Journal of Agricultural and Resource Economics 30(3):449–468

Trading Behavior in a Marginal Organized Market

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As increasingly more transactions occur away from open markets, the so-called "thin" market issues arise. This paper analyzes unpublished transaction data from Egg Clearinghouse, Inc. (ECI), a marginal marketplace for eggs that trades 4% of all eggs (80% of eggs available for open trading). Results suggest that marginalized markets can serve as an inventory adjustment mechanism while maintaining the role of price discovery as a check for non-market prices. At ECI, most firms both buy and sell regardless of operational types, participation is balanced across all types of firms in the industry, and sellers in general yield to buyers' preferred terms of trade.

Key words: eggs, inventory adjustment, organized market, price discovery, thin market

Introduction

Many U.S. agricultural commodity sectors rely on market transactions to discover prices. Yet, an increasing number of transactions take place away from open markets through alternative pricing mechanisms such as private negotiations and formula pricing. In 2001, 36% of commodities were produced under contract, compared to 12% in 1969 (MacDonald et al., 2004). For some commodities, such as poultry and eggs, less than 10% of total volume is available for transactions in open markets. These open and organized markets are becoming increasingly marginalized in the sense that they handle a smaller fraction of total volume. Some would refer to these markets as "thin" markets (Mueller et al., 1996; Raikes, 1978; Dunn, 1978).[1]

The thinness of a market does not necessarily imply poor market performance, but prices determined in thin markets raise concerns (Tomek and Robinson, 1990; Hayenga et al., 1978). First, transacted and reported prices may no longer represent overall supply and demand conditions. Second, thinness may cause excess volatility in the market price, increasing transaction costs for market participants due to higher price risk. Finally, potential impacts of individual transactions on price in thin markets create incentives for price manipulation. Unless such opportunities to influence market prices are merely a perception or exist for very brief periods, market efficiency will be compromised.

Hikaru Hanawa Peterson is assistant professor, Department of Agricultural Economics, Kansas State University. This study would not have been feasible without the generous cooperation of the Egg Clearinghouse, Inc. The author is particularly indebted to its president, Wayne Clapper. Helpful comments from two anonymous reviewers, DeeVon Bailey, Wade Brorsen, Ted Schroeder, Dong Li, and Jeff Peterson are gratefully acknowledged, as are those from participants of the NCR-134 Conference, St. Louis, MO, April 22–23, 2002. The author is solely responsible for any remaining errors.

Review coordinated by Gary D. Thompson and DeeVon Bailey; publication decision made by DeeVon Bailey.

[1]No universally accepted definition of "thin" markets exists, although many associate them with small transaction volume, few participants, and/or low liquidity. Hayenga et al. (1978), for example, defined thin markets as those "with few negotiated transactions per time period" (p. 11).

These concerns were first addressed in the late 1970s (see Hayenga, 1978). Past research on thin markets is sparse, and has focused either on price precision (Tomek, 1980; Nelson and Turner, 1995; Ward and Choi, 1998) or liquidity in futures trading (e.g., Thompson and Waller, 1988).[2] Mueller et al. (1996) conducted a unique study on the National Cheese Exchange and found evidence of price manipulation by three major cheese manufacturers from 1988 to 1993. Recently, several studies have addressed developments in the livestock sector caused by increased thinness in open markets (e.g., Schroeter and Azzam, 2004; Zhang and Sexton, 2000). Since the proportion of open market transactions relative to total market volume is expected to decline with the further industrialization of agriculture, trading behavior in a marginal organized market warrants examination. This paper contributes to the literature by analyzing transaction data from a marginal open marketplace to document trading behavior and to explore alternative roles for open and organized markets as they become marginalized.

The data consist of unpublished transaction records from Egg Clearinghouse, Inc. (ECI), an organized national farm-level marketplace for eggs. In the U.S. egg industry, approximately 95% of eggs have been marketed through contracts during the recent decade, where the price is based on wholesale quotes published online daily in Urner Barry's (UB's) *Price-Current*. The remaining 5% are available for trading through an open market (Clapper, 1999), of which about 80% are traded at ECI. This proportion of trading volume relative to quantity available for open trading suggests that ECI has been functioning well. For example, another marginal marketplace, the spot cheese market at the Chicago Mercantile Exchange (CME), trades less than 1% of U.S. cheese, where about 20% of cheese is available for open trading (Ledman, 2005). Thus, a natural question is: *What has contributed to ECI's success?*

A critical difference between the two marketplaces is that the cheese exchange price is used to price all U.S. cheese, while ECI's role in price discovery is secondary because most eggs are priced relative to UB quotes. The primary role of ECI appears to be an inventory adjustment mechanism for egg industry constituents. Another notable difference between the marketplaces is that only two cheese products are traded at the CME in specific units (1,000 40-pound blocks or 44-pound barrels for delivery within 300 miles of Green Bay, WI), whereas at ECI, numerous egg products are traded for any quantity to be delivered to trader-specified locations.

Preliminary examination of the transaction data used in this study reveals that most ECI members both buy and sell eggs, allowing for the possibility of price manipulation. Specifically, firms intending to sell (buy) may initially purchase (sell) some eggs to lessen (increase) market supply and raise (lower) the price, while they negotiate other transactions off the open market. In fact, Mueller et al. (1996) found evidence of price manipulation during the period when firms bought and sold concurrently at the National Cheese Exchange. However, these seemingly converse transactions, where the good is purchased by its producers and sold by its users, are consistent with ECI being used as a means of inventory adjustment, prompted by changes in supply chain coordination. With increased private negotiations, sellers commit themselves to deliver

[2] Literature on thin markets can be found in many areas of study besides agricultural economics: finance (e.g., Kyle, 1985), financial econometrics (e.g., Campbell, Lo, and MacKinlay, 1997), game theory (e.g., Selten and Wooders, 1991), studies of water or land markets (e.g., Saleth, Braden, and Eheart, 1991), and in macroeconomics (e.g., Howitt and McAfee, 1992) among others.

quantities demanded by their clients. When their inventory is short of commitment, they would rely on spot trading to procure the difference.

