the function that they provide to clients. Furthermore, the "dot.com rush" provided large amounts of business for these innovative companies. For these reasons, it was determined that observations in the data associated with e-commerce providers could be omitted from the empirical model.

A second model was developed with 115 observations. Table 3 shows the result of omitting e-commerce provider observations from the data set as an increase in the explanatory power and significance of the model. Models 3 and 4 isolate sites that are agriculture or food oriented, respectively.

Table 3. Comparison of Models 1-4

	Model 1	Model 2 Without E-commerce Providers	Model 3 Agriculture	Model 4 Food Service
Observations	128	115	50	72
R^2	0.1900	0.2381	0.3438	0.4733
Signif. Variables*	MI, n, md, A, E	MI, A, e	MI, N, MD, a, oss	MI, PN, a, E
Chi-Square	19.5965	22.6136	14.9029	31.5612
P-Value	0.0206	0.0071	0.0936	0.0002

*Variable acronyms displayed in uppercase are significant at $\alpha = 0.1$, those in lower case signify that the variable is approaching levels of significance at $\alpha = 0.1$.

Agricultural and food service e-commerce ventures can be empirically differentiated. This suggests that these two groups of observations could be treated separately. Two additional regression models were developed by separating the data of model 2 into two different data sets: one containing observations associated with agricultural ventures and another for those associated with food service ventures.

The two data sets are comprised of 50 agricultural observations and 72 food service observations. Note that the number of total observations from both categories (122) exceeds the number of observation in model 2 (115); this is the result of several ventures operating in both categories simultaneously. The results from these regressions are also presented in Table 4. Clearly both represent a substantially better explanatory power than model 2 as judged by R^2. One might argue that since the food service regression holds far more explanatory power than the agricultural regression, food service e-commerce markets are far more developed than agricultural e-commerce markets.

Table 4. Comparison of the Odds Ratios of Models 2, 3, and 4.

	Model 2 Without E-Commerce Providers	Model 3 Agriculture	Model 4 Food Service
Market Information	**4.42**	**7.01**	**12.90**
Degree of Automation	0.89	0.59	0.59
Neutrality	0.57	**0.22**	1.05
Industry Consortium	1.84	1.64	0.98
Market Depth	0.96	**0.85**	0.97
Private Negotiation	0.71	1.65	**0.05**
Auctions	**3.03**	5.09	4.50
Exchanges	0.38	1.48	**0.02**
One-Stop-Shop	1.77	3.26	1.55

Bolded entries are associated with significant coefficients ($\alpha = 0.1$). Underlined entries are associated with coefficients which approach significance.

As presented in Table 4, the odds ratio for market information is higher for food service firms than agricultural firms, and both are higher than in the combined Model 2. These results suggest that market information has the most powerful effect on the probabilities of survivals of e-commerce ventures. The variable's odds ratio is considerably higher for the food service sector than for agriculture. This in turn implies that food service e-commerce ventures should exhibit a greater degree of market information than agricultural ventures, since they have more to gain. Degree of automation is never significant in any of the models, but always decreases the odds of survival. Neutrality decreases survival odds in the combined and agriculture models, but increases them slightly for food service sites. Market depth was significant in several of the models but has only a minor negative effect on survival odds. Private negotiation's impact on the survival odds is quite different for

the two types of sites. It increases survival odds by more than 50% for agricultural ventures. At the same time the odds of survival of firms displaying private negotiation is one twentieth the odds of exiting the market in the food service ventures. Exchange's odds ratio exhibit extremely low values for the food service industry, while in agriculture the odds of survival surpass the odds of exiting the market by roughly 50%. Auctions have a positive effect across both industries, but with a stronger effect in agricultural e-commerce markets. One-stop-shop has a much better odds ratio in agriculture than in food service. This could be related with the relative ease and speed of internet in urban areas where the food service industry operates. Making it a lot faster to go from one site to the next and thus decreasing the positive effects of having a one-stop-shop offering complementary products.

Conclusions and Implications for Food and Agriculture e-Commerce Ventures

Based on the results of the empirical models presented in this study, the factors that significantly influence the viability or success of e-commerce ventures are shown in Table 5.

Table 5. Variables Displaying Significant Influence on survival Probabilities of E-commerce Ventures

Variables	In Agricultural Markets	In Food Service Markets
Market Information	A community feature displaying valuable market information and customizable settings for users.**	A community feature displaying valuable market information and customizable settings for users.**
Neutrality	Avoid neutrality.**	
Market Depth	Avoid deep markets where competition is intense.**	
Auctions	Use of auctions as a price discovery mechanism.*	Use of auctions as a price discovery mechanism.*
Exchanges		Avoid exchanges.**
Private Negotiation		Avoid private negotiation.**
One-Stop-Shop	Operate a one-stop-shop.*	

**Variables significant $\alpha = 0.1$
* Variables significant $\alpha = 0.15$

Successful e-commerce ventures had a customizable community feature to their e-commerce website where important market information is displayed. The importance of the market information is evident in information portals, such as *directag.com* and *agweb.com*, which survived exclusively as information providers. These two sites are agricultural sites. Market information is at least as important in the food chain industry. Here the same kinds of information portals existed such as *meatandpoultry.com* and *foodweb.com*. Schiefer has investigated information portals and their structures in his work, detailing the importance of this variable in e-commerce success.

