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

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Abstract:

E-commerce's value creation along agricultural markets and the food chains will only occur to the extent that e-commerce firms exist throughout the electronic markets. The problem is that e-commerce firms throughout agriculture and the food chains face a serious challenge to stay in business. Many have been forced to exit the market, and only a few have survived to develop into functional web-based businesses. Increasing the benefits of e-commerce available to firms throughout the agricultural and food chain markets is the ultimate purpose of this study. The objective of this research study is to identify characteristics that are associated with successful e-commerce firms throughout the agricultural and food chain markets. Relevant e-commerce and agricultural e-commerce literature suggests a series of characteristics that will serve as determinants of success for agricultural and food chain e-commerce firms. A limited-dependent variable technique, binomial logistical regression analysis, will be used to relate websites' characteristics to their probability of survival.

Introduction:

Agriculture and the food supply chain in general posses 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 specially 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 (Weatley, Buhr, and DiPietre, 2001).

Twenty years later, with internet technology Farms.com was established as the first agricultural e-commerce website. The internet highly 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 market place 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 highly 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 out of 1400 electronic marketplaces present at the time; only about 200 will remain in business through 2004. Those websites that survive do not have a definite success path to follow through the remaining evolution of e-commerce into a business practice.

E-commerce's value creation along agricultural markets and the food chains will only occur to the extent that e-commerce firms exist throughout the electronic market. The problem is that e-commerce firms throughout agriculture and the food chains face a serious challenge to stay 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 research study is to identify characteristics that are associated with successful e-commerce firms throughout the agricultural and food chain markets. This research will help e-firms in their struggle to remain in business, provide a method of estimating the survival probabilities of e-commerce sites, and evaluate feasible changes to a web site's functioning and the likelihood of survival based on these changes. Increasing the benefits of e-commerce available to firms throughout the agricultural and food chain markets is the ultimate purpose of this study.

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. Ecommerce can further be divided into two categories: business to business e-commerce and business to consumer e-commerce. 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 a 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 for the extreme 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 (2000) evaluated productivity gains from business to business e-commerce into 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, 1999).

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, 1999). 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 Shawney 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.

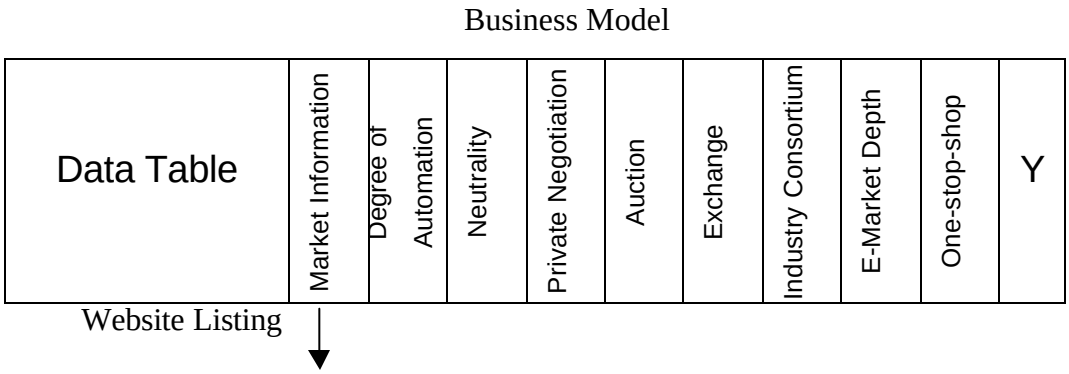
Agriculture was identified by Goldman Sachs' research as one of the seven most business to business inclined industries (Carrere, 2001). The high level of fragmentation in the supply chain, large volumes traded and homogeneous product all incline agriculture towards e-commerce. The agricultural supply 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:

Necessary data were gathered into a table that conveniently displays the values of the determinants of success for every website on the data set. A sample of the table format is presented below:



Y is the survival state of the e-commerce firms were a 1 signifies that the business is still operating and a zero the opposite.