The literature on successful trading, which has focused on futures contracts and exchanges (e.g., Carlton, 1984), suggests that a successful marketplace needs to offer trading terms which are evenly balanced between buyers and sellers (Leuthold, Junkus, and Cordier, 1989, p. 20). Thus, one possible explanation for ECI's success is that it has attracted balanced levels of participation from various egg industry groups. The first objective of this paper is to examine the degree of ECI participation by firm characteristics.

While the role of price discovery may be secondary, prices discovered at ECI should serve as a check for assessing how UB quotes reflect market conditions.[3] A term of trade at ECI allows for trades to be consummated for spot or future delivery, and eggs can be quoted in terms of the spot price or priced off of the UB quote at the time of delivery. The latter term is referred to as being "market-adjusted," and it does not contribute to price discovery. The ECI prices may not represent the market situation accurately if certain firms favored one term over another. Accordingly, the second objective of the paper is to identify characteristics of the transaction and firms involved that determine the selected pricing terms. The analysis may shed light on the price discovery role of ECI and the relative bargaining power between egg producers and users.

The remainder of this paper commences with overviews of egg trading and of trading statistics at ECI. Next, marginal market trading is conceptualized as an inventory management problem, and ECI trading data are analyzed using tobit and logit regression. The paper concludes with implications for agricultural sectors with thinning open markets.

Egg Trading

Ninety-five percent of eggs produced in the United States are exchanged based on long-term contracts (Clapper, 1999). A typical contract specifies pricing in terms of the difference from the UB quotes, which are wholesale-level prices that include farm-level egg prices plus the costs of processing, cartoning, and transportation, based on public and private sources of information (Clapper, 2001). The UB quotes are released daily for four egg types and two egg products bought in six regions. In a standard egg contract, Sunday through Saturday deliveries are priced off of the preceding Thursday's UB quotes. In addition to the egg types and packaging desired by the buyer, some contracts specify the shelf life of the eggs. This is possible because with proper handling, eggs can remain fresh for four to five weeks at an appropriate temperature and humidity. The quantity is determined by daily orders made by the buyer.

ECI was formed in 1971 based on the recommendation of a study commissioned by the U.S. Congress troubled by egg pricing difficulties. The purpose of ECI was to develop quality and grade standards for eggs and to implement trading that would discover a fair price of eggs.[4] As an initial step toward this goal, ECI categorized eggs into table eggs and eggs sold to egg product manufacturers.[5] Then, a blind trading system was

[3] Maynard (1997) found a feedback relationship between the UB quotes and ECI prices during 1994–95.

[4] The concern remains today due to the lack of transparency in the formula used for UB quotes.

[5] All table eggs are required to meet the U.S. Department of Agriculture (USDA) egg grade standards, which—in descending order of quality—are AA, A, and B, based on shell, air cell, white, and yolk.

implemented where the identity of both buyers and sellers is unknown to each other until the trade has been consummated. Trading privileges are granted to ECI members who pay monthly dues.

The trading volume at ECI stagnated through the early 1980s. In 1984, ECI was placed under new management, and over the subsequent decade trading volume increased approximately four-fold. In 2001, 203 million cases (1 case = 30 dozen) of shell eggs were produced in the United States, and ECI traded 8.7 million cases, representing 4.3% of total shelled eggs produced and about 80% of eggs that were not marketed under contract. In 2001, there were approximately 750 U.S. egg producers, with 60 companies producing 95% of eggs (American Egg Board). At the end of 2001, ECI membership consisted of 169 egg producers, including 51 out of 64 firms listed by *Egg Industry* trade magazine as the top egg producers (Watt Publishing Co.).

ECI's U.S. trading regions are the Northeast, Northwest, Midwest, South Central, Southeast, and Southwest. A few ECI members are Canadian firms. In 2001, the Midwest and the Northeast accounted for more than half of members, while about 42% of members were situated in the three southern regions. The Midwest region accounted for 66% of regional selling, followed by the Northeast (18.5%)—three midwestern states (Iowa, Indiana, and Ohio) in combination with Pennsylvania accounted for 34% of U.S. production in 2001 (USDA/Agricultural Statistics Board, 2004). Regional buying was more evenly distributed, with the Southwest and the Midwest responsible for 30.6% and 24.2%, respectively.

Five types of eggs are traded at ECI: (*a*) gradeable nest run (GNR), (*b*) cartoned (CTN), (*c*) graded loose (GL), (*d*) nest run breaking stocks (NRBS), and (*e*) checks (CHEX). GNR eggs are unwashed, unoiled, unsized, and ungraded table eggs. CTN and GL eggs are the most commonly traded table eggs at ECI.[6] NRBS do not meet the quality standards of table eggs, and eggs traded as checks (CHEX) are mainly with broken or cracked shells and intact membranes. All five egg types are sold in different weight or size classes (e.g., jumbo, extra large, large, medium, and small for CTN and GL eggs), and table eggs are further delineated by color (white and brown). In addition, two egg products are traded at ECI: liquid egg products (LIQ) in tanker-loads and frozen egg products (FRZN) in 30-pound pails or cans.

