Familiarity vs. Efficiency: Evidence of Economic Paradoxes in Agricultural Supply Chains

by

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The use of electronic dynamic pricing mechanisms through exchanges or auctions can improve firm and market performance through reduced transactions costs, greater efficiency in supply chain coordination, and by bringing markets closer to the norms of perfect competition (Garicano and Kaplan, 2001; Lucking-Reiley and Spulber, 2001; Siems, 2001). Such systems would provide buyers and sellers with timely market information that could be used to plan production and increase supply chain efficiency. Based on our results, however, these pricing mechanisms would not be preferred or even appropriate for some agricultural users. Some agribusinesses apparently prefer the "known"—marketing system and marketing partners—to the potentially more efficient "unknown". We present evidence of this economic and behavioral paradox in agricultural marketing.

CONCEPTUAL MODEL

The Internet provides several incentives and means to coordinate agribusinesses in a supply chain. As an advanced and inexpensive communication network, the Internet has the potential to reduce many constraints and distortions that chronically plague agricultural markets. Expectations of lower transactions costs and better matching of demand and supply drive marketing developments on the Internet. However, as judged by minimal recent activity on agricultural e-commerce sites (e.g. XsAg.com, Farms.com), as well as the demise of numerous other agricultural e-commerce sites (e.g., FoodUSA.com, CyberCrop.com, GrainPlace.com, Rooster.com), agribusinesses appear not yet to be taking extensive advantage of these economic "improvements".

Following a methodology used by Pennings (1998) in a study of acceptance of futures markets by farmers, our research project aimed at understanding how farmers process and value information about alternative marketing systems. Combining farmers' perceptions of features of Internet marketing systems with decision-making theory, we developed a framework that captures the mental processes leading to the selection of an online marketing system. It includes individual behaviors, information processing, and expectations about the marketing systems.

The research question was twofold: (1) What are the criteria and mental processes that are involved in a selection of a new marketing system, and (2) To what extent do features of Internet-based marketing systems provide value to potential market participants? According to the theory of reasoned action (Fishbein and Ajzen, 1975), a specific decision is made by separately evaluating different attributes of the choice alternatives. Farmers generally evaluate two major dimensions when they select marketing channels: price performance and convenience (Ward et al., 1992). Research in the field of information technology (IT) consistently identified similar dimensions as determinants of acceptance of new IT by professionals. Perceived usefulness, perceived ease of use, and compatibility with work-style are main factors driving the choice of using new IT (Tornatzky and Klein, 1982; Davis et al., 1989; Moore and Bensabat, 1991; Taylor and Todd, 1995; Rogers, 1995).

Based on these consistent results, we derived three broad criteria for evaluating marketing alternatives: marketing performance, ease of use, and compatibility. Marketing performance from a seller's standpoint is defined as the extent to which the marketing alternative exposes farm products to many buyers, facilitates competitive bidding among buyers, minimizes transaction costs, provides complete and timely market information, as well as promotes adequate matching of sellers and buyers. Ease of use refers to the cognitive effort needed to learn and use a specific marketing alternative. Compatibility with work-style is defined as the extent to which the electronic market is adequately designed to fit with farmer's production and marketing habits. We then modeled the choice process after a modified version of the expectancy-value comparison model from Dabholkar (1994).

In the expectancy-value comparison framework, an individual is assumed to make comparisons based on perceptions he/she has about choice alternatives. When choosing among market clearing mechanisms, a farmer is likely to process information about the features of each marketing alternative and make cognitive representations of the different alternatives. These subjective assessments of consequences of selecting such or such alternative are called beliefs. In other words, a belief is the individual's feeling

that an alternative carries a characteristic, which in turn has a specific consequence on the user of the alternative. Choosing one alternative implies the individual then has to deal with the associated consequences. At the stage where the individual forms beliefs, he/she actually reviews these anticipated consequences.

The individual also weighs the importance of the consequences to him/her by expressing how much he/she values the system's characteristics. These weights are called evaluations. As a result of this mental analysis, the farmer forms beliefs and evaluations about all the alternatives. He then combines beliefs with their associated affective evaluations and groups them into three consistent dimensions: marketing performance, ease of use, and compatibility. These groups of beliefs-evaluations combinations are turned into expectancy-value components (EVCs) for each alternative. An EVC is the expected utility that an alternative can bring to the individual with respects to one dimension of comparison. The EVC "marketing performance" for an alternative is the farmer's appraisal of his/her marketing utility derived from selecting this alternative. The EVC "ease of use" is the extent to which the farmer values the ease of marketing his/her products through the specific marketing alternative. The EVC "compatibility" is the degree to which a marketing alternative is perceived to be consistent with the individual's production practices. Equation 1 presents the formal relationship between the beliefs, the evaluations, and the EVC, where *EVCij* is the expected-value component for dimension *j* and alternative *i*, b_{ik} is a belief about alternative *i* that pertains to dimension *j*, and e_k is the evaluation of one feature of the marketing alternative within dimension *j*.