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 one represents that the website displays the determinant of success and a zero the opposite. 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 by Thompson and Nageotte. The table consists of a time series data at four points in time: 1999, 2000, 2001, and a recent update in 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: logistical regression analysis will be used to relate websites' characteristics to their probability of survival.

Providing valuable market information 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. Goldman and Sachs Investment Research included community features as one of its ten success factors for an e-commerce firm.

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 Spulberg 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 automotive compatibility with other firms.

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, 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.

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 verse, neutral firms are expected to have an advantage and a better chance of survival.

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.

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.

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 (2000) discuss the potential economic advantages of intermediation as a source of productivity gains from e-commerce. They focus the initial discussion in 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.

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 with survival probability of agricultural e-commerce firms without a specific deadline, time until closure is regarded little importance.

A binary logistical regression model is the limited-dependent variable technique used to relate websites' characteristics to their probability of survival. The logistic model will resemble that used by Harrell to estimate the survival probability of Titanic passengers based age, sex, ticket class, and number of family members aboard.

To achieve further insight and test statistical significance, several variations of the original model were executed. This results in a total of six 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 is the same as model two but a dummy variable is introduced to differentiate between agricultural and food service e-commerce websites. The fourth

model is model three plus the interactions for the new dummy variable and each of the original variables in the empirical model. Models five and six are the result of separating the data set for model two into agricultural and food service e-commerce ventures and then running separate regressions.

Each model was run using SAS. The next chapter presents more detailed information on the commands used and results from these programs. The descriptive statistics, statistical tests, and overall model results are discussed in chapter 5.

The Results:

This section contains descriptive statistics for the model variables and the results of the logistic regression analysis. The estimated coefficients and equation are described, and the expected vs. observed coefficient signs discussed. Model fit is assessed, and the coefficients are interpreted both as odds ratios and probabilities. The last portion of this section deals with the analysis of the maximum likelihood estimates, which yields variables' significance. Finally, modifications of the original regression model and additional regressions involving a subset of the data set are presented.

Descriptive Statistics:

Table 1

Explanatory Variable	Mean	Standard Deviation	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	0.164	0.372	21	13	8
Private Negotiations	0.593	0.493	76	44	32
Auction	0.180	0.385	22	14	8
Exchange	0.484	0.502	61	29	32
One-stop-shop	0.503	0.502	64	39	25
Market Depth	22.06	6.07	22.04	21.46	23.13

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 explanatory variable (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 is a special case on this table. Its mean and standard deviation are presented first, then the average for all observations, the average for the observations that survived, and the average for those that exited the market.

The logistic regression yields the following equation for the probability of e-commerce venture survival.

$$Y = 1.27 + 1.02\,MI - 0.09\,DA - 0.53\,N + 0.34\,IC - 0.05\,MD - 0.21\,PN + 1.18\,A - 1.14\,E + 0.38\,OSS + e$$

(1.10)	(0.42)	(0.42)	(0.43)	(0.54)	(0.04)	(0.57)	(0.61)	(0.57)	(0.42)
1.34	5.90	0.05	1.53	0.41	1.89	0.13	3.78	3.99	0.81

$R^2 = 0.19$

Standard errors are presented in parenthesis. A generalized R^2 is presented. The method for developing R^2 is discussed later in this section.

Table 2: Results for SAS Logistic Regression

Explanatory Variable	Parameter Estimate	Standard Error	Wald chi square	Variance Inflation	Odds Ratio
Intercept	1.27	1.10	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

*Statistically significant at $a = 0.1$

Analysis of Maximum Likelihood Estimates:

Table 2 lists the coefficient estimates, their standard errors, and the Wald statistics testing the hypothesis that each coefficient equals 0. From these data one can observe that market information, auction, and exchanges are the significant variables. A private negotiation is the least significant variable followed by industry consortium and one-stop-shop. Finally neutrality and market depth are approaching significant levels but do not make the cutoff at a = 0.10.