Accordingly, eggs traded on ECI are identified by region, type, weight or size class, and color. Given the detailed classification, the number of trades that occur per variety of eggs in a given period is limited. Even for the most commonly traded CTN white/large eggs, only one load was purchased in the Southeast during the entire year of 2001. Moreover, even in the most actively traded Southwest region, where 629 total loads were purchased, trading occurred on only 88 days. Hence, a spot, farm-level price series for a single variety of eggs does not exist, which is consistent with the ECI's role in price discovery being secondary.[7]

Most bids and offers on ECI are phoned to one of four trade coordinators; alternatively, they can be submitted online. The posted bids and offers include: bid or ask price, egg type (including weight/size and color), quantity, region (destination for bids, origin

[6] In 2001, GL white eggs accounted for over 36% of total traded eggs, followed by CTN white eggs (21%), GNR white eggs (13.3%), and NRBS (12.8%). Buyers with packing facilities tend to prefer CTN eggs over GNR eggs that require grading and cartoning, and trading of CTN eggs has increased during recent years. Similarly, there has been an increase in the number of GL eggs sold for repackaging purposes at fully integrated in-line layer complexes (Clapper, 2002).

[7] Another source of egg prices is the USDA's Agricultural Market News, which surveys wholesale prices on a weekly basis.

for offers), date of delivery, packaging format, weight per unit, and additional comment regarding the load. Bid and ask prices can be posted in spot terms or in market-adjusted terms that specify differences relative to the UB quote on the delivery date. Delivery schedules are specified in the ECI trading rule.[8] The ECI trade coordinators mediate transactions by proposing changes to the posted terms to firms with similar bids and offers until an agreement is reached. The firms' identities are revealed to each other only after the trade is consummated.

Trading Statistics at ECI

ECI members consist of various egg operations, including small producers with no packing facilities, producers with packing facilities, egg breakers, manufacturers of egg products, distributors of eggs and egg products, and brokers. Each member was classified into one or a combination of the following three types (Clapper, 2001): (*a*) those with layers ("producers"), (*b*) those with processing or breaking facilities ("users"), and (*c*) those distributing eggs ("brokers"). Of the 154 firms that traded on ECI at least once during 2001, 84 were producers, 13 were users, 28 were brokers, and 23 owned both layers and a user facility ("prod-user"). Five firms conducted brokerage and also owned layers and/or a user facility. In total, 111 firms owned layers.

Information on the size of the operation is available for egg production but not for user or brokerage activities. The trade magazine *Egg Industry* publishes results from its annual survey of leading egg producers, which include self-reported numbers of layers on December 31 (Watt Publishing Co.). Since information is self-reported and may have changed dramatically during the year, averages of the self-reported number of layers in the *Egg Industry*'s 1999, 2000, and 2001 surveys were computed for each member and grouped to maintain anonymity of firms: 1–2 million, 2–5 million, 5–10 million, and more than 10 million layers. The firms with layers that were not listed in the survey results were assumed to have fewer than 1 million layers.

Table 1 summarizes trade activity in 2001 for selected operational types and flock sizes. Frequency and quantities of purchases and sales clearly differed across operational type. The average producer bought half as frequently (27 buys versus 54 sells) and also bought about half as many eggs as it sold (21,693 cases bought versus 48,141 cases sold). Users and brokers bought on average about 74 to 92 times during the year, while they sold 12 to 20 times. Integrated "prod-user" operations bought and sold approximately 150,000 cases each. The average transaction sizes were, in general, smaller for producers than for the other operational types. For users, the average quantity sold was more than 10 times larger than the average quantity bought, because sales of egg products brought up the average.[9]

The purchase-sales pattern varied across flock size as well. For firms with more than 1 million layers, the numbers of buys and sells were positively correlated with flock size. Firms with less than 1 million layers bought and sold more frequently than some of their larger counterparts, likely because various vertical arrangements were not accounted for in the classification. The average transaction size was relatively similar across flock size.

[8] A regular delivery arrives three days after the date of trade. Loads can also be specified for delivery one to eight weeks from the date of trade, or for accelerated delivery.

[9] For example, a tanker-load of liquid egg product is equivalent to 48,000 cases.

Table 1. Mean Levels of Trading by Selected Operational Type and Flock Size at ECI, 2001

	Operational Type [a]				Number of Layers [b]				
Description	Producer	User	Broker	Prod-User	> 10 Million	5–10 Million	2–5 Million	1–2 Million	< 1 Million
Number of ECI Members [c]	84	13	28	24	5	7	18	14	67
Buys versus Sells:									
Number of buys	27	92	74	115	121	125	68	17	32
Number of sells	54	12	20	135	249	231	63	21	53
Quantity [d] bought	21,693	47,466	94,686	144,186	137,751	148,813	56,341	21,329	33,790
Quantity [d] sold	48,141	28,160	21,719	151,930	277,633	236,700	70,601	17,713	47,198
Average quantity [d] bought in a transaction	824.6	663.2	1,809.1	1,809.0	1,891.4	902.0	814.2	1,813.9	948.4
Average quantity [d] sold in a transaction	795.7	8,598.7	1,927.7	1,111.7	1,166.4	862.4	1,038.7	987.4	737.8
Pricing Terms:									
% of market-adjusted buys relative to all buys	50.1	73.3	28.0	58.0	54.3	71.4	66.2	59.9	44.9
% of market-adjusted sells relative to all sells	45.3	12.5	19.7	46.2	58.8	57.1	46.1	36.7	45.3

Note: Table data are based on trade records of 154 traders who traded at ECI during 2001.

[a] "Producer" refers to firms specializing in production, "user" refers to firms specializing in processing or breaking eggs, "broker" refers to firms specializing in brokerage, and "prod-user" refers to firms that own layers and processing or breaking facilities but do not engage in brokerage.

[b] Number of layers is based on the average of self-reported numbers of layers from 1999, 2000, and 2001 *Egg Industry* (Watt Publishing Co.) surveys.

