Journal of Agricultural and Resource Economics 30(3):502–519

After the Bubble: The Survival and Ownership of Internet Marketplaces for Farmers and Agribusiness

W. Parker Wheatley and Brian L. Buhr

This paper presents a theory of how industry structure and beliefs about Internet marketplace use have driven choice and ownership of marketplaces. The theory's predictions suggest that surviving Internet marketplaces will be those with strong historical linkages in an industry and those owned by or affiliated with major commodity buyers. Comparisons of these predictions with actual outcomes provide validation of the theory. Where predictions differ from results, observations are made as to the nature of the deviations.

Key words: agricultural markets, electronic commerce, Internet markets, network externalities, technology adoption

Introduction

Internet commerce contributes to the continuing search for new or different marketplaces for agricultural products, improved business processes, and less costly transactions. Despite this growing phenomenon, little attention has been paid by the agricultural economics literature to the fundamental economic issues of who owns Internet marketplaces and how this affects the success of an Internet marketplace. The issue of marketplace ownership in agriculture is particularly important as traditional marketplaces continue to consolidate and raise the prospect of increased exercise of market power.

The great exuberance of firms to set up online marketplaces in the late 1990s was soon tempered by post-Internet bubble economic realities. Prior to 2002, some Internet marketplaces began operations, obtained financing, and went out of existence or were acquired through merger in less than a year. Many firms which began business as places for exchange and negotiated trading moved toward being service and software providers for individuals or groups of businesses seeking to buy or sell commodities via the Internet. In examining these processes, this paper reviews the literature on market formation, sponsorship,[1] and choice. Based on the theory of market formation, a game

---

W. Parker Wheatley is assistant professor, Department of Economics, the College of Saint Benedict/Saint John's University, Saint Joseph, MN; Brian L. Buhr is professor, Department of Applied Economics, University of Minnesota, Saint Paul, MN.
The authors wish to thank Robert King, Robert J. Kauffman, and Donald Liu for helpful comments and contributions. The authors also gratefully acknowledge the helpful suggestions of an anonymous reviewer. This research was supported by the Minnesota Agricultural Experiment Station. Finally, we wish to thank Brice Keown for his able assistance in programming, and to express gratitude to the Department of Economics at Carleton College for supporting this collaboration with funds from the Ada M. Harrison Fund.

Review coordinated by DeeVon Bailey.

[1] We treat sponsorship and ownership as synonymous. Sponsorship allows a slightly broader interpretation including, for example, an exclusive agreement to conduct all transactions in a particular marketplace even with no ownership stake. However, the intent is the notion that a firm is somehow committed to trading in a particular marketplace and other firms are aware of this; ownership is the clearest signal of the intent to trade.

theoretic approach is used to analyze the potential for alternative ownership structures of Internet markets given the existing structure (size, number, and volume of firms and transactions) of agricultural industries.

Review of the Literature on Marketplace Formation

In the early 1980s, there were broad discussions of the effects of electronic marketing on agricultural industries (Henderson, 1984; Purcell, 1984; Russell, 1984; Schrader, 1984; Sporleder, 1984). The rise of the Internet again brought attention to the question of how electronic markets would affect agricultural markets (Chambers et al., 2001; Schiefer, Helbig, and Rickert, 2001). In addition to cataloging Internet initiatives, the more recent work arrives at a broad set of questions about the effects of information technologies on agricultural markets.

However, discussing the impacts of Internet markets presupposes their formation and successful implementation. As noted by Mulherin, Netter, and Overdahl (1991, p. 593), "Markets arise only after extensive interaction between entrepreneurial experimentation, contract development, and legal review that results in a complex apparatus in which to conduct trade." Research suggests that the process of marketplace choice and sponsorship incorporates the following: (*a*) the theory of network externalities and its relationship to market liquidity and market choice, (*b*) the role of ownership and pricing in marketplace formation, and (*c*) the importance of beliefs and expectations about adoption of an Internet marketplace by buyers and sellers.

Network Externalities, Liquidity, and Market Choice

For an Internet marketplace to succeed, it must attract adequate liquidity. Multiple definitions for liquidity exist (Lippman and McCall, 1986; Economides and Siow, 1988), but it is sufficient to characterize liquidity of Internet marketplaces as the feature that makes it possible to readily buy or sell a product. From a buyer's perspective, a marketplace is less liquid if there is little prospect of the participation of sellers, and vice versa for the case of the seller. Related to the concept of liquidity is the idea of a network externality. Economides (1996) remarks that the components of the exchange transaction, the "offer" and "counteroffer," are complementary, with each having no value without the other, and hence resemble a network externality effect. The literature on network externalities, technology, and financial markets tends to support the argument for the formation of single marketplaces which build on positive network externalities that would be lost if markets fragmented (Di Noia, 2001; Domowitz, 1995; Economides, 1996; Ellison and Fudenberg, 1993; Farrell and Saloner, 1986; Katz and Shapiro, 1985, 1986; Pagano, 1989).

These varied methodologies support the conclusion that positive network externalities of increased liquidity and buyer and seller participation will frequently, although not always, lead to consolidation of Internet marketplaces. The theories developed in this literature also emphasize the importance of the cost of services in a given marketplace in the decision to use it. Therefore, the success of a single Internet market will depend on its ability to provide liquidity by attracting large and similar numbers of buyers and sellers and through having competitive fees for users.

The Role of Sponsorship or Ownership

Several studies have recognized that if liquidity and pricing are two key components to market success, then those who are buyers or sellers might find a natural advantage in sponsoring a marketplace. Ownership and participation provide assurance that liquidity will be present (Dai and Kauffman, 2003; Lucking-Reilly and Spulber, 2001). The nexus of ownership and pricing for use of marketplaces has been discussed in the literature by Di Noia (2001) as well as Hart and Moore (1996). These studies note there may be a natural tension between profit maximization of the exchange mechanism itself and increasing the liquidity of the market. Despite this conflict and other arguments against participant-owned marketplaces, the history of futures exchanges reveals the common occurrence of mutual ownership by buyers and sellers of commodities, thereby supporting the notion that sponsorship has historically played a role in marketplace formation and success (Baer and Saxon, 1949).

The Role of Beliefs

Most prior research focuses heavily on a static concept of market choice and does not attempt to model the role of beliefs in market choice (Di Noia, 2001; Economides, 1996; Ellison and Fudenberg, 2002; Ellison, Fudenberg, and Mobius, 2004). However, those studies do raise the issue of the potential effects of expectations about the equilibrium size of competing markets on market choice. In a practical setting, this arises in Domowitz's (1995) argument that beliefs about the persistence of floor trading have slowed the adoption of electronic trading in domestic and European markets.

Other researchers have considered how expectations about adoption of competing technologies are fulfilled and how lock-in, critical mass, and historical events affect network technology adoption. Arthur (1989) presents a theoretical model which supports Domowitz's logic that historical factors leading to the adoption of one technology can lock agents into using the technology despite its potential inferiority. Using a similar methodology, Witt (1997) argues that lock-in cannot be a permanent phenomenon because many innovations eventually gain preeminence by obtaining a critical mass of adoption and ultimately gaining the network advantage. In the context of modeling technology adoption, Witt finds adoption depends heavily on the probabilistic nature of adoption (i.e., prior beliefs) and the initial conditions (i.e., historical factors). Furthermore, he asserts that one must incorporate preexisting technologies, or in the case of the Internet, trading platforms, in order to more appropriately capture the salient features of the real world. Witt also shows that if a large company sponsors a major innovation, it may have greater incentives to support technological diffusion. Such sponsorship would allow a technology or Internet marketplace to attract the attention of potential users and thereby affect users' beliefs about whether such Internet marketplaces will attract adequate liquidity.