Neutrality is seldom displayed in successful agricultural e-commerce ventures. Those that do display neutrality and are still in business such as *dairy.com* are also involved in the food chain sector and thus can afford to remain neutral. In agricultural e-commerce few neutral firms remain viable. For example, *Efruitinternational.com*, *cybercrop.com*, and *agex.com* are some of the neutral e-commerce websites that have exited the market. In the food chain and food service sector the probability of survival is nearly unaffected by a change in market orientation, thus an e-commerce venture operating in this sector is indifferent between neutrality or buyer/seller orientation. This suggests that agricultural e-commerce ventures are better off avoiding neutrality. Unfortunately for farmers, market bias is always against their best interest. As a business firm selling to farmers, or buying from farmers, the e-commerce venture must exploit their biased position in order to remain in business.

Market depth was insignificant for food chain ventures, but significant and detrimental to e-commerce survival in agriculture. In the cattle and livestock industry for example, all of the following sites exited the market before the end of the study period: *cattleinfonet.com*, *cattleoffering.com*, *cyberstockyard.com, meatexchange.com*, and *sellmeat.com.* There were also numerous e-commerce firms operating in the livestock sector at the end of the study period, which should raise a flag to any entrepreneur with intentions to enter that market.

The model implies that food service ventures should avoid private negotiation. Agricultural e-commerce ventures may improve the probability of survival through private negotiation, but this result is not significant. *Fielderschoicedirect.com* is an example of a successful e-commerce venture featuring private negotiation. This reinforces the idea that farmers exhibit a preference for personal business relationships, while the food service industry is far more efficiency oriented.

E-commerce ventures that ran auctions such as *farms.com*, *cattlesale.com, emergeinteractive.com*, and *winterlivestock.com* were able to sustain their e-commerce operations. Auctions also proved significant in the food chain sector. *Dairy.com*, *dairynetwork.com*, *bakeryonline.com*, and *beverageonline.com* are all examples of currently successful e-commerce ventures.

The exchange variable was not significant for agricultural ventures, yet it is very significant for food service ventures, which, according to the model, should avoid exchange mechanisms. This implies that food service ventures should in general always operate auctions, which may be complemented by any other business model. Finally one-stop-shop is significant in improving probabilities of survival. *Emergeinteractive.com*, *farms.com*, and *dairy.com* are examples of firms offering complementary products.

This study evaluated agricultural and food service e-commerce markets and designated characteristics as determinants of success. Of the variables in our models, market information, auctions and exchanges are the most important determinants of success. When only agricultural e-commerce ventures are evaluated, market information, neutrality and market depth are significant, while auctions and one-stop-shop are approaching levels of significance. For food service e-commerce ventures, market information, private negotiation and exchanges are clearly important and auctions may be important.

While not a direct implication of our analysis, it seems clear that firms entering the e-commerce markets need to remember that even though e-commerce is online, it is business. Having a strong business plan and a sound business structure are critical. The way in which e-commerce facilitates business misled many into believing that it would be simple to make money in electronic markets. The truth is that e-commerce has the capacity to make running a business easier, or help the business run more smoothly by enhanced efficiency and productivity gains. But e-commerce by itself is not going to magically fix business problems. For example, the almonds exchange site of *agex.com* failed when it was expected to create a market solution. The market for almonds is fragmented, fickle, and inefficient; the product passes through many different hands before reaching its final destination. Seasonal changes and large harvest variability plague the market. Since the market for almonds does not work optimally, there is a need for a new market for almonds. Introducing an e-commerce market made a lot of sense and created quite a stir in the almond industry. While many people joined the exchange, it experienced low levels of trading and exited the market. The problem is that those marketing problems that had plagued the physical market for almonds were not directly addressed. So in a nutshell, a non-operational physical market was moved online to become a non-operational e-commerce market. The website collapsed as have so many others in the e-commerce market shakeout.