[c] Five ECI members not included in the operational types are integrated firms with some brokerage activities. Only 111 members owned layers.

[d] Quantity is measured in cases, where one case = 30 dozen eggs.

A case of price manipulation occurs if a firm that needs additional inventory decides to initially sell some of its inventory to lower the price, or vice versa. On 151 out of 255 trading days in 2001, at least one firm bought and sold on the same day. Overall, 28 firms bought and sold on the same day, each averaging 8.3 days. A random examination of transactions made by two firms that most frequently bought and sold on the same day shows that their purchases and sales consisted of distinct loads differing by product type, weight/size, and/or color. Thus, this particular case of price manipulation is most likely not occurring at ECI.[10]

Regarding the usage of pricing terms, reported in the last two rows of table 1, patterns were distinct across operational types but not across flock size.[11] Producers and prod-users used the two terms relatively equally. Users chose market-adjusted terms for a large share of their purchases (73.3%), but for only a small share of sells (12.5%). Brokers traded in spot terms most of the time.

Model Development

In an industry where the majority of transactions are contracted and the contract price is based on a third-party quote, market transactions likely address an inventory management problem. As noted earlier, prices of eggs under contracts change on a weekly basis, but quantity orders arrive daily. Let Q_{it} denote the inventory of the ith firm at time t. The inventory represents eggs available for a producer to meet delivery orders and for a user to utilize in processing. The quantity the firm needs at time t is $\bar{Q}_{it}$, which represents the quantity of eggs received in orders for a producer, and for a user, a target quantity that maximizes the efficiency of the processing procedure or to meet storefront demand. The inventory needs to be adjusted if Q_{it} does not match $\bar{Q}_{it}$. For producers, both production and daily orders are variable. In particular, a disruption in production is inevitable when a portion of layers needs to be culled and replaced. Users, on the other hand, can request target quantities on a daily basis from contracted suppliers, but suppliers may not be able to meet changes in demand. Also, many users maintain their own inventory, requiring adjustments beyond daily contacts with contracted suppliers.

Assuming price manipulation does not occur, the firm will buy the difference $qb_{it} = \bar{Q}_{it} - Q_{it} > 0$, and will sell the difference $qs_{it} = Q_{it} - \bar{Q}_{it} > 0$. The objective of the firms in the short run is to minimize the cost of inventory adjustment, $C(q_{it})$, where the quantity of adjustment is $q_{it} = qb_{it} + qs_{it}$. Circumstances in which the need to buy or sell arises will vary at any given point in time. Aggregated over time, quantities traded by a firm are expected to depend on its operational characteristics and inventory adjustment costs.

There are several venues for a firm to adjust inventory with various costs. Spot and market-adjusted trading on ECI represent two such venues, while adjustments can also be made through individual contacts with suppliers, clients, or brokers. Let Ω_i denote the set of available venues to firm i to adjust inventory and $C_\omega(q)$, $\omega \in \Omega_i$, the cost of adjustment in venue ω. The firm chooses venue ω when $C_\omega(q) < C_\zeta(q)$ for all $\zeta \neq \omega$. Since

[10] A more serious case of price manipulation is if the ECI trades were used to impact the contract price. Because firms do not know how ECI prices are incorporated into UB quotes, such cases seem improbable, and in any event cannot be examined due to data unavailability.

[11] Similar patterns were observed from traded quantity.

data on alternative venues are not available, the choice set Ω_i in the current analysis will be limited to the two pricing terms at ECI, focusing on the relative costs of the venues available at ECI, rather than how the trading costs at ECI compare to other venues. Recent trading volume at ECI, however, suggests it has become a low-cost, if not the lowest-cost, alternative for an increasing number of firms.

The choice of pricing terms depends on factors that determine the inventory adjustment cost $C_\omega(q_{it})$. First, inventory schedules vary by differences in the equipment and management choices available to firms and their scale of operation. Second, contractual agreements and existing packaging and processing facilities result in varying costs of inventory adjustment by egg type. For example, the cheapest alternative for producers who have contracted for deliveries of cartoned eggs is to make adjustments with CTN eggs. Yet, to have CTN eggs packaged in custom cartons, time must be allowed for packaging materials to be shipped to the egg supplier. If particular packaging material is specified in contracts and time is limited, these producers may prefer to purchase GL or GNR eggs and package them at their own facility.

The storability of eggs implies that price expectations may affect inventory adjustment decisions. As noted above, the price under contract becomes known on Thursday for Sunday through Saturday deliveries. Thus, every firm knows the difference between the spot and next week's price from Thursday through Saturday. Prior to Thursday, firms can follow the changes in the UB quotes to adjust expectations for the following week's contract price. Also, seasonality likely matters, as the largest volume of eggs is consumed during holiday seasons. Inventory adjustments may be less active during the tight market conditions surrounding holidays because there is little excess inventory available.

Empirical Specification

Two relationships are investigated empirically: (*a*) the relationship between quantities traded by firms and their characteristics using trader-level data aggregated to monthly observations, and (*b*) the relationship between the chosen pricing terms and their determinants using transaction-level observations. All variables used in the analysis are identified in table 2.

Quantities Traded

On average, ECI members in 2001 traded on 38 days. Because not all firms traded positive quantities every month, the quantity traded by firm i in month t (q_{it}) can be specified as a censored regression model:

$$(1) \qquad q_{it}^* = \mathbf{x}_{it}'\beta + \varepsilon_{it}, \quad q_{it} = 0 \text{ if } q_{it}^* \leq 0, \quad q_{it} = q_{it}^* \text{ if } q_{it}^* > 0,$$

where $\mathbf{x}$ is a vector of firm characteristics, inventory adjustment costs, and seasonal factors; β is a coefficient vector; ε is an error term; and q_{it}^* is the unobservable need for inventory adjustment. The error term may be related to some or all operation characteristics and is assumed to be normally distributed with mean zero and variance $\sigma_{\varepsilon_i}^2 = \sigma_\varepsilon^2 e^{\mathbf{z}_i'\gamma}$, where σ_ε is a constant, $\mathbf{z}$ is a vector of operation characteristics, γ is a coefficient vector, and the null of homoskedasticity is $\gamma = 0$.