Issues of this entrenchment or lock-in of marketplaces are also connected with the embeddedness concept in the management literature. In the logic of Gnyawali and Madhavan (2001), one could note that the structure of inter-firm relationships in agriculture (structural embeddedness) and the social connections between players in commodity markets (relational embeddedness) hypothetically work in tandem to limit the ability of buyers and sellers to deviate from current networks of trading despite the

potential enhancements to competition of Internet marketplaces. One might make a further connection to the tensions in the Witt (1997) and Arthur (1989) lock-in arguments on this point. Specifically, Dacin, Ventresca, and Beal's (1999) work supports the argument that given the potential complexity and degree to which current trading relationships are embedded, significant changes and broadening in markets will be required in order to "disembed" local networks and trading relationships, and thereby supplant them with Internet marketplaces.

Conceptual and Game Theoretic Approach to Marketplace Adoption and Formation

The literature reviewed above is summarized as a decision process for marketplace formation in figure 1. Marketplace choice in agriculture will be modeled to depend on factors of network externality effects, costs and prices of using the markets, ownership of markets, and the beliefs of participants. Business process (e.g., guaranteeing payments, product quality, and managing logistics as part of the arms-length transaction) is important to the question of marketplace adoption and success. However, business process issues can be subsumed into transactions cost efficiency, an operational issue, in which case economic theory clearly leads to a least-cost selection criterion. Other factors described in the literature review, and which are the focus of this research, are conjectural on the part of participants and subject to game theoretic analysis.

Conceptual Model of Network Externalities of Marketplace Choice

In a basic structure and environment of trading, agents trade a single commodity q for a price p_q. For the cotton business, this commodity would be pounds of cotton, for grains it would be bushels, and for livestock it would be per hundredweight (cwt) of cattle, and so on. There are B buyers who use q as an intermediate input for producing product y which sells for p_y and which is taken as exogenous to the model. Buyers are differentiated into two types by their holding of a fixed resource A, where B_m and B_h are the components of B representing the middle (m) and high (h) types of buyers. The nomenclature "average" and "large" sized buyers and sellers is used interchangeably with "middle" and "high" sized buyers and sellers. Large/high type buyers and sellers are simply the group of largest buyers and sellers, and average/middle type buyers and sellers represent the average of all other buyers and sellers. Allowing for two types of buyers and sellers introduces heterogeneity of types of farms and processors while not overcomplicating the analysis. This differentiation of buyers by a fixed resource is analogous to the differentiation of agents in Pagano's (1989) model by their initial endowments. In general, the heterogeneity could be applied to risk preferences, wealth differences, or any other number of differentiating factors. Buyers combine their intermediate good (q) with their fixed resource (A) into a final output (y) through a standard technology.

On the seller side of the market, there are S sellers who produce q as their final output. As with the buyers, sellers are differentiated by their holding of a fixed resource L, where S_m and S_h are the component members of S classified as the middle and high types of sellers. For example, sellers are generally constrained by land (in the case of

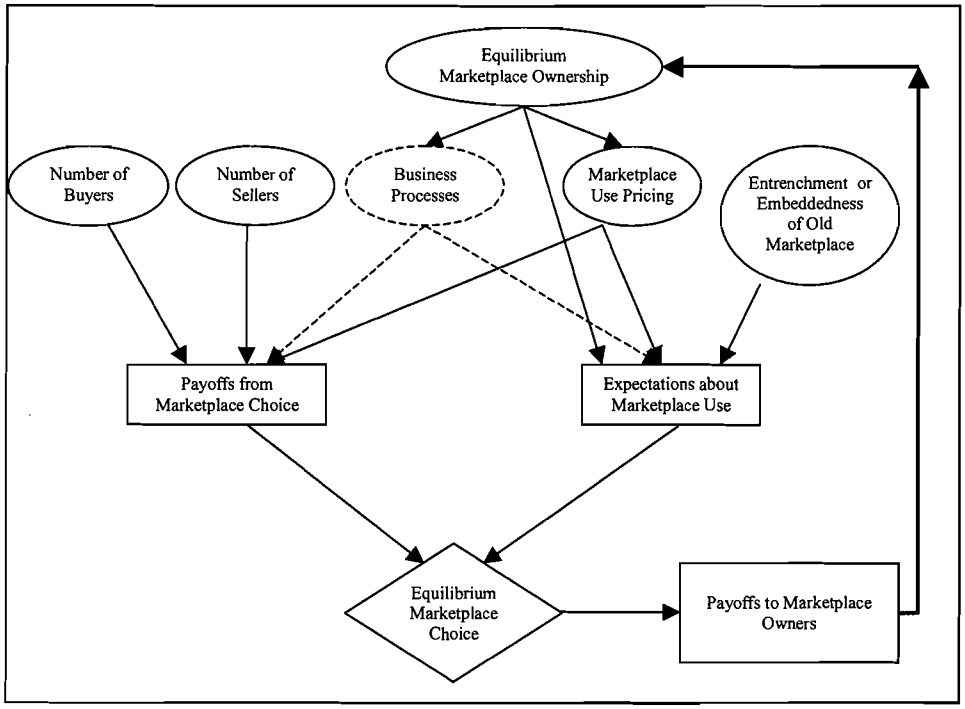

Figure 1. Market structure, use expectations, and the choice and formation of internet marketplaces

grain and other crop producers), and growing, finishing, laying, feedlot facilities in the cases of cattle, poultry, and swine. Sellers' technology is characterized by a standard cost function. As with buyers, the different holdings of the fixed resource will yield different output supplies by these differentiated producers.

In terms of creating a tractable strategic environment, it is assumed that either all or none of the buyers or sellers of a particular type participate in a market. In a context where a particular group of consumers is considering the purchase of a network technology, Katz and Shapiro (1986) assume these consumers coordinate their decisions to choose the technology that is Pareto preferred by the group. This assumption effectively reduces the analysis of thousands of agents' behaviors into a situation with four strategic agents in our case. Specifically, we have high buyers (B_h), medium buyers (B_m), high sellers (S_h), and medium sellers (S_m) with groups of buyers and sellers acting as a single entity. In the parlance of Ellison and Fudenberg (2002), the limitation of this assumption is that there will be a larger "market impact" effect from the entry or exit of a group of buyers from a market, for example, as opposed to the small impact of entry or exit by one buyer.

In order to consider payoff variations due to player entry and exit, we make a further simplifying assumption that buyers and sellers choose a level of quantity demanded and supplied based on their estimates of the quantities demanded and supplied by all other buyers and sellers. An ex ante fixed level of quantity demanded or supplied by any given agent prior to marketplace choice is consistent with the commonly used unit demand/supply assumptions of Katz and Shapiro (1985, 1986); DiNoia (2001); and Ellison and

Table 1. Industry Structures, Defined by the Feasible Intersections of Conditions with Subconditions

	Condition 1 $S_h q_{jh} > S_m q_{jm}$ $B_h q_{ih} > B_m q_{im}$	**Condition 2** $S_h q_{jh} < S_m q_{jm}$ $B_h q_{ih} > B_m q_{im}$	**Condition 3** $S_h q_{jh} > S_m q_{jm}$ $B_h q_{ih} < B_m q_{im}$	**Condition 4** $S_h q_{jh} < S_m q_{jm}$ $B_h q_{ih} < B_m q_{im}$
Subcondition 1 $B_m q_{im} > S_m q_{jm}$ $B_h q_{ih} < S_h q_{jh}$ $B_h q_{ih} > S_m q_{jm}$ $B_m q_{im} < S_h q_{jh}$	Industry Structure 1.1		Industry Structure 3.1	
Subcondition 2 $B_m q_{im} < S_m q_{jm}$ $B_h q_{ih} > S_h q_{jh}$ $B_h q_{ih} < S_m q_{jm}$ $B_m q_{im} > S_h q_{jh}$		Industry Structure 2.2		Industry Structure 4.2
Subcondition 3 $B_m q_{im} > S_m q_{jm}$ $B_h q_{ih} < S_h q_{jh}$ $B_h q_{ih} < S_m q_{jm}$ $B_m q_{im} > S_h q_{jh}$			Industry Structure 3.3	Industry Structure 4.3
Subcondition 4 $B_m q_{im} < S_m q_{jm}$ $B_h q_{ih} > S_h q_{jh}$ $B_h q_{ih} > S_m q_{jm}$ $B_m q_{im} < S_h q_{jh}$	Industry Structure 1.4	Industry Structure 2.4		

Fudenberg (2002). Given the optimal quantities demanded and supplied under these conditions, we allow agents to choose the marketplace in which they will trade when faced with a choice of two or three possible marketplaces.