(Equation 1)

$$EVC_{ij} = \sum_{k=1}^{K} b_{ik} e_k$$

By adapting the expectancy-value comparison model we assume comparisons across alternatives are made at the EVC level. Within each dimension *j*, the farmer compares EVCs for each alternatives with EVCs for the other alternatives and forms relative expectancy-value components (REVCs). The REVCs are simply EVCs that account for the fact that the individual does not cluster the different alternatives in a choice situation. Rather, their cognitive representations of each alternative *i* are mapped compared to the other alternatives. Equation 2 states that the REVC of dimension *j* for alternative *i* is the ratio of the EVC for this alternative over the sum of EVCs for all other alternatives, within dimension *j* (we assume that the comparison is made by ratio based on the evidence of Candel and Pennings (1999) who tested different comparison schemes of farmers).

(Equation 2)

$$REVC_{ij} = \frac{EVC_{ij}}{\left(\sum_{i=1}^{I} EVC_{ij}\right) - EVC_{ij}}$$

Then, for each alternative the decision maker aggregates the REVCs pertaining to it across the three evaluated dimensions to form his/her relative attitude (RAT_i) towards alternative *i*, relative to other marketing alternatives. This conceptual construct is the individual's affective response toward the use of alternative *i*. It is the individual's overall feeling about the alternative. The alternative that has the largest relative attitude is the preferred one at this point in the decision making process. Formally, the RAT_i towards alternative *i* is defined as the sum of all REVCs for this alternative across the dimensions marketing performance, ease of use, and compatibility with work style. In Equation 3 the β_{ij} coefficients represent the affective weights an individual assigns to his/her REVCs in the formation of the overall attitude toward the alternative *i*. These coefficients are estimated empirically.

(Equation 3)

$$RAT_i = \beta_{iMP} REVC_{iMP} + \beta_{iEU} REVC_{iEU} + \beta_{iCW} REVC_{iCW}$$

Where $REVC_{iMP}$, $REVC_{iEU}$ and $REVC_{iCW}$ are the relative expectancy components marketing performance, ease of use and compatibility for farmer *i* respectively.

Before the individual makes the final choice, his/her attitude affects the intention to choose alternative *i* over other alternatives. The attitude plays the role of mediator between the cognitive

representation of the alternative and the intention of selecting this alternative. The marketing alternative that receives the largest intention is most likely to be chosen in the end. The intention is the direct predictor of actual choice behavior.

However, external information from significant advisors for instance may influence the intention. This 'bias' in the individual decision process occurs when informational inputs moderate or enhance the attitude's effect on intention, whether positively or negatively. The effect of external input is defined for each alternative. The relative subjective norm (RSN_i) is the extent to which the individual perceives that external advisors support an alternative compared to the others. In turn, the relative intention toward alternative i (RIN_i) is formed upon the relative attitude and the relative subjective norm, as shown in Equation 4. The β_{i1} and β_{i2} coefficients are the respective weights of the relative attitude and the subjective norm in the formation of the relative intention. They are estimated empirically.

(Equation 4)

$$RIN_i = \beta_{i1} RAT_i + \beta_{i2} RSN_i$$

Finally, the relative intention is converted into the final decision FC_{1i} whether to choose the associated alternative i over the others. Only one alternative is chosen to be implemented according to the following relationship:

(Equation 5)

$$g\left(\Pr\left(FC1_i = 1\right)\right) = \alpha_i + \beta_i RIN_i$$

where $g\left(\Pr\left(FC1_i = 1\right)\right)$ is a function of the probability of choosing alternative i that is linearly related to the relative intention. This expectancy-value comparison model represents the decision process that is assumed to occur when farmers choose a marketing alternative to market specialty chicken. Each step of the model was tested with either multiple regression or logistic regression.

EMPIRICAL MODEL: EVIDENCE FROM LABEL ROUGE STUDY

Using a survey design, we studied choice behaviors of 600 potential participants in the specialty chicken market in the US with respect to their acceptance of a posted price system, a classified ad system, a call auction, or a continuous auction. The survey instrument is available upon request from the authors.