Table 2. Definitions of Variables Used in the Analysis

Variable	Definition
BTW1N2	Equals 1 if the firm owns between 1 and 2 million layers; 0 otherwise
BTW2N5	Equals 1 if the firm owns between 2 and 5 million layers; 0 otherwise
BTW5N10	Equals 1 if the firm owns between 5 and 10 million layers; 0 otherwise
CTN	Equals 1 if the load is cartoned eggs; 0 otherwise
DELLAG	Number of business days between the trade and delivery dates (scaled so that 1 = 10 days)
EUBBP	One-day-ahead forecast of UB quote (10¢/dozen) if the buyer is *PONLY*; 0 otherwise
EUBBU	One-day-ahead forecast of UB quote (10¢/dozen) if the buyer is *UONLY*; 0 otherwise
EUBSP	One-day-ahead forecast of UB quote (10¢/dozen) if the seller is *PONLY*; 0 otherwise
EUBSU	One-day-ahead forecast of UB quote (10¢/dozen) if the seller is *UONLY*; 0 otherwise
GL	Equals 1 if the load is graded loose eggs; 0 otherwise
GNR	Equals 1 if the load is graded nest run eggs; 0 otherwise
GT10	Equals 1 if the firm owns more than 10 million layers; 0 otherwise
JANFEB	Equals 1 if January or February; 0 otherwise
JULAUG	Equals 1 if July or August; 0 otherwise
MARAPR	Equals 1 if March or April; 0 otherwise
MAYJUN	Equals 1 if May or June; 0 otherwise
MIX12M	Average degree of diversity of egg types traded over the previous 12 months
MW	Equals 1 if the firm is headquartered in [equation (1)], the load is destined to, or the load originated in [equation (3)] IA, IL, IN, MI, MN, ND, NE, OH, SD, or WI; 0 otherwise
NE	Equals 1 if the firm is headquartered in [equation (1)], the load is destined to, or the load originated in [equation (3)] CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, or VT; 0 otherwise
NRBS	Equals 1 if the load is nest run breaking stocks; 0 otherwise
NW	Equals 1 if the firm is headquartered in [equation (1)], the load is destined to, or the load originated in [equation (3)] ID, MT, OR, WA, or WY; 0 otherwise
p	Equals 1 if the transaction is priced in market-adjusted terms; 0 if it is priced in spot terms
$PCTN_{-1}$	Proportion of trades involving cartoned eggs in the previous month, if the firm traded a positive quantity; 0 otherwise
PGL_{-1}	Proportion of trades involving graded loose eggs in the previous month, if the firm traded a positive quantity; 0 otherwise
$PGNR_{-1}$	Proportion of trades involving graded nest run eggs in the previous month, if the firm traded a positive quantity; 0 otherwise
$PNRBS_{-1}$	Proportion of trades involving nest run breaking stocks in the previous month, if the firm traded a positive quantity; 0 otherwise
PNU	Equals 1 if the firm owns both layers and a user facility, and is not involved in any brokerage activities; 0 otherwise
PONLY	Equals 1 if the firm owns layers and no user facility, and is not involved in any brokerage activities; 0 otherwise
q	Quantity of eggs traded (measured in units of 10,000 30-dozen cases)
QTY	Quantity of eggs traded in a given transaction (measured in units of 10,000 30-dozen cases)
QTY2	*QTY* squared
SC	Equals 1 if the firm is headquartered in [equation (1)], the load is destined to, or the load originated in [equation (3)] AR, CO, KS, LA, MO, NM, OK, or TX; 0 otherwise

(continued . . .)

Table 2. Continued

Variable	Definition
SE	Equals 1 if the firm is headquartered in [equation (1)], the load is destined to, or the load originated in [equation (3)] AL, FL, GA, KY, MS, NC, SC, TN, VA, or WV; 0 otherwise
SEPOCT	Equals 1 if September or October; 0 otherwise
TQ12M	Quantities of eggs traded by a given firm during the previous 12 months (measured in units of 10,000 30-dozen cases)
UONLY	Equals 1 if the firm owns a user facility and no layers, and is not involved in any brokerage activities; 0 otherwise
USPROD	U.S. egg production (billions)

Marginal effects of explanatory variables in tobit regression models can be computed as follows. Let y_{it} be a variable that appears in $\mathbf{x}_{it}$ and $\mathbf{z}_i$, or both. If y is continuous, its marginal effect can be computed as:

$$(2) \qquad \frac{\partial \mathrm{E}[q_{it} \mid \mathbf{x}_{it}, \mathbf{z}_i]}{\partial y_{it}} = \Phi\left(\frac{\mathbf{x}_{it}'\beta}{\sigma_{\varepsilon_i}}\right)\beta_y - \phi\left(\frac{\mathbf{x}_{it}'\beta}{\sigma_{\varepsilon_i}}\right)\sigma_{\varepsilon_i}\gamma_y,$$

where E[·] is the expectation operator, $\Phi(\cdot)$ and $\phi(\cdot)$ are the standard normal cumulative distribution function and probability density function, respectively, and β_y and γ_y are coefficients associated with y (Greene, 2002b, E21-44, 45). If the explanatory variable is binary, the marginal effect is computed as $\mathrm{E}[q_{it} \mid \mathbf{x}_{it}, \mathbf{z}_i, y_{it} = 1] - \mathrm{E}[q_{it} \mid \mathbf{x}_{it}, \mathbf{z}_i, y_{it} = 0]$.[12]