Industry structure is characterized by the number and quantity produced by different types of buyers and sellers. The numbers of high buyers, medium buyers, high sellers, and medium sellers are denoted B_h, B_m, S_h, and S_m, respectively. The corresponding input demands and output supplies of these buyers and sellers are denoted q_{ih}, q_{im}, q_{jh}, and q_{jm}. Industry structure then is based on the relative sizes of quantities demanded and supplied by the different types of buyers and sellers. For example, $B_h q_{ih}$ is simply a representation of the total quantity demanded by high buyers, with similar interpretations holding for $B_m q_{ih}$, $S_h q_{jh}$, and $S_m q_{jm}$. Again, other factors could be used such as risk aversion, but size is easily quantifiable and readily observable. Given the earlier assumption on output supply and input demand determination, the following aggregate condition must hold (i.e., no excess demand for the market as a whole):

$$B_h * q_{ih}(p_q) + B_m * q_{im}(p_q) - S_h * q_{jh}(p_q) - S_m * q_{jm}(p_q) = 0. \tag{1}$$

With the market-clearing condition in mind, we first split industries based simply on the relationships between high buyers and medium buyers as well as between high sellers and medium sellers. Second, industries are split based on subconditions derived from the relative sizes of buyer quantities demanded to seller quantity supplied. Table 1 summarizes the eight feasible industry structures for this study, where the industry structures are defined by the feasible intersections of conditions (columns) with subconditions (rows).

Given a particular industry structure, one can derive the payoff orderings from each possible configuration of buyers or sellers participating in a given marketplace. In notational terms, we compare $\Pi_{ih}(B_h, S_h)$ with $\Pi_{ih}(B_h, S_h, B_m, S_m)$, where the first expression represents the payoffs to high buyers when only buying from high sellers, and the second expression corresponds to the payoffs to high buyers when the market includes all types of buyers and sellers. With this prefatory remark, table 2 shows the payoff orderings for each buyer and seller type under each industry structure. These payoff orderings form the core of the strategic environment of marketplace choice. [The proofs and/or assumptions required for the orderings are available from the authors upon request and may also be found in Wheatley (2004).]

Ownership, Marketplace Pricing, and User Costs

Given the above description of payoffs, we now incorporate fees and user costs for Internet marketplaces. In order to trade in the traditional marketplace, there is a linear transaction cost (τ) per unit of output traded at the market. This cost might be attributed to search and effort expended in trading in traditional marketplaces. This aspect represents the final component needed to consider firm behavior, profits, and market equilibrium for a commodity exhibiting heterogeneity of buyers and sellers.

In the event an Internet marketplace is formed, buyers and sellers face a new transaction cost of exchange. This new cost is denoted as τ_{MKT}. Evidence suggests these transaction costs should be lower than those of traditional markets (Garicano and Kaplan, 2001). This information can then be incorporated into payoffs to allow for post-Internet payoff comparisons between different types of marketplaces. For purposes of clarity, aside from the traditional pre-Internet marketplace (TM), we posit that four basic types of marketplace ownership patterns are possible: (*a*) high-buyer (HB) owned marketplaces, (*b*) high-seller (HS) owned marketplaces, (*c*) high-buyer/high-seller (JO) owned marketplaces, and (*d*) third-party (TP) marketplaces. This constraint is plausible in the sense that medium-buyer and medium-seller owned marketplaces may find it prohibitively expensive to organize.

To support such Internet ventures, firms must charge users some price, denoted here as *UC* with subscripts *TP*, *HB*, *HS*, and *JO* corresponding to the Internet marketplaces under different ownerships. For example, UC_{TP} represents the user cost of a third-party marketplace. Finally, the subscript *PO* is used generically to refer to all participant-owned marketplaces. We consider two key scenarios on cost of use: (*a*) $UC_{TP} < UC_{PO}$, and (*b*) $UC_{TP} > UC_{PO}$. The total costs of using any Internet marketplace are also restricted to be less than those of a traditional marketplace (i.e., τ_{MKT} and $UC_{any} < \tau$). We abstract from the topic of price competition as discussed by Caillaud and Jullien (2001, 2003).

Games of Marketplace Choice

With information on payoffs and user costs, we can address how buyers and sellers react when faced with different possible choices of marketplaces. In this context, there are seven basic marketplace choice games, as summarized in table 3.

The first four games identified in table 3 are simply the standard two-market choice environment where agents, excluding participant-owners, decide which marketplace to use. The latter three games are slightly more complex in that there are two possible user

Table 2. Payoff Relationships Under Each Industry Structure

Industry Structure 1.1: Concentrated–High Seller Dominant (CHSD)

$\Pi_{jm}(B_h, B_m, S_m) > \Pi_{jm}(B_h, S_m) > \Pi_{jm}(B_m, S_m) > \Pi_{jm}(B_h, B_m, S_h, S_m) > \Pi_{jm}(B_h, S_h, S_m) > \Pi_{jm}(B_m, S_h, S_m)$

$\Pi_{im}(B_m, S_h, S_m) > \Pi_{im}(B_m, S_h) > \Pi_{im}(B_h, B_m, S_h, S_m) > \Pi_{im}(B_m, S_m) > \Pi_{im}(B_h, B_m, S_h) > \Pi_{im}(B_h, B_m, S_m)$

$\Pi_{jh}(B_h, B_m, S_h) > \Pi_{jh}(B_h, B_m, S_h, S_m) > \Pi_{jh}(B_h, S_h) > \Pi_{jh}(B_m, S_h) > \Pi_{jh}(B_h, S_h, S_m) > \Pi_{jh}(B_m, S_h, S_m)$

$\Pi_{ih}(B_h, S_h, S_m) > \Pi_{ih}(B_h, S_h) > \Pi_{ih}(B_h, B_m, S_h, S_m) > \Pi_{ih}(B_h, S_m) > \Pi_{ih}(B_h, B_m, S_h) > \Pi_{ih}(B_h, B_m, S_m)$

Industry Structure 1.4: Concentrated–High Buyer Dominant (CHBD)

$\Pi_{jm}(B_h, B_m, S_m) > \Pi_{jm}(B_h, S_m) > \Pi_{jm}(B_h, B_m, S_h, S_m) > \Pi_{jm}(B_m, S_m) > \Pi_{jm}(B_h, S_h, S_m) > \Pi_{jm}(B_m, S_h, S_m)$

$\Pi_{im}(B_m, S_h, S_m) > \Pi_{im}(B_m, S_h) > \Pi_{im}(B_m, S_m) > \Pi_{im}(B_h, B_m, S_h, S_m) > \Pi_{im}(B_h, B_m, S_h) > \Pi_{im}(B_h, B_m, S_m)$

$\Pi_{jh}(B_h, B_m, S_h) > \Pi_{jh}(B_h, S_h) > \Pi_{jh}(B_h, B_m, S_h, S_m) > \Pi_{jh}(B_m, S_h) > \Pi_{jh}(B_h, S_h, S_m) > \Pi_{jh}(B_m, S_h, S_m)$