The posted price is the simplest alternative considered in the study as sellers would know in advance their gross revenue per bird. However it gives little flexibility to buyers who want to negotiate. The classified ad system is also simple but could be inconvenient to use, as it requires that buyers and sellers spend time in negotiations, either over the phone or by email. Such a system would not support speedy transactions. In addition, a classified ad system is likely to generate little market information if prices are negotiated privately. A call auction, as it is currently used in the livestock industry, draws all market participants together at a pre-specified time. Transactions are fast and generate instant market information. However, call auctions require buyers and sellers to commit to the market at specific times, which may be inconvenient. Finally, a continuous auction offers dynamic pricing, market information, and flexibility to users. The drawback is that transactions are slow to occur and must be planned ahead of intended deliveries.

Beliefs about the marketing alternatives were measured on semantic nine-point scales anchored by "strongly disagree" and "strongly agree". The scale for the marketing performance dimension was based on the theoretical considerations of marketing efficiency. Widely used scales developed by Moore and Bensabat (1991) were adapted to our context for the ease of use and compatibility dimensions, along with one item from Pennings (1998). The evaluations were also measured with semantic nine-point scales, with the end-poles being "not at all important" and "very important". Corresponding to the measurement of beliefs, evaluations of marketing performance were measured, while other questions referred to ease of use and measured compatibility with work-style. According to Equation 1 and Equation 2, the values for the three REVCs were directly computed from the products of the scores from questionnaire items.

The relative attitudes were measured by asking respondents to distribute 100 points across the four alternatives to indicate the relative strength of their preferences for the marketing alternatives. Similarly, for the relative subjective norms, participants distributed 100 points across the four alternatives to represent the degree of perceived support of external advisors for each alternative. Relative intentions

were also measured by distributing 100 points across the four alternatives to express the relative likelihood, or intention, to use a marketing alternative. The "final choice" was a discrete variable representing the participant's alternative choice.

Scales for multi-item constructs were either created or adapted from other studies. The meaningfulness of the marketing performance scale was assessed through exploratory factor analysis. The results, presented in Table 1, suggested that the scale be divided into three scales: efficiency of price discovery, market information, and expected buyer's satisfaction. The quality of all scales was then assessed using confirmatory factor analyses (Hair et al., 1992).

Table 1. Matrices of factor loadings on standardized beliefs variables

	Factor loadings[‡]						
	Varimax rotation			Oblimin rotation			Final
Item	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	communalities
B1 exposure	**0.684**	0.217	0.245	0.016	-0.027	**0.764**	0.574
B2 best prices	**0.663**	0.311	0.268	0.040	0.091	**0.693**	0.609
B3 quickly sell	**0.535**	0.267	0.290	0.122	0.084	**0.522**	0.441
B4 low cost	**0.603**	0.179	0.160	-0.053	-0.030	**0.700**	0.421
B5 plentiful info	0.282	0.178	**0.942**	**1.045**[†]	-0.015	-0.061	0.999
B6 timely info	0.317	0.186	**0.623**	**0.632**	0.024	0.114	0.523
B7 quality	0.311	**0.549**	0.300	0.183	**0.511**	0.110	0.488
B8 delivery date	0.209	**0.864**	0.141	-0.019	**0.953**	-0.077	0.809
B9 lot size	0.285	**0.758**	0.125	-0.053	**0.798**	-0.071	0.671
Eigenvalue	1.959	1.934	1.642				5.535
% of trace*	35.4	34.9	29.7				100.0
% of common variance	21.8	21.5	18.2				61.5

[‡] Bold numbers indicate factor loadings that were retained in the interpretation

[†] The loading of B5 on Factor 1 in the oblique solution was greater than one, which is not theoretically acceptable. It is a phenomenon that can happen in oblique solutions (McDonald, 1985; SPSS User's Guide). This result is displayed only to support the convergence of orthogonal and oblique solutions

* Trace = 5.535, with 61.5% of total variation being common variance

Table 2 shows the model estimates for the confirmatory analysis run using AMOS 4.0. Overall the data fit our model reasonably well (Chi-square = 288.803 with 94 degrees of freedom, GFI= 0.908, Normed chi-square = 3.072, RMSEA = 0.077, TLI = 0.933, NFI = 0.924, AGFI = 0.868).[1] Our findings suggest that farmers aggregate the features of marketing alternatives into five broad dimensions: (1) efficiency of the price discovery procedure, (2) market information, (3) expected buyer's satisfaction, (4) ease of use, and (5) compatibility with work style.