The sample consists of monthly trades by 154 firms who traded at ECI during 2001. The firm characteristics considered include the operational type, flock size, and location. Four operational types (producer, user, user that owns layers, and other operations that are involved in brokerage activities) were represented by binary variables (*PONLY*, *UONLY*, and *PNU*), with the miscellaneous types in brokerage as the base. Production scale was included as a set of binary variables based on the averages of the self-reported number of layers in *Egg Industry*'s 1999, 2000, and 2001 surveys, classified into groups of less than 1 million, 1–2 million, 2–5 million, 5–10 million, and more than 10 million layers (*BTW1N2*, *BTW2N5*, *BTW5N10*, and *GT10*); the group with less than 1 million layers was the base. Binary location variables were defined according to the state where each firm was headquartered (*NE*, *MW*, *NW*, *SE*, and *SC*), with the Southwest and Canada combined as the base.

To test whether ECI is a preferred marketplace for certain egg types, lagged proportions of egg types traded and the degree of egg type diversification were included as regressors, using monthly observations from 2000 when needed. Egg trades were categorized into seven product types described above, aggregated over color and weight/size classes. The proportions of trades involving each egg type relative to the total number of trades made by each firm in the previous month were specified as regressors ($PCTN_{-1}$, PGL_{-1}, $PGNR_{-1}$, and $PNRBS_{-1}$), excluding the combined proportion of CHEX,

[12] If a group of binary variables represent a category of characteristics, the marginal effects are computed as the difference between $\mathrm{E}[q_{it} \mid \mathbf{x}_{it}, \mathbf{z}_i]$, where the variable is equal to 1 and the other binary variables within the category are equal to zero, and $\mathrm{E}[q_{it} \mid \mathbf{x}_{it}, \mathbf{z}_i]$, where all binary variables within the category are equal to zero.

LIQ, and FRZN as the base. For firms that did not trade in a given month, the proportions were set at zero. As a measure of egg type diversity, a normalized entropy was computed from the proportions and averaged over the previous 12 months (*MIX12M*).[13]

In addition, the total quantities each firm traded in the previous 12 months (*TQ12M*) was included to control for the size effect of the firm's ECI activity. Monthly numbers of eggs produced in the United States (USDA/Agricultural Statistics Board, 2004) were included (*USPROD*) to examine whether participation in a marginal marketplace is related to the total quantity of commodity. Seasonality was captured by bimonthly dummy variables.

Choice of Pricing Terms

The choice of pricing terms is specified as a function of the factors impacting inventory adjustment costs in alternative venues, which is denoted by a vector $\mathbf{u}$. The nth trade can be quoted in market-adjusted terms ($p_n = 1$) or spot terms ($p_n = 0$). Assuming a logistic probability distribution, the relationship between the pricing term and its determinants can be written:

$$p_n = \mathbf{u}_n'\lambda + \upsilon_n, \tag{3}$$

where λ is a vector of coefficients and υ is an error term with a mean-zero logistic distribution. The variance of the error term may be related to operational characteristics of the buyer and the seller involved in the nth trade $\mathbf{v}_n$ such that $\sigma_{\upsilon_n}^2 = (e^{\mathbf{v}_n'\kappa})^2\pi^2/3$, where κ is a vector of coefficients and $\kappa = 0$ is the null of homoskedastic errors (Greene, 2002a, E15-47).

The marginal effect is computed for a continuous explanatory variable m as:

$$\frac{\partial \mathrm{E}[p_n \mid \mathbf{u}_n, \mathbf{v}_n]}{\partial m_n} = \frac{e^{a_n}}{(1+e^{a_n})^2} e^{-\mathbf{v}_n'\kappa}(\lambda_m - \mathbf{u}_n'\lambda\kappa_m), \tag{4}$$

where $a_n = \mathbf{u}_n'\lambda e^{-\mathbf{v}_n'\kappa}$, and λ_m and κ_m are the coefficients on m (Greene, 2002a, E15-53). If m appears nonlinearly in equation (3), the last term in parentheses is replaced by the first derivative of (3) with respect to m. If the explanatory variable is a dummy variable (see footnote 12 for a description of the case of a group of dummy variables), the marginal effect is computed as the difference $\mathrm{E}[p_n \mid \mathbf{u}_n, \mathbf{v}_n, m_n = 1] - \mathrm{E}[p_n \mid \mathbf{u}_n, \mathbf{v}_n, m_n = 0]$.

The sample includes 8,522 trades consummated in 2001. Operational type and flock size, defined analogous to the quantities traded model, of both the buyer and the seller in each transaction were included as explanatory variables. Because eggs under typical contracts are market-adjusted, all firms likely prefer market-adjusted terms, regardless of whether they are buying or selling. An exception may be brokers who likely do not partake in contracts. Also, producers may find spot prices more convenient to compare with production costs.

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[13] The ith firm's egg type diversity in month t was computed as

$$MIX12M_{it} = \sum_{s=1}^{12}\sum_{l=1}^{7}\left(P_{i,t-s}^l \log\left(1/P_{i,t-s}^l\right)/\log(7)\right)/12,$$

where P_i^l, l = {CTN, GL, GNR, NRBS, CHEX, LIQ, FRZN} are proportions of trades corresponding to egg type l.

A consummated trade reflects a negotiated outcome through a trade coordinator between the buyer and the seller. Large-scale retailers who warehouse their eggs, such as Wal-Mart and other supermarket chains, typically demand 20 to 25 days of shelf life from their suppliers (Miller, 2003). Thus, most commercially produced eggs reach supermarkets within a few days of laying, leaving producers with less flexibility in terms of timing of inventory adjustment than users. Under the assumption that market-adjusted terms are usually preferred, these facts suggest producers must accept spot terms more frequently than other operational types.