$\Pi_{ih}(B_h, S_h, S_m) > \Pi_{ih}(B_h, B_m, S_h, S_m) > \Pi_{ih}(B_h, S_h) > \Pi_{ih}(B_h, S_m) > \Pi_{ih}(B_h, B_m, S_h) > \Pi_{ih}(B_h, B_m, S_m)$

Industry Structure 2.2: Buyer Concentrated–Medium Seller Dominant (BCMSD)

$\Pi_{jm}(B_h, B_m, S_m) > \Pi_{jm}(B_h, B_m, S_h, S_m) > \Pi_{jm}(B_h, S_m) > \Pi_{jm}(B_m, S_m) > \Pi_{jm}(B_h, S_h, S_m) > \Pi_{jm}(B_m, S_h, S_m)$

$\Pi_{im}(B_m, S_h, S_m) > \Pi_{im}(B_m, S_m) > \Pi_{im}(B_h, B_m, S_h, S_m) > \Pi_{im}(B_m, S_h) > \Pi_{im}(B_h, B_m, S_m) > \Pi_{im}(B_h, B_m, S_h)$

$\Pi_{jh}(B_h, B_m, S_h) > \Pi_{jh}(B_h, S_h) > \Pi_{jh}(B_m, S_h) > \Pi_{jh}(B_h, B_m, S_h, S_m) > \Pi_{jh}(B_h, S_h, S_m) > \Pi_{jh}(B_m, S_h, S_m)$

$\Pi_{ih}(B_h, S_h, S_m) > \Pi_{ih}(B_h, S_m) > \Pi_{ih}(B_h, B_m, S_h, S_m) > \Pi_{ih}(B_h, S_h) > \Pi_{ih}(B_h, B_m, S_m) > \Pi_{ih}(B_h, B_m, S_h)$

Industry Structure 2.4: Buyer Concentrated–High Buyer Dominant (BCHBD)

$\Pi_{jm}(B_h, B_m, S_m) > \Pi_{jm}(B_h, S_m) > \Pi_{jm}(B_h, B_m, S_h, S_m) > \Pi_{jm}(B_m, S_m) > \Pi_{jm}(B_h, S_h, S_m) > \Pi_{jm}(B_m, S_h, S_m)$

$\Pi_{im}(B_m, S_h, S_m) > \Pi_{im}(B_m, S_m) > \Pi_{im}(B_m, S_h) > \Pi_{im}(B_h, B_m, S_h, S_m) > \Pi_{im}(B_h, B_m, S_m) > \Pi_{im}(B_h, B_m, S_h)$

$\Pi_{jh}(B_h, B_m, S_h) > \Pi_{jh}(B_h, S_h) > \Pi_{jh}(B_h, B_m, S_h, S_m) > \Pi_{jh}(B_m, S_h) > \Pi_{jh}(B_h, S_h, S_m) > \Pi_{jh}(B_m, S_h, S_m)$

$\Pi_{ih}(B_h, S_h, S_m) > \Pi_{ih}(B_h, B_m, S_h, S_m) > \Pi_{ih}(B_h, S_m) > \Pi_{ih}(B_h, S_h) > \Pi_{ih}(B_h, B_m, S_m) > \Pi_{ih}(B_h, B_m, S_h)$

Industry Structure 3.1: Seller Concentrated–High Seller Dominant (SCHSD)

$\Pi_{jm}(B_h, B_m, S_m) > \Pi_{jm}(B_m, S_m) > \Pi_{jm}(B_h, S_m) > \Pi_{jm}(B_h, B_m, S_h, S_m) > \Pi_{jm}(B_m, S_h, S_m) > \Pi_{jm}(B_h, S_h, S_m)$

$\Pi_{im}(B_m, S_h, S_m) > \Pi_{im}(B_m, S_h) > \Pi_{im}(B_h, B_m, S_h, S_m) > \Pi_{im}(B_m, S_m) > \Pi_{im}(B_h, B_m, S_h) > \Pi_{im}(B_h, B_m, S_m)$

$\Pi_{jh}(B_h, B_m, S_h) > \Pi_{jh}(B_h, B_m, S_h, S_m) > \Pi_{jh}(B_m, S_h) > \Pi_{jh}(B_h, S_h) > \Pi_{jh}(B_m, S_h, S_m) > \Pi_{jh}(B_h, S_h, S_m)$

$\Pi_{ih}(B_h, S_h, S_m) > \Pi_{ih}(B_h, S_h) > \Pi_{ih}(B_h, B_m, S_h, S_m) > \Pi_{ih}(B_h, S_m) > \Pi_{ih}(B_h, B_m, S_h) > \Pi_{ih}(B_h, B_m, S_m)$

Industry Structure 3.3: Seller Concentrated–Medium Buyer Dominant (SCMBD)

$\Pi_{jm}(B_h, B_m, S_m) > \Pi_{jm}(B_m, S_m) > \Pi_{jm}(B_h, B_m, S_h, S_m) > \Pi_{jm}(B_h, S_m) > \Pi_{jm}(B_m, S_h, S_m) > \Pi_{jm}(B_h, S_h, S_m)$

$\Pi_{im}(B_m, S_h, S_m) > \Pi_{im}(B_h, B_m, S_h, S_m) > \Pi_{im}(B_m, S_h) > \Pi_{im}(B_m, S_m) > \Pi_{im}(B_h, B_m, S_h) > \Pi_{im}(B_h, B_m, S_m)$

$\Pi_{jh}(B_h, B_m, S_h) > \Pi_{jh}(B_m, S_h) > \Pi_{jh}(B_h, B_m, S_h, S_m) > \Pi_{jh}(B_h, S_h) > \Pi_{jh}(B_m, S_h, S_m) > \Pi_{jh}(B_h, S_h, S_m)$

$\Pi_{ih}(B_h, S_h, S_m) > \Pi_{ih}(B_h, S_h) > \Pi_{ih}(B_h, S_m) > \Pi_{ih}(B_h, B_m, S_h, S_m) > \Pi_{ih}(B_h, B_m, S_h) > \Pi_{ih}(B_h, B_m, S_m)$

Industry Structure 4.2: Unconcentrated–Medium Seller Dominant (UMSD)

$\Pi_{jm}(B_h, B_m, S_m) > \Pi_{jm}(B_h, B_m, S_h, S_m) > \Pi_{jm}(B_m, S_m) > \Pi_{jm}(B_h, S_m) > \Pi_{jm}(B_m, S_h, S_m) > \Pi_{jm}(B_h, S_h, S_m)$

$\Pi_{im}(B_m, S_h, S_m) > \Pi_{im}(B_m, S_m) > \Pi_{im}(B_h, B_m, S_h, S_m) > \Pi_{im}(B_m, S_h) > \Pi_{im}(B_h, B_m, S_m) > \Pi_{im}(B_h, B_m, S_h)$

$\Pi_{jh}(B_h, B_m, S_h) > \Pi_{jh}(B_m, S_h) > \Pi_{jh}(B_h, S_h) > \Pi_{jh}(B_h, B_m, S_h, S_m) > \Pi_{jh}(B_m, S_h, S_m) > \Pi_{jh}(B_h, S_h, S_m)$

$\Pi_{ih}(B_h, S_h, S_m) > \Pi_{ih}(B_h, S_m) > \Pi_{ih}(B_h, B_m, S_h, S_m) > \Pi_{ih}(B_h, S_h) > \Pi_{ih}(B_h, B_m, S_m) > \Pi_{ih}(B_h, B_m, S_h)$

Industry Structure 4.3: Unconcentrated–Medium Buyer Dominant (UMBD)

$\Pi_{jm}(B_h, B_m, S_m) > \Pi_{jm}(B_m, S_m) > \Pi_{jm}(B_h, B_m, S_h, S_m) > \Pi_{jm}(B_h, S_m) > \Pi_{jm}(B_m, S_h, S_m) > \Pi_{jm}(B_h, S_h, S_m)$