It is of interest to review the signs of the coefficients and compare them with the expectations derived from the literature. 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.

Degree of automation is assigned a negative coefficient which contradicts our expectations. Firms exhibiting a high degree of automation are penalized slightly by the model. Perhaps a high degree of automation should be substituted by the right degree of automation as the success factor. Commenting on the demise of many e-commerce ventures: “they built a Cadillac when a Chevy would do!”. Serious e-commerce automation is a substantial investment, especially for large firms. The return on investment is constant but slow, thus an excessively high cost of automation could tie down substantial portions of capital and eventually result in the exit of an e-commerce firm from the market.

Neutrality displays a negative coefficient. 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.

Industry consortium behaves according to expectations and contributes positively to the survival probability of e-commerce ventures. Support by an industry consortium may provide the minimum level of business necessary to ensure e-commerce survival.

Market depth, the only continuous variable in the model, displays a negative sign. The explanatory variable meets the expected result given the level of market saturation; 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 may reduce e-commerce offerings to sustainable levels.

The next three explanatory variables are related to business model choice and thus it is appropriate to discuss them together. There is no clear way to generalize optimality of business model for e-commerce firms. The model yields private negotiation with a negative sign, auctions with a positive sign, and exchanges with a negative sign. The default case is a community website where profits accrue only due to advertisement. 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. According to the model, auctions are preferred to private negotiations, but both are preferred over exchanges. This prediction is accompanied by a comparison to the evolution of financial markets. The model captures this trend, if both markets follow the same or a similar evolutionary path, then indeed exchange mechanisms will eventually establish their way as the optimal. At present however, the model indicates that exchange mechanisms still have a long way to go; this in turn suggests that the e-commerce markets are far from being fully developed.

Finally the last explanatory variable, one-stop-shop also behaved according to expectations, making a positive contribution to the survival probability of the e-commerce venture. E-commerce websites offering complementary products and services will benefit in their probability of survival.

Assessing Model Fit:

Initially we test the hypothesis that the coefficients for all the explanatory variables are not significantly different from zero. This is equivalent to an overall F test in linear regression. In this model however, we use chi-square statistics. We will use the maximum likelihood ratio chi- square in this case, since it has been shown to perform better with small samples or extreme data patterns (Allison 1999).

This statistic is obtained by doubling the positive difference between the log likelihood of the model and the log likelihood of a "control" model with no explanatory variables. Here we answer the question whether the current model is better than nothing.

Likelihood ratio chi-square: 19.5965 D F: 9 P-value: 0.0206
So we reject the null hypothesis, concluding that at least one of the coefficients is non-zero.

Additional analysis was performed to measure the predictive power of the model. This is generally reported as the coefficient of determination R^2, which is rarely part of the results in a logistic regression. However, it can be derived by manipulating the likelihood ratio chi squared for testing the overall hypothesis that all Bs = 0 (Allison 1999). Let this statistic be represented by L^2, R^2 can be derived from the following equation:

$$R^2 = 1- \exp (-L^2/n)$$

Where n is the number of observations. This value is known as the generalized R^2. The R^2 terms presented have been rescaled to their upper bound.

The resulting value: $R^2 = 0.1900$

Assessing the overall model, we can see that it fits well but holds low predictive power.

Interpreting the coefficients:

Sign coefficient effects are discussed in the previous section. The variable coefficients ßs themselves can be hard to interpret. Normally ßs would yield the change in the predicted probability of the event (survival) associated with a 1-unit increase in the explanatory variable. Logistic regression coefficients however, tell us the change in the log-odds associated with a 1-unit increase in the explanatory variable. A value greater than one is associated with an increase in likelihood, a value less that one is associated with a smaller likelihood.

To understand the meaning of the coefficients, we need to consider them in terms of odds ratios. Odds ratios are presented in table 2. To do this we manipulate the ßs in the

following fashion: $e^{ß}$, which yields an adjusted odds ratio. These numbers are the point estimates of the odds ratio.