Regardless of the operational types involved in a transaction, another issue is whether the pricing terms are more often resolved in favor of the buyer's or the seller's preferences. A firm buying to fill its shortfalls may be willing to yield in order to secure the commodity; in contrast, a firm selling excess inventory may be happy to find a buyer for it. Thus, whether buyers obtain more favorable terms than sellers is an empirical question.

In addition to firms' characteristics, other terms of trade were included as regressors: location of eggs, egg type, transaction volume, time to delivery, and price expectations. Destination and origin of eggs, classified by ECI regions, were specified to capture regional effects, with the Southwest and Canada as the base. The Northwest was also included in the base group for place of origin due to the limited number of trades from this region. Egg types were represented by binary variables (*CTN*, *GL*, *GNR*, and *NRBS*), with CHEX, LIQ, and FRZN as the base. The quantity of eggs in each transaction (*QTY*) and its squared term (*QTY2*) were included to capture any volume effect on the pricing terms.[14] The number of business days between the date of the trade and the date of delivery (*DELLAG*) was specified to account for the timing effect of delivery. It is expected that the longer into the future the delivery is made, the more likely eggs are priced on a market-adjusted basis to be compatible with eggs under contracts.

For price expectations, the relevant price is the UB quote on which most regular contracts are based. A time-series model was estimated using daily UB quotes in 2001 for a common type of egg—cartoned, large, white eggs bought in the Northeast region. During the sample period, the selected UB quotes remained unchanged for several weeks at a time, and hence, heteroskedasticity was suspected. Based on the Akaike information and Schwartz Bayesian criteria, the UB quote series (g) was modeled as the following GARCH(1, 1):

$$\begin{aligned}(5)\qquad g_\tau &= \underset{(0.262)}{2.292} + \underset{(0.080)}{1.527}g_{\tau-1} - \underset{(0.080)}{0.561}g_{\tau-2} + \xi_\tau,\\ \xi_\tau &= \sqrt{h_\tau}\,e_\tau, \quad e_\tau \sim \text{Normal}(0, 1),\\ h_\tau &= \underset{(0.012)}{0.0958} + \underset{(0.104)}{0.392}\xi^2_{\tau-1} + \underset{(0.043)}{0.590}h_{\tau-1},\end{aligned}$$

[14] In the conceptual model, transaction volume equals inventory adjustment needs, which arise due to factors beyond the firm's control. As a reviewer points out, however, transaction volume may be endogenous. Testing for its endogeneity would require firm-level observations on the factors determining inventory adjustment needs, including the volume under contract and the inventory level at the time of transaction, which are not available. Lacking sufficient data to indicate otherwise, *QTY* and *QTY2* are assumed to be exogenous variables.

Table 3. Descriptive Statistics of Variables in the Quantities Traded Model

Variable	Mean	Std. Dev.	Variable	Mean	Std. Dev.
q [a]	0.942	2.573	*MIX12M*	0.091	0.127
PONLY	0.545	0.498	$PCTN_{-1}$	0.062	0.200
UONLY	0.084	0.278	PGL_{-1}	0.336	0.428
PNU	0.162	0.369	$PGNR_{-1}$	0.134	0.298
GT10	0.032	0.177	$PNRBS_{-1}$	0.083	0.238
BTW5N10	0.045	0.208	*TQ12M*	10.819	22.013
BTW2N5	0.117	0.321	*USPROD*	7.188	0.228
BTW1N2	0.091	0.288	*JANFEB*	0.167	0.373
NE	0.260	0.439	*MARAPR*	0.167	0.373
SE	0.110	0.313	*MAYJUN*	0.167	0.373
MW	0.305	0.461	*JULAUG*	0.167	0.373
SC	0.091	0.288	*SEPOCT*	0.167	0.373
NW	0.026	0.159			

Notes: Number of observations = 1,848. Variables are defined in table 2.
[a] This variable equaled zero for 650 observations. The positive observations of q had a mean of 1.452 and a standard deviation of 3.078.

where numbers in parentheses are standard errors, and the initial lagged observations were obtained from 2000. Using these estimates, one-day-ahead forecasts of the UB quote were computed for each trading day.

A firm is expected to respond differently to price expectations when the intended transaction is a purchase or a sale. Expecting a higher UB quote, sellers would prefer to trade on market-adjusted terms, because the following week's price is likely to increase. On the other hand, buyers would prefer spot pricing, all else equal. Preferences would reverse if the UB quotes were expected to decrease. Yet, as noted earlier, producers and users are expected to have differing degrees of flexibility in their purchases or sales. To account for these differences in preferences and flexibility, the UB quote forecasts were multiplied by binary variables that indicated whether the buyer of the transaction was a producer or a user, and whether the seller was a producer or a user (*EUBBP*, *EUBBU*, *EUBSP*, and *EUBSU*).

Last, similar to the quantities traded model, U.S. egg production during the month the trade was consummated (*USPROD*) was included to reflect general market conditions, and bimonthly dummy variables were included to account for seasonality.

Results

Equations (1) and (3) were estimated using LIMDEP version 8.0 (Greene, 2002a,b). Marginal effects were evaluated at the sample means, and their approximate standard errors were computed using the software's WALD command (Greene, 2002c, R11-11).