There are e-commerce ventures that, at the time of this study, appeared to be successful, both in the agricultural as well as in the food chain sectors. Among the strongest e-commerce ventures at the time of the study were *theseam.com* and *eggclearinghouse.com* (now *eggs.org*); both benefit from industries familiar with electronic trading. The cotton industry has been practicing electronic marketing for

over 25 years. The true revolutionary was Plains Cotton Cooperative, which introduced TELCOT, an electronic trading system for cotton. The system required terminals at selling points, usually the gins, and also on the buyer site. TELCOT now operates under the name The Seam. Louis Baioni, The Seam's former chief executive officer, credits guaranteed trading as the key characteristic that has allowed the company to reach its current success. The seller receives payment for his cotton directly from The Seam and the buyer is guaranteed the quality and grade of cotton when cotton is sold through The Seam's exchange. The Seam collects payments from the buyers. Uvine.com is another site where guaranteed trade settlement has positively influenced survival as an e-commerce venture. "In any situation where a party trading in wine fails to meet their sales obligations, Uvine will act to preserve the integrity of the exchange and, as such, guarantees settlement to all of our customers" (*Uvine.com*, 2003).

The results of this study have led to the conclusion that e-commerce markets are not fully developed. Internet technology is itself in a developmental stage and technological growth is occurring at high rates. Regulatory institutions, whether governmental or private, needed to support business practices online are yet to become established. Furthermore, food service e-commerce markets are more developed than agricultural e-commerce markets. Differences in the amount of information and processes that can be automated between the food service and agricultural environments have resulted in a more established food service e-commerce sector. High speed internet is far more accessible in urban areas such as those in which the food service industry operates, while farmers and those involved in agriculture find themselves in rural areas where the internet is available, but is much slower. The agricultural industry also has a preference for familiarity and personal business relationships.

The models presented in this study should be revisited in the future when online markets are better developed and market information is more readily available, perhaps through regulatory institutions. Further research is also needed on the possible benefits of establishing an e-commerce regulatory institution, and the form that this institution should take to maximize the aggregate benefits for all involved in the market. Additional studies should be aimed at determining the outcome of the clash or complementarity between e-commerce and physical markets. The effect of e-commerce on market structure also deserves consideration for research to determine if markets will tend to become more vertically integrated, or if more intermediaries will appear to promote further specialization. The effects of e-commerce on market dynamic efficiency are also important.

References

Allison, Paul D. Logistic Regression Using the SAS System: Theory and Application. Cary, N.C: SAS Institute, 1999.

Carrere, Antonio. E-Business Models in Agriculture. Purdue University, August 2001.

Cash, J. I., Jr., and Konsynski, B.R. "IS Redraws Competitive Boundaries," *Harvard Business Review* (63:2), March-April 1985.

Dai, Qizhi and Robert J. Kauffman. "Business Models for Internet –Based B2B Electronic Markets: An Exploratory Assessment." Carlson School of Management University of Minnesota, October 2001.

Dai, Ishim and Robert J. Kauffman. "To Be or Not B2B? An Evaluative Model for E-Procurement Channel Adoption," University of Minnesota, August 2001.

Forbes.com. "The Best of the Web B2B Directory." Forbes Best of the Web. May 21, 2001.

Harrell, Frank E. Regression Modeling Strategies: With Applications to Linear Models, Logistic Regression and Survival Analysis. New York: Springer, 2001.

Kaplan, Steven, and Mohanbir Showney. "E-Hubs: the New B2B Marketplaces." *Harvard Business Review*. 78 (6): 119-125, 2000.

Lucking-Reiley, D. and Spulber, D.F. (2001). "Business-to-Business Electronic E-Commerce." *Journal of Economic Perspectives*, 15 (1), 55-68.

Lucking-Reiley, D. (2000) "Auctions on the Internet: What's being Auctioned, and How?" *Journal of Industrial Economics,* 48 (3), 227-252.

Schiefer, Gerhard and Anne Catharina Kreuder. "Vertical and Horizontal Information Portals: Cooperation Models for Sector and Chain Information Services." Business and Information Management. University of Bonn, Germany. 2001.

Spulber, Daniel F., Market microstructure: Intermediaries and the theory of the firm 1999, pp. 374, Cambridge; New York and Melbourne: Cambridge University Press.

Thompson, Sarahelen and Clement Nageotte, "List of Agricultural e-commerce Web sites. May 19, 2001." http://www.farmfoundation.org/ecommerce/thompson.pdf

Thompson, Sarahelen and Steven T. Sonka. "Potential Effects of Information Technology on the Economic Performance of Agricultural and Food Markets." *American Journal of Agricultural Economics.* May 1997. p 657-662.

Timmers, Paul. Electronic Commerce: Strategies and Models for Business to Business Trading. John Wiley & Sons, 1999.

Vulkan, Nir. The Economics of E-commerce: A Strategic Guide to Understanding and Designing the Online Marketplace. Princeton University Press, 2003.

Wheatley, W. Parker, Brian Buhr, and Dennis DiPietre. "E-Commerce in Agriculture: Development, Strategy, and Market Implications." Department of Applied Economics, University of Minnesota. Staff paper P01-6 July 2001.