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 change of success in thinner markets.

Coefficients can also be manipulated in order to interpret them in terms of probabilities. Choosing the general odds ratio as a starting point, 70 e-commerce ventures out of 127 in the data set survived, yielding a ratio of (70 / 127) = 0.55. We multiply this number by (1 - 0.55) = 0.45 to get (0.55 * 0.45) = 0.2475 to obtain our odds ratio for the full set of observations. Multiplying this number by each coefficient yields the estimated probabilities:

Table 3:

MI	1.02	*	0.2475	=	0.25
DA	-0.09	*	0.2475	=	-0.02
N	-0.52	*	0.2475	=	-0.13
IC	0.34	*	0.2475	=	0.08
MD	-0.05	*	0.2475	=	-0.01
PN	-0.21	*	0.2475	=	-0.05
A	1.18	*	0.2475	=	0.29
EX	-1.14	*	0.2475	=	-0.28
OSS	0.38	*	0.2475	=	0.09

Interpretation of these results suggests that, on average, an e-commerce venture displaying substantial market information has a probability of survival 0.2469 higher than those that do not. In the same fashion an e-commerce venture that is neutral has a

probability of survival that is 0.1385 lower than those that are biased. The rest of the variables can be interpreted in the same manner. Overall, market information, industry consortium, auction and one-stop-shop variables have a positive effect on the probability of survival of an e-commerce venture. Degree of automation, neutrality, market depth, private negotiation, and exchanges all have detrimental effects on the survival probabilities of e-commerce ventures.

Model Interpretations:

From the model as a whole we can 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 with good fit given historical data, but makes poor predictions. Since the development track of e-commerce markets is uncertain, it follows that survival probability predictions are not reliable at this time. Furthermore, the only sensible thing to do is look back at those that have survived and those that have not, and determine what can be learned from their experience.

Secondly, it became apparent throughout 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 b-to-b 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 on the pie? Truth seems to be that it does both; thus we have contradicting effects. On one side, cost reducing automation and increased transparency and market reach are expected to increase market size. An e-commerce firm will compete directly with established firms, splitting the pie into a greater number of slices. This phenomenon is emphasized by the large number of e-commerce ventures. On the other side, geography must be emphasized given the bulk and relatively low value of most agricultural inputs and products. Logistical costs are so great given the bulkiness of products that small

savings in automation still will not allow a farmer in Indiana to buy 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 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 4 shows the result of omitting e-commerce provider observations from the data set as an increase in the explanatory power of the model.

Table 4	Model 1	Model 2	Model 3	Model 4
Observations	128	115	115	115
R^2	0.1900	0.2381	0.2479	0.3898
Likelihood Ratio Chi Square	19.5965	22.6136	23.6474	39.7577
P-Value	0.0206	0.0071	0.0086	0.0035

Agricultural and food service e-commerce ventures can be empirically differentiated. This suggests that these two groups of observations could be treated separately. To incorporate these differences into the model, a dummy variable for agricultural e-commerce ventures was introduced in model 2 (AG). This generates our third model. The new variable will allow a distinction between agricultural and food service observations. The results are presented in table 4. The addition of the dummy variable (AG) increases the explanatory power of the model. The new variable exhibits low levels of significance. Significance data on this variable is presented in table

Additional scrutiny suggested interactions between the dummy variable AG and each of the original variables might be introduced in the model; generating model 4. This resulted in a substantial increase in R^2, from 0.2479 to 0.3898 as presented in table 4.

When the hypothesis that all the newly introduced interactive variables were conjunctively 0 was tested, the results were a Wald Chi Square statistic of 11.53 with 9 degrees of freedom and a P-value of 0.2408. Thus we can accept the null hypothesis that all coefficients of the interactive variables equal 0 and the interactions are discarded.