Quantities Traded

Descriptive statistics of the variables used in equation (1) are presented in table 3, and the results are reported in table 4. The null of homoskedastic errors was rejected with a p-value of less than 0.001. The marginal effects of firm characteristics collectively

Table 4. Estimated Coefficients and Marginal Effects for Monthly Quantities Traded (dependent variable = *q*)

	Primary Index Function			Variance Term	
Explanatory Variable	Coefficient	Standard Error	Marginal Effects[a]	Coefficient	Standard Error
Constant	-1.429**	0.632			
PONLY	0.202**	0.101	-0.214**	-0.970**	0.043
UONLY	-0.003	0.133	-0.203**	-0.370**	0.063
PNU	-0.503**	0.172	-0.234**	0.070	0.063
GT10	-0.299	0.894	0.135	0.620**	0.084
BTW5N10	0.251	0.166	0.166	-0.094	0.086
BTW2N5	-0.082	0.062	0.078*	0.318**	0.056
BTW1N2	0.046	0.045	-0.073**	-0.449**	0.063
NE	0.114**	0.050	-0.005	-0.422**	0.043
SE	0.125**	0.061	0.000	-0.453**	0.077
MW	0.005	0.087	0.317**	0.646**	0.039
SC	-0.093	0.079	0.015	0.211**	0.072
NW	-0.372	0.279	-0.070	0.378**	0.127
MIX12M	0.471*	0.259	0.926**	1.722**	0.136
$PCTN_{-1}$	0.492**	0.198	0.597**	0.717**	0.081
PGL_{-1}	0.392**	0.045	0.182**	-0.286**	0.043
$PGNR_{-1}$	0.387**	0.057	0.152**	-0.362**	0.059
$PNRBS_{-1}$	0.310**	0.153	0.244**	0.065	0.045
TQ12M	0.087**	0.003	0.062**		
USPROD	0.081	0.085	0.058		
JANFEB	0.295**	0.068	0.211**		
MARAPR	0.224**	0.061	0.157**		
MAYJUN	0.179**	0.060	0.124**		
JULAUG	0.084	0.066	0.057		
SEPOCT	0.105*	0.063	0.071*		
Disturbance Std. Dev.	1.517**	0.059			
No. of Observations	1,848				
Lagrange Multiplier Test[b] (p-Value)	655.69 (0.00)				

Notes: Single and double asterisks (*) denote statistical significance at the 10% and 5% levels, respectively. Variables are defined in table 2.

[a]Marginal effects for continuous variables are computed as equation (3) evaluated at sample means of variables. For binary variables, marginal effects are computed as the difference between the expected value of the dependent variable when the binary variable equals one and all other binary variables in the same category equal zero, and the expected value of the dependent variable when all binary variables in the same category equal zero.

[b]The null hypothesis is the presence of homoskedasticity.

suggest that ECI must have provided balanced access to all industry participants across operational types, flock sizes, and regions. The marginal effects for the operational type variables (*PONLY*, *UONLY*, and *PNU*) were statistically significant and negative, consistent with the expectation that firms with brokerage activities trade more actively, and were statistically equivalent to each other based on pairwise likelihood ratio tests. The marginal effects of the flock size variables were mostly statistically insignificant, and those that were significant were small in magnitude (about 700 cases).

The only location variable with a statistically significant marginal effect was the Midwest (*MW*). The result implies an average firm in the Midwest trades 3,170 cases more than firms in other regions. The magnitude seems reasonable given the overall monthly average trading of 9,416 cases and a high industry concentration in the Midwest.

An increase in the diversity of egg type mix increased the quantities traded, ceteris paribus, suggesting for firms that handle a variety of eggs, ECI serves as a "one-stop" source for their inventory adjustment needs. ECI also appears to be a preferred inventory adjustment venue for CTN, GL, GNR, and NRBS eggs relative to other egg types and products. Moreover, firms that use ECI must be repeaters; an average firm traded 620 cases more in the current month for every additional 10,000 cases it traded in the previous 12 months, holding all else equal.

The level of ECI trading was not related to U.S. egg production (*USPROD*). This finding would be of concern if ECI's role of price discovery were essential. Yet, as an inventory adjustment means, trading volume at a marginal marketplace need not coincide with the national market. It is likely that local market conditions, if observable, would have had more impact. Finally, seasonal impacts were mostly statistically significant. In 2001, trading was more active in the first half of the year than in the latter half, holding all else constant.

Choice of Pricing Terms

The descriptive statistics and regression results for equation (3) are presented, respectively, in tables 5 and 6. Since four of the regressors with expected UB quotes (*EUBBP*, *EUBBU*, *EUBSP*, and *EUBSU*) are predicted values based on equation (5), standard error estimates of coefficient estimates reported in table 6 are likely underestimated (Pagan, 1984). However, the number of observations was ample, and diagnostic tests suggest the generated regressor problem was minimal.[15] The null hypothesis of homoskedastic errors was rejected with a *p*-value of less than 0.001.

No single operational type except for prod-users seemed to systematically obtain one pricing term more often than the other. The marginal effect of *PONLY* as a seller was -0.306, favoring spot terms, reflecting producers' limited flexibility compared to other operational types. Eggs bought or sold by prod-users were more likely to be priced in market-adjusted terms, all else equal, consistent with the flexibility of integrated firms. Several marginal effects with statistical significance suggest that eggs bought (sold) by a user or a firm with many layers were more likely priced in market-adjusted (spot) terms, all else equal. This finding implies pricing terms were generally resolved in favor of the buyers' preferences. The results for firms with 1–2 million layers were different, which could partly be explained by the fact that 7 out of 14 producers with this flock size were integrated with processing or brokerage activities.

Pricing terms also depended on other terms of trade. Eggs originating from the Northeast, Southeast, Midwest, and South Central regions were more likely to be priced in market-adjusted terms, while GL, GNR, and NRBS eggs were more likely traded in spot terms than other eggs, all else equal. The pricing terms were nonlinearly related to transaction size (*QTY*). At the sample mean of 1,021 cases, an additional 1,000 cases

[15] The χ