Discriminant validity of scales was investigated using chi-square difference tests to ensure that constructs are indeed distinct (Campbell and Fiske, 1959). With all differences in chi-squares between alternative and original models above the critical chi-square of 9.488 (df = 4, $\alpha = 0.05$), these results suggest discriminant validity for each pair of factors, i.e. all five factors are distinct from each other and are represented by different questionnaire items.

The five choice dimensions identified in the previous section are used to understand the process that led farmers to choose one of the four marketing alternatives. For each marketing alternative, the five relative expectancy value components are computed for each respondent using Equation 2, and the relative attitudes are linearly regressed against them according to Equation 3. High scores on relative attitudes are interpreted as very positive attitudes. Due to missing data on one or several variables, a total of 91 observations are used for the regression analyses. The estimated standardized regression coefficients

[1] The Goodness-of-Fit Index (GFI), which represents the overall degree of fit, is, the squared residuals from prediction compared with the actual data. The measure ranges from 0 (poor fit) to 1.0 (perfect fit). The Tucker Lewis Index (TLI) is an incremental fit measure that combines a measure of parsimony into a comparative index between the proposed and null model. A recommended value is 0.9 or greater. The Root Mean Squared Error of Approximation (RMSEA) estimates how well the fitted model approximates the population covariance matrix per degree of freedom. A value below 0.08 indicates a close fit (see Pennings and Leuthold, 2000).

for the four marketing alternatives are presented in Table 3 with respect to relative attitudes towards the alternative and in Table 4 with respect to relative intentions to use the alternative.

The choice criteria that significantly influenced producers' choice of marketing system are ease of use for the posted price and compatibility with work style for the classified ad system. Efficiency of the price discovery mechanism is the main reason for preference of an auction. Also significant, but of lesser importance, is compatibility with work style and ease of use for the call auction and the continuous auction, respectively. Across the four marketing alternatives, market information and expected buyer's satisfaction have no significant effect on the relative attitudes towards marketing alternatives, suggesting that farmers do not perceive a value for these features in any of the four marketing alternatives relative to the other alternatives.

Table 2. Results for the confirmatory factor analysis of choice dimensions

	Factor loadings						
Dependant variables	Efficiency of Price Discovery EPD	Market Information MI	Expected Buyer's Satisfaction EBS	Ease of Use EU	Compatibility with Workstyle CW	Squared multiple correlations	Measurement Errors
B1 exposure	0.737					0.543	0.457
B2 best prices	0.790					0.624	0.376
B3 quickly sell	0.695					0.483	0.517
B4 low cost	0.594					0.353	0.647
B5 plentiful info		0.910				0.827	0.173
B6 timely info		0.787				0.619	0.381
B7 quality			0.703			0.495	0.505
B8 delivery date			0.853			0.727	0.273
B9 lot size			0.822			0.676	0.324
B10 easy way to sell				0.851		0.725	0.275
B11 way I want				0.846		0.716	0.284
B12r ease of use				0.521		0.272	0.728
B13 easy learning				0.608		0.370	0.630
B14 compatibility					0.889	0.791	0.209
B15 fit workstyle					0.963	0.927	0.073
B16 good fit					0.891	0.794	0.206
Factor reliability	0.799	0.838	0.837	0.806	0.939		
Variance extracted	0.501	0.723	0.632	0.520	0.837		
Factor correlations	EPD	MI	EBS	EU	CW		
EPD	1.000						
MI	0.692	1.000					
EBS	0.687	0.511	1.000				
EU	0.888	0.510	0.689	1.000			
CW	0.739	0.367	0.489	0.915	1.000		

Table 3. Building attitudes: standardized regression coefficients for the four alternatives

	Standardized regression coefficients			
	Posted price system	Classified ad system	Call auction	Continuous auction
Dependent variables				
Relative attitude towards the alternative				
Independent variables (for each alternative)				
REVC Efficiency of Price Discovery	-0.209	0.230	0.451*	0.538*
REVC Market information	0.209	0.123	0.109	-0.108
REVC Expected Buyer's Satisfaction	-0.116	-0.111	-0.150	-0.148
REVC Ease of Use	0.508*	-0.035	0.059	0.273*
REVC Compatibility with Work Style	0.271	0.578*	0.363*	0.212

* Significance: $p < 0.05$

Regarding the impact of perceived social influence on the choice process, relative subjective norms have positive significant effects on relative intentions to use an alternative only for the posted price system and the call auction.