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 presented in table 5. Clearly both represent a substantially better explanatory power than model 2 as judged by R^2, but present a slight decrease in the goodness of fit statistics. 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 5	Model 2	Model 5	Model 6
# of Observations	115	50	72
R2	0.2381	0.3438	0.4733
Significant Variables *	MI, A, e	MI, N, MD, a, oss	MI, PN, a, E
Likelihood Ratio Chi Square	22.6136	14.9029	31.5612
P-Value	0.0071	0.0936	0.0002

Variable acronyms displayed in lower case signify that the variable is approaching levels of significance at a = 0.1.

Table 6 presents a comparison of the odds ratios from models 2, 5 and 6.

Odds Ratios

Table 6	Model 2	Model 5	Model 6
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	3.255	1.55

Market information presents a strong increasing trend in odds ratio across models. 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 displays decimal numbers across all models, signifying that the odds of survival are always less than the odds of exiting the market for firms displaying high levels of automation.

The odds of survival are only slightly better than the odds of exiting the market for food service e-commerce ventures displaying neutral market orientation. Agricultural e-commerce ventures have odds of survival five times less than the odds of exiting the market.

Private negotiation exhibits odds of survival more than 50% better than the odds of exiting the market 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.

Conclusion:

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 7:

Table 7	In Agricultural Markets	In Food Service Markets
Variables		
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.	

Successful e-commerce ventures will have 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 have survived exclusively as information providers. The two sites previously mentioned were agricultural sites. Market information is at least as important in the food chain industry. Here the same kinds of information portals exist 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 there seems to be a trend of neutral firms exiting the market. *Efruitinternational.com*, *cybercrop.com*, and *agex.com* are just 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. The conclusion here is that agricultural e-commerce ventures are much better of by 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 have exited the market in the last couple of years: *cattleinfonet.com*, *cattle offering.com*, *cyberstockyard.com*, *meatexchange.com*, and *sellmeat.com*. There are also numerous e-commerce firms currently operating in the livestock sector which should raise a flag to any entrepreneur with intensions to enter that market.

The model implies that food service ventures should avoid private negotiation significantly. 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 exhibiting 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 run auctions such as *farms.com*, *cattlesale.com*, *emergeinteractive.com*, *winterlivestock.com* have been able to sustain their e-commerce operations. Auctions also proved significant in the food chain sector. *Dairy.com*, *dairynetwork.com*, *bakeryonline.com*, and *brevageonline.com* are all examples of currently successful e-commerce ventures.

The exchange variable is not significant for agricultural ventures, yet it is very significant for food service ventures, who 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* can all be used as examples of firms offering complementary products.

This study evaluated agricultural and food service e-commerce markets and designated characteristics as determinants of success. Out 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.

The technological advances in internet technology have allowed e-commerce to emerge as a way to do business. The expectations for this new business practice were high and to the present have not been fulfilled in food and agricultural markets. The phenomenon has been called the e-commerce revolution. Revolution does not come without bloodshed. In this case the casualties are e-commerce ventures who are forced to exit the market and leave their investments behind.

Firms entering the e-commerce markets need to remember that even though it is business 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 smoother 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 is 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 almonds industry. While many people joined the exchange, it experienced low levels of trading and exited the market. The problem is that those market inhibitors which had plagued the physical market for almonds were not directly addressed. So in a nut shell, 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 appear to be successful, both in the agricultural as well as in the food chain sectors. Among the strongest e-commerce ventures at present times are *theseam.com* and *eggclearinghouse.com* that 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 creation of regulatory institutions for e-commerce is of critical importance for both e-commerce entrepreneurs and researchers. As an advance in information technologies, it is very hard to find good quantitative information on e-commerce. The increase in transparency that was expected to result from e-commerce might be just that an expectation. Intranets and privacy policies of e-commerce firms have inhibited the availability of good e-commerce information. It is important for both e-commerce leaders and economic researchers investigating e-commerce that a regulatory institution is established to provide good record keeping, providing access to information for decision making and e-market research.

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. In many cases established business relationships in agriculture have been around for a long time.

The models presented in this study should be revisited in the future when the 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 than 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 complementation 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.

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