$\Pi_{im}(B_m, S_h, S_m) > \Pi_{im}(B_h, B_m, S_h, S_m) > \Pi_{im}(B_m, S_m) > \Pi_{im}(B_m, S_h) > \Pi_{im}(B_h, B_m, S_m) > \Pi_{im}(B_h, B_m, S_h)$

$\Pi_{jh}(B_h, B_m, S_h) > \Pi_{jh}(B_m, S_h) > \Pi_{jh}(B_h, B_m, S_h, S_m) > \Pi_{jh}(B_h, S_h) > \Pi_{jh}(B_m, S_h, S_m) > \Pi_{jh}(B_h, S_h, S_m)$

$\Pi_{ih}(B_h, S_h, S_m) > \Pi_{ih}(B_h, S_m) > \Pi_{ih}(B_h, S_h) > \Pi_{ih}(B_h, B_m, S_h, S_m) > \Pi_{ih}(B_h, B_m, S_m) > \Pi_{ih}(B_h, B_m, S_h)$

Table 3. Market Choice Games

Game	Description	Game	Description
I	Traditional (TM) vs. Third-Party (TP)	V	TM vs. TP vs. HB
II	Traditional (TM) vs. High Buyer (HB)	VI	TM vs. TP vs. HS
III	Traditional (TM) vs. High Seller (HS)	VII	TM vs. TP vs. JO
IV	Traditional (TM) vs. Jointly-Owned (JO)		

cost relationships between the TP and each of the other participant-owned marketplaces (i.e, $UC_{TP} < UC_{PO}$ and $UC_{TP} > UC_{PO}$). With this information, potential investors can predict the outcome of each of the seven marketplace choice games so as to arrive at an ex ante assessment of their possibility to successfully launch an Internet marketplace under any industry structure and cost scenario.

Equilibrium Selection and the Role of Beliefs in Marketplace Choice

Because most of these games exhibit the potential for two or more Nash equilibria, we note that previous researchers have attempted to model expectations (Witt, 1997; Arthur, 1989; Ellison and Fudenberg, 1993) and use these beliefs to select a single equilibrium result from among many possible candidates. For purposes of this analysis, we use the payoff orderings discussed above, in combination with priors about marketplace choice, to select a Nash equilibrium using a procedure developed in Harsanyi (1975) and Harsanyi and Selten (1988), and made implementable via computer by Herings and Peeters (2001). The basic goal of Harsanyi and Selten was to "offer rational criteria for selecting one equilibrium point as the solution of any non-cooperative game...." To that end, market participants must establish some prior about the market choice of other market participants. We use a simple linear weighting system to develop such priors, where these priors are based on the following characteristics: (*a*) whether the Internet marketplace has previous history in electronic trading, (*b*) whether the Internet marketplace is owned by market participants, and (*c*) whether one Internet marketplace has higher or lower fees. Three different methods of creating priors are used, and are differentiated by the weight they place on the preexistence of a marketplace in electronic form. (The details of the procedures of aggregation and development of prior beliefs are available from the authors upon request.)

The linear tracing procedure developed by Harsanyi and Selten (1988) updates these priors until they converge with certainty that each of the other players will play a unique strategy, selecting a single Nash equilibrium in strategies. The procedure uses initial beliefs and payoffs to choose a single Nash equilibrium from among the many candidate equilibria.

Marketplace Ownership

Given the equilibria selected in the above marketplace choice games, potential investors (e.g., high buyers, high sellers, and third-party investors) can ascertain the value of investing in the setup of an Internet marketplace. In essence, they engage in a sequential game whereby large buyers and sellers decide whether to form a joint marketplace

or to form separate enterprises. Then, the third-party investors can reasonably assess the viability of a third-party marketplace.

For a given commodity, an outcome with two Internet marketplaces would be described as untenable over the long run due to inefficiency concerns as well as the likelihood that such an outcome would lead to economic loss for all Internet marketplaces. This claim is particularly relevant for two cases. First, even if a third-party marketplace attains some liquidity and continues to compete with a participant-owned marketplace in the short run, covering its costs will be challenging given the small fees it will be able to charge. Moreover, since large participant-owned marketplaces can absorb operating losses, provided the owners' net sale or procurement costs remain lower than traditional channels, they can likely outlast third-party marketplaces in such a two-way competition. Second, while it is technically possible for high buyers and high sellers to have distinct Internet marketplaces, this would necessitate doubling the costs of Internet marketplaces while simultaneously reducing the liquidity of each in a way that was detrimental to both parties. Long-term competition between Internet marketplaces of this type would also be unreasonable. Based on this information, the solutions to the marketplace choice games can be used to determine the ownership decisions of potential investors.

Simulation Method and Results

The key tasks performed to implement the above theory and derive predictions are as follows: (*a*) create priors and payoff matrices which are consistent with theoretical constraints on payoff relationships, (*b*) use the Herings and Peeters (2001) algorithm to solve the marketplace choice games, and (*c*) solve the market entry/ownership games which determine equilibrium ownership patterns. In completing the first two parts of this process, we solved 768 marketplace choice games. The following paragraphs summarize the key results.

Whenever the traditional marketplace competes with the third-party marketplace alone, the two marketplaces are alternatively dominant, depending on whether or not the third-party marketplace has a preexisting electronic market (e.g., the case of Eggs.org). While it is assumed the third-party marketplace always costs less to use than the traditional marketplace, it is only when the third-party marketplace has some pre-Internet experience as a marketplace that it attracts users (e.g., the cases of Eggs.org and the various livestock marketplaces). In these latter cases, the equilibrium can be described symbolically as {TP, TP, TP, TP}, i.e., the high buyers, medium buyers, high sellers, and medium sellers all choose the same third-party Internet marketplace. When the traditional marketplace competes with the high buyer-owned marketplace, all other buyers and sellers choose the high buyer-owned marketplace instead of the traditional marketplace, such that the equilibrium marketplace choice vector in this game is always {HB, HB, HB, HB}. Similarly, when the traditional marketplace competes with the high seller-owned marketplace, other buyers and sellers (i.e., high buyers, medium buyers, and medium sellers) all choose the high seller-owned marketplace, denoted by {HS, HS, HS, HS}. Finally, in the last bilateral game when the traditional marketplace competes with the jointly-owned marketplace (i.e., high buyer and seller-owned), the remaining buyers and sellers (i.e., medium buyers and sellers) choose the jointly-owned marketplace instead of the traditional marketplace, or {JO, JO, JO, JO}. These results for all the bilateral games hold under all weighting systems used to construct prior beliefs.

The three-way marketplace choice games, while favoring the participant-owned marketplaces in most cases, have more diversity of results. For example, when there is three-way competition for users among the traditional marketplace, the third-party marketplace, and the high buyer-owned marketplace, the latter of these tends to be chosen by other market participants. However, under the two weighting systems which place the greatest weight on pre-Internet use, the third-party marketplace receives critical levels of use provided that it has pre-Internet experience as an electronic market, has a lower user cost than the high buyer-owned marketplaces, and certain industry structures prevail (i.e., industry structures 3.1, 3.3, 4.2, or 4.3 from table 1). In none of these industry structures is the buyers' side of the market concentrated, and the high buyer never represents the largest total quantity traded in the market. Industry structures 3.1 and 3.3 (table 1) represent industries where the sellers' side of the market is concentrated, while industry structures 4.2 and 4.3 (table 1) are unconcentrated on both sides of the market such that either the medium sellers or medium buyers are dominant in terms of total quantity on the market. In summary, the industry structures where the high buyers can provide the least assurance of liquidity are those where the high buyer-owned marketplace may fail to attract all users.