To test for relationships between the relative intention to use a marketing alternative and the actual final choice of that alternative, we ran a logistic regression of the final choice against the relative intention, for each alternative. Due to missing data, 104 observations were used in the four logistic regressions. An increase of one point on the intention to use a specific marketing alternative translates in an increase by 11% to 24% in the odds of eventually choosing that alternative.

Table 4. Building intentions: standardized regression coefficients for the four alternatives

	Standardized regression coefficients			
	Posted price system	Classified ad system	Call auction	Continuous auction
Dependent variables				
Relative intention to use the alternative				
Independent variables				
Relative attitude towards the alternative	0.788*	0.724*	0.590*	0.862*
Relative subjective norm for the alternative	0.157*	0.174	0.312*	0.029

* Significance: $p < 0.05$

A majority of farmers (56.7%) chose the fixed, posted price system, while another 25% of respondents expressed preference for electronic classified ads. Less than 15% chose the continuous auction. The least preferred marketing system was the call auction (3.8%). Thus, very few preferred the auction-based systems, which might ultimately yield users the greatest benefits. With over 80% of producers choosing either the posted price or classified ad systems, it seems their choice is conservative. Producers chose an electronic system that replicates their traditional ways of selling chickens in their current local markets.

Further empirical analysis will investigate choice of marketing alternatives in a simultaneous context to reflect the choice challenges faced by farmers in real life. We will apply a multinomial logit model to the data to take all choice alternatives simultaneously into account and investigate further which marketing features are most important in influencing choice. The multinomial logit analysis may also allow us to gain further insight into the apparent familiarity versus efficiency paradox.

IMPLICATIONS FOR AGRICULTURAL SUPPLY CHAINS

The results found in this study may or may not be generalized beyond specialty poultry production. Specialty poultry producers in the United States may be unique, or at least not similar to other participants in agricultural supply chains, in their preferences for and choices of marketing arrangements. However, these findings may be relevant to and help explain the lack of success of several online agricultural marketplaces that appear to suffer from a lack of liquidity and trading interest. Why has agriculture, at least in the United States, been so reluctant to adopt e-commerce?[2] Several competing or complementary hypotheses may explain why we are seeing relatively less e-commerce adoption in agriculture than we are in other sectors. Some of these hypotheses are flattering to agriculture (pre-existing competition and low transactions costs that limit the benefits of e-commerce); others are less so (unprogressive industry slow to adopt new technologies; lack of leadership initiative due to industry fragmentation and decentralization; entrenchment of legacy systems; dominance of relationships in marketing arrangements; uncompetitive geographic markets where arbitrage is constrained; preference for information asymmetry).

Is agriculture different from other industries in its choice of systems for supply chain management? Will agriculture eventually adopt efficient new-economy models of e-commerce, or will it

[2] One of the most successful agricultural e-commerce sites appears to be foodtrader.com that is mostly populated by foreign buyers and sellers of relatively exotic commodities by U.S. standards.

chose to continue with old-economy systems based on the familiar? Agriculture has been reluctant to adopt open, auction-based systems for pricing in numerous other instances. Very few new agricultural futures contracts have survived their introduction (see for instance problems with the high fructose corn syrup futures contract as discussed by Thompson et al., 1996). Due to high learning costs and uncertainty, could it be more efficient for traders to adopt electronic supply chain management systems most like traditional systems?[3]

Another explanation is that these results are not typical or representative of agribusiness in general, but maybe typical of farmers. Farmers may not be like other "Bs," or other agribusinesses. They may have other objectives than profit maximization, and be less concerned with economic efficiency than other types of firms. Or, perhaps farmers have characteristics, such as a strong preference for privacy in transactions and familiarity with trading partners, which make auctions less attractive to them.

The familiarity versus efficiency paradox, which likely applies to other agricultural supply chains besides specialty poultry, presents significant challenges to improvements in supply chain management. What can be done to encourage an industry to make more radical changes in its supply chain management practices? Education? Profits? Losses? Industry leadership? Radical changes in industry structure? Or, will changes just come in due time? Is the focus on "change enablement" now prevalent in large corporations a reflection of the need for agribusinesses and other firms to focus explicitly on tactics that promote adoption of new practices and technologies?

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[3] One interesting aspect of the paradox though is that auctions are usually most preferred when the demand for a product is most uncertain (Lucking-Reiley, 2000). Currently the demand for specialty poultry in the United States is quite uncertain.

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