When considering three-way competition among the traditional marketplace, the third-party marketplace, and the high seller-owned marketplace, it is the case that the former two marketplaces tend to be unable to attract users under most weighting systems and industry structure combinations. Again, under weighting systems placing a heavier weight on preexistence of electronic markets, the third-party marketplace receives a critical level of participation provided it has previous experience in managing electronic markets, has lower costs, and specific industry structures are in place (i.e., for industry structures 2.2, 2.4, 4.2, and 4.3 in table 1). Industry structures 2.2 and 2.4 are comprised of those industries which are only concentrated on the buyers' side of the market, while industry structures 4.2 and 4.3 consist of those which are unconcentrated on both sides.

Based on our consideration of the past two competitive scenarios, we note that the third-party marketplace fails under industry structures 1.1 or 1.4. These industries are concentrated on both the buyers' side and the sellers' side of the market. Consequently, both a high buyer-owned marketplace and high seller-owned marketplace can assure significant levels of liquidity under such structures, thereby placing third-party marketplaces at a competitive disadvantage.

For the final game when there is three-way competition among the traditional marketplace, the third-party marketplace, and the jointly-owned marketplace (i.e., high buyer and seller-owned), the third-party marketplace as well as the traditional marketplace are always dominated by the participant-owned marketplace.

Given these findings for the marketplace choice games and the previous discussion on the process of deciding marketplace ownership, the following summary statements can be made about the final equilibria and outcomes from the marketplace ownership games:

- FINDING 1. Liquidity assurance tends to dominate initial beliefs in the determination of equilibrium marketplace choice and ownership, and will encourage convergence toward a single marketplace.

- FINDING 2. Participant-owned marketplaces will always dominate even when it is not socially optimal (i.e., when costs of service provision are minimized) because participant owners provide greater assurance of liquidity.[2]
- FINDING 3. A single marketplace owned by the types of players with fewer members but a higher total output/demand (i.e., the more concentrated side of the market) will tend to survive due to liquidity assurance and lower overall costs.
- FINDING 4. Government intervention to prevent market participants from jointly or separately forming Internet marketplaces may yield more efficient marketplaces provided that the costs of setup are lower for the third-party marketplace.
- FINDING 5. When the third-party marketplace has higher setup costs, welfare is improved by preventing competition from the third-party marketplace because it can act as a spoiler and force non-optimal ownership of Internet marketplaces by a jointly-owned marketplace (JO) or by the higher cost side of the market.

While these findings recognize that third-party marketplaces can play an important role in affecting the survival of Internet marketplaces, this does not mitigate the fact that participant-owned marketplaces will tend to arise without government intervention. In other words, unless beliefs in the use of the third-party marketplace are extremely high, the third-party marketplace will falter when faced with competition from participant-owned marketplaces. Furthermore, by assumption, it is not possible for buyers and sellers to be worse off by using an Internet marketplace relative to using a traditional marketplace; hence, moving to use Internet marketplaces is Pareto improving. However, because some players (medium buyers or sellers) may be better off in a separate marketplace from high buyers or sellers, it is possible for there to be "losers" when one compares a third-party marketplace with a participant-owned marketplace. On net, aggregate efficiency is increased when only one marketplace prevails for a given commodity due to the economies of scale of providing intermediation services.

Internet Marketplaces and the Case of Agriculture

The focus of this paper is to develop a conceptual and game theoretic approach for analyzing Internet market formation. However, the conceptual results can be compared to developments in agricultural Internet markets. For comparison purposes, the current state of Internet marketplaces in agriculture is shown in table 4, which reports the number and names of surviving Internet marketplaces. The information presented is derived from an extensive review of popular press articles, press releases, and information collected by other researchers and organizations (i.e., Business.com; the

[2] One could look at the spate of demutualizations and proposed demutulaizations among financial and commodity exchanges worldwide since the early 1990s (Aggarwal, 2002) and then question this finding. The demutualization of these exchanges could, in fact, yield efficiency gains and greater managerial flexibility (Hart and Moore, 1996; Steil, 2002). However, at this point in time, these exchanges have already achieved the necessary crucial liquidity needed for survival, thereby eliminating the initial network advantages of participant ownership. In this context, it is possible that some Internet marketplaces for agriculture could evolve into independent entities in the future, but this is most likely to occur *after* a critical mass is achieved—as seen in the domain of financial exchanges. Even then, the markets should maintain a close affiliation to the key players in their respective commodities.

Table 4. Current Internet Marketplaces in Agriculture

Industry	Number of Marketplaces	Marketplace Name
Cotton	1	▸ TheSeam.com
Dairy	1	▸ Dairy.com
Eggs	1	▸ Egg Clearinghouse, Inc. (Eggs.org)
Grains [a]	4	▸ CargillAgHorizons.com ▸ e-ADM.com ▸ Icecorp.com ▸ Farmstech.com
Cattle [b]	5	▸ Mountainlivestock.com ▸ producerscattleauctions.com ▸ SuperiorLivestock.com ▸ WVMcattle.com ▸ WinterLivestock.com
Swine [c]	0	[All marketplaces failed]
Produce/Citrus [c]	0	[All marketplaces failed]

[a] It is hard to categorize the three large buyer-owned websites for grains as e-markets. They integrate the traditional marketing channels of ADM, Cargill, and Seaboard (Icecorp.com) to the Internet. Only Icecorp.com allows for other buyers to use its services. Similarly, Farmstech.com provides private trading platforms for major grain buyers.
[b] The number of cattle markets is constantly changing. However, producerscattleauctions.com, SuperiorLivestock.com, WVMcattle.com, and WinterLivestock.com have been persistent players in this area.
[c] The swine and produce/citrus commodity groups failed, and are now served by proprietary Internet procurement systems.

National Agri-Marketing Association; and Thompson and Nageotte, 2001), as well as by monitoring developments on the Internet.

Viable grower-to-agribusiness marketplaces still exist for cotton, dairy, eggs, grains, and livestock. Agricultural marketplaces which have failed include those for almonds, apples, oranges, pecans, pulses, and tomatoes. We must be careful in interpreting this failure to adopt Internet marketplaces as an indication of a lack of adoption of Internet technologies for these commodities. Verticalnet.com, iTradenetwork.com, and GNX.com (Global Net Exchange) serve these industries by providing software integration services and dedicated private Internet procurement systems between buyers and sellers of these commodities. Similarly, it must be kept in mind that the game theoretic model applies a limited set of factors (ownership, liquidity, and beliefs) in explaining the development of Internet marketplaces. Many other factors—such as insufficient capitalization, poor business processes, lack of sufficient technical or management expertise, or even idiosyncrasies of bulk agricultural commodities—can and do contribute to outcomes in the development of Internet marketplaces. It is therefore all the more striking (and perhaps beneficial) that we have arrived at our findings through a relatively straightforward modeling process without being concerned with such details.

Evidence on Liquidity and Ownership

The cotton, dairy, and the grain industries provide illustrations for the first two findings above. In the cases of cotton and dairy, ownership of the marketplaces is on the large buyers' sides of these industries. The grain market provides another example of the

importance of liquidity assurance. Despite being able to influence the early beliefs of sellers and smaller buyers in this industry of their value as intermediaries, third-party grain sites lacked credibility in their competition with the higher liquidity of buyer-owned marketplaces.

However, investment in the Internet continues as an enabler of trade in grain markets. Among participant-owned marketplaces, Cargill AgHorizons, e-ADM, and Icecorp.com survive as some form of Internet marketplaces. Cargill AgHorizons and e-ADM provide proprietary sites to allow clients to trade directly with them only, and Icecorp, supported by the Seaboard Corporation, provides for private procurement networks. As a result, these three Internet marketplaces represent three buyer-owned marketplaces while most others failed. Notably, Farms Technology, LLC, represents a unique amalgam in that it is a privately owned company but serves primarily to set up buyer and seller trading systems for specific locations. Sellers can use the system only if there is a buyer in the area who is also using the trading platform. At present, it has two key clients (Jennie-O Turkey Store and CHS) which use the trading platform to procure grain. Consequently, we observe that this firm facilitates grain trading by affiliating itself with clients who happen to be large buyers—again validating the importance of liquidity assurance.

Eggs.org might be characterized as third-party and not owned by participants, but its history must be considered. The Electronic Clearinghouse, Inc. (owner of Eggs.org) was formed through direct government intervention in the late 1960s, with electronic trading beginning in 1970 with the closure of cash trading on the Chicago Board of Trade and Chicago Mercantile Exchange. Its role as a third party is somewhat attenuated by the fact that large buyers and sellers in the egg industry are on its board of directors. Thus, Eggs.org obtains the liquidity assurance of a participant-owned marketplace due its strong affiliation with buyers and sellers.

Those Internet marketplaces surviving in the cattle industry also have relationships with key players in the livestock business. Furthermore, the three ventures having pre-Internet experiences with electronic marketing also have a geographic link: WinterLivestock.com (focusing on midwestern markets), producerscattleauctions.com (focusing on the southern states), and WVMcattle.com (focusing on the western livestock markets). Moutainlivestock.com appears to be integrated into the traditional marketing channels of the livestock industry, and simply helps to augment its live auctions or sales of various other intermediaries with an online component. Similarly, Superior-Livestock.com is deeply entrenched in livestock marketing in the United States at many levels. In all cases, one might take issue with presenting these marketplaces as third parties. In particular, Salin (2000) characterizes these Internet companies as being among the first-handlers of cattle (i.e., movement from cow-calf to feedlot operations of feeder cattle), along with other intermediaries. In short, while these companies explicitly would classify themselves as intermediaries, some of them are, in fact, better characterized as buyers.

Before concluding the evidence on the importance of ownership in the survival of an Internet marketplace, brief mention of AgEx.com's market for almonds offers further case observations. Williams (2001) provides various arguments and lessons explaining the institutional features leading to the failure of this marketplace; however, what is most noteworthy is that of all the players in almond markets, the key firm choosing to opt out of the new marketplace was the Blue Diamond Cooperative, one of the world's

largest tree nut and marketing enterprises. That such a large player chose not to participate would have reduced its potential liquidity and, consistent with the game theoretic model, may have been a crucial factor in its subsequent failure.

Evidence on Market Structure and Concentration

As argued by Finding 3 above (and consistent with findings reported by Lucking-Reilly and Spulber, 2001), the more concentrated side of the market will be the owners of Internet marketplaces. For agriculture, the buyers' side of the market is observed to be more concentrated, and the majority of Internet marketplaces are owned by buyers for those commodities. Specifically, TheSeam.com, Dairy.com, and all of the major grain websites are owned by large buyers in their respective industries.[3] Of all of these, only Eggs.org has direction from large-scale commodity producers.

Convergence

In three of the five industries where Internet marketplaces survive, the prediction of convergence is validated by the evidence. However, in both the grain and beef industries, we see multiple marketplaces. It might be argued that this failure of convergence of marketplaces for the cattle and grain industries may well represent just one stage in the movement toward a single Internet marketplace. For the cattle industry, one might argue that nonconvergence is a result of the unique nature of the livestock business and the highly specialized role of cattle companies and order buyers, the regional dispersion of the cattle market (especially the cow-calf sector from which feeder cattle originate), and the lack of fungibility of feeder cattle due to large variation of quality. However, as noted earlier, effective grading and legal structures associated with business processes should overcome these issues. In fact, in many web-based markets (e-Bay is a classic example), products are often one-of-a-kind or completely nonfungible, and descriptive capabilities (similar to grading in agricultural commodity markets) and reputational recourse allow for trading.

What does observed nonconvergence imply for the prediction of convergence in the game theoretic model? First, the model does not deal with matters of strategy in imperfect competition; however, the separation of marketplaces could be an effort to avoid direct competition in buying which a single marketplace might provide. Also, the businesses may not have the ability or willingness to share the necessary information in order to allow an Internet marketplace to effectively act as a coordination mechanism. This reasoning may help to explain why Cargill and ADM, early investors in the broad-based Internet marketplaces of Rooster.com and Pradium.com, have separate systems currently. Moreover, the remaining Internet marketplaces for these businesses are actually just a small extension of their traditional procurement systems. Consequently, a joint market that fully integrated the needs of all large buyers might prove too costly relative to the small gains in lowering transaction costs. Finally, these large players may have recognized that a

[3] Ownership, in accord with our discussion, simply means the firm is an investor in the Internet marketplace. If a firm's primary enterprise is to both produce and sell raw agricultural products, then it is a seller. If not, we characterize the firm as a buyer. This is an important distinction in the dairy and cotton industries, where owners of Dairy.com include Land O'Lakes and some owners of TheSeam.com are marketing cooperatives. We argue that these cooperatives effectively operate as buyers in the context of Internet marketplaces.

large buyer-owned marketplace on the Internet might not be appealing to producers in the context of the grain industry with its long history of producer mistrust of these large players and skepticism about the fairness of their dealings.

Conclusions and Implications

In this study, we have used a novel game theoretic framework and solution procedure to model agribusiness decisions related to the choice and ownership of Internet marketplaces. The analysis illustrates how industry structure, participant beliefs, transaction costs, and ownership affect the success of an Internet marketplace. Liquidity is identified as the linchpin of success in that potential participants (both buyers and sellers) primarily make their decision to participate based on whether there will be sufficient trading in the marketplace. Ultimately, this exercise allows us to conclude that Internet marketplaces which were owned by large or major buyers and sellers would have the greatest chance of success given their ability to create liquidity by their own participation. We are further able to highlight other subsidiary nuances in the strategic environment of marketplace survival as well as the efficiency of various outcomes.

While it is very difficult to generate testable hypotheses related to market formation, this paper also provides observations on the development of Internet marketplaces in agriculture to tie observed market formation with the results of the game theoretic simulations of behavior. By nature, this must be done carefully because there are numerous real-world frictions that can potentially create results far different from model representations. For example, realities such as tax codes and trading regulations, or even the nature of the commodities and business operations in existence, may create barriers that prevent success of a potential Internet marketplace. However, the model allows us to better understand the broader undercurrents observed—the failure of third-party marketplaces, the sponsorship of marketplaces by industry participants, and the ownership of the marketplaces by the more concentrated side of the market.

The strongest result emerging is that large participants in primary commodity sectors did well to consider sponsoring Internet marketplaces given their relatively high probability of success. At the same time, it tells third-party marketplace entrepreneurs and investors that the barriers to entry would be too great for them to survive unless they had some sort of government sponsorship and/or a high degree of support or contractual relationships with buyers and sellers in a market. Most such third-party players learned these lessons quickly, thereby explaining the rapid movement of e-Markets.com, eCotton.com, Farms.com, and many others into the business of software services and system integration for the agricultural sector.

A more tenuous observation is related to the convergence of marketplaces. While several commodities have converged to a single Internet trading platform, others such as grain and livestock have multiple Internet marketplaces. Reasons for lack of convergence could include the regionality of production or markets, differences in the characteristics of the commodity, and extreme rivalry and lack of cooperation, among others, which are not captured in the model.

Notably, the issue of size in this exercise is a construct to model liquidity assurance; however, in the absence of size of ownership, an alternative to creating a successful marketplace requires some other guarantee of very high probabilities of large volumes of participants. It is also important to recognize that the model does not directly address

issues of imperfect competition and the persistent mistrust which smaller participants may perceive in the motives of large-scale trader/owners. As such, we do not directly confront the concerns expressed by legislators and policy makers regarding participant alliances in the formation of marketplaces (e.g., Rooster.com, which was a consortium including ADM and Cargill). Nevertheless, the model presented provides a clear economic explanation of why, irrespective of market power matters, the large players in agricultural markets would consider investing in such marketplaces.

The Internet has not resulted in a dramatic change in the marketing structures in agriculture. That being said, it represents an important future marketing channel for agriculture. Consequently, this paper has examined the factors affecting Internet marketplace choice and ownership. In doing so, it has shown how game theoretic and network considerations provide for a clearer view and analysis of the events which unfolded in this environment without the clouding hype that was so prevalent just a few years ago.

[*Received February 2005; final revision received September 2005.*]

References

Aggarwal, R. "Demutualization and Corporate Governance of Stock Exchanges." *J. Appl. Corporate Finance* 15(2002):105–113.

Arthur, W. B. "Competing Technologies, Increasing Returns, and Lock-in by Historical Events." *Econ. J.* 99(1989):116–134.

Baer, J. B., and O. G. Saxon. *Commodity Exchanges and Futures Trading.* New York: Harper and Brothers, 1949.

Business.com. Business Directory for Agriculture. Online. Available at http://www.business.com/directory/agriculture/. [Searched periodically, 2001–2005.]

Caillaud, B., and B. Jullien. "Competing Cybermediaries." *Euro. Econ. Rev.* 45(2001):797–808.

———. "Chicken and Egg Competition Among Intermediation Service Providers." *Rand J. Econ.* 34(2003):309–328.

Chambers, W., J. Hopkins, K. Nelson, S. Pryor, J. Perry, P. Stenberg, and T. Worth. "E-Commerce in United States Agriculture." Unnumbered ERS white paper, U.S. Department of Agriculture/Economic Research Service, Washington, DC, May 2001.

Dacin, M. T., M. J. Ventresca, and B. D. Beal. "The Embeddedness of Organizations: Dialogue and Directions." *J. Management* 25(1999):317–356.

Dai, Q., and R. Kauffman. "Understanding B2B E-Market Alliance Strategies." MISRC Work. Pap. No. 03-03, the Carlson School of Management, University of Minnesota, Minneapolis, 2003.

Di Noia, C. "Competition and Integration Among Stock Exchanges in Europe: Network Effects, Implicit Mergers, and Remote Access." *Euro. Financial Mgmt.* 7(2001):39–72.

Domowitz, I. "Electronic Derivative Exchanges: Implicit Mergers, Network Externalities, and Standardization." *Quart. Rev. Econ. and Fin.* 35(1995):163–175.

Economides, N. "The Economics of Networks." *Internat. J. Industrial Org.* 14(1996):673–699.

Economides, N., and A. Siow. "The Division of Markets Is Limited by the Extent of Liquidity." *Amer. Econ. Rev.* 78(1988):108–121.

Ellison, G., and D. Fudenberg. "Rules of Thumb for Social Learning." *J. Polit. Econ.* 101(1993):612–643.

———. "Competing Auctions." Discussion Pap. No. 1960, Harvard Institute of Economic Research, Harvard University, Cambridge, MA, 2002.

Ellison, G., D. Fudenberg, and M. Mobius. "Competing Auctions." *J. Euro. Econ. Assoc.* 2(2004):30–66.

Farrell, J., and G. Saloner. "Installed Base and Compatibility: Innovation, Product Preannouncements, and Predation." *Amer. Econ. Rev.* 76(1986):940–955.

Garicano, L., and S. N. Kaplan. "The Effect of Business-to-Business E-Commerce on Transactions Costs." *J. Industrial Econ.* 49(2001):463–485.

Gnyawali, D., and R. Madhavan. "Cooperative Networks and Competitive Dynamics: A Structural Embeddedness Perspective." *Academy Mgmt. Rev.* 26(2001):431–445.

Harsanyi, J. C. "The Tracing Procedure: A Bayesian Approach to Defining a Solution for n-Person Non-cooperative Games." *Internat. J. Game Theory* 4(1975):61–94.

Harsanyi, J. C., and R. Selten. *A General Theory of Equilibrium Selection in Games.* Cambridge, MA: MIT Press, 1988.

Hart, O., and J. Moore. "The Governance of Exchange: Members' Cooperatives versus Outside Ownership." *Oxford Rev. Econ. Policy* 12(1996):53–69.

Henderson, D. R. "Electronic Marketing in Principle and Practice." *Amer. J. Agr. Econ.* 66(1984): 848–853.

Herings, J., and R. Peeters. "A Differentiable Homotopy to Compute Nash Equilibria of n-Person Games." *Econ. Theory* 18(2001):159–185.

Katz, M., and C. Shapiro. "Network Externalities, Competition, and Compatibility." *Amer. Econ. Rev.* 75(1985):424–440.

———. "Technology Adoption in the Presence of Network Externalities" *J. Polit. Econ.* 94(1986): 822–841.

Lippman, S. A., and J. J. McCall. "An Operational Measure of Liquidity." *Amer. Econ. Rev.* 76(1986): 43–55.

Lucking-Reilly, D., and D. F. Spulber. "Business-to-Business Electronic Commerce." *J. Econ. Perspectives* 15(2001):55–68.

Mulherin, J. H., J. M. Netter, and J. A. Overdahl. "Prices Are Property: The Organization of Financial Exchanges from a Transaction Cost Perspective." *J. Law and Econ.* 34(1991):591–664.

National Agri-Marketing Association. Member Company Websites. Online. Available at http://www.nama.org/links/links-index.html. [Searched periodically, 2001–2005.]

Pagano, M. "Trading Volume and Asset Liquidity." *Quart. J. Econ.* 104(1989):255–274.

Purcell, W. D. "Implications of Electronic Marketing for Agriculture: Discussion." *Amer. J. Agr. Econ.* 66(1984):866–867.

Russell, J. R. "Implications of Electronic Marketing for Agriculture: Discussion." *Amer. J. Agr. Econ.* 66(1984):864–865.

Salin, V. "Information Technology and Cattle-Beef Supply Chains." *Amer. J. Agr. Econ.* 82(2000): 1105–1111.

Schiefer, C., R. Helbig, and U. Rickert, eds. *E-Commerce and Electronic Markets in Agribusiness and Supply Chains: Proceedings of the 75th Seminar of the European Association of Agricultural Economists (EAAE)—February 14–16, 2001.* Bonn, Germany: Universitat Bonn-ILB (Rheinische Friedrich-Wilhelms-Universitat Bonn, Institut fur Landwirtschaftliche Bertriebslehre), 2001.

Schrader, L. F. "Implications of Electronic Marketing for Agricultural Prices." *Amer. J. Agr. Econ.* 66(1984):854–858.

Sporleder, T. L. "Implications of Electronic Marketing for the Structure of Agricultural Markets." *Amer. J. Agr. Econ.* 66(1984):859–863.

Steil, B. "Changes in the Ownership and Governance of Securities Exchanges: Causes and Consequences." *Brookings-Wharton Papers on Financial Services* (2002):61–82.

Thompson, S., and C. Nageotte. "List of Agricultural E-Commerce Websites as of May 19, 2001." *Proceedings of Impacts of E-Commerce and Information Technology on Global Agricultural Markets*, a symposium sponsored by the Economic Research Service, the Farm Foundation, and the University of Minnesota, Washington, DC, 29–30 May 2001. Online. Available at http:/www.farmfoundation.org/e-commerce.htm. [Retrieved May 2002.]

Wheatley, W. P. "Industry Structure, Network Externalities, and Strategy in the Choice and Ownership of Internet Marketplaces for Agriculture." Unpub. Ph.D. diss., Dept. of Appl. Econ., University of Minnesota, Saint Paul, 2004.

Williams, J. "E-Commerce and the Lessons from Nineteenth Century Exchanges." *Amer. J. Agr. Econ.* 83(2001):1250–1257.

Witt, U. "'Lock-in' vs. 'Critical Masses'—Industrial Change Under Network Externalities." *Internat. J. Industrial Organization* 15(1997):753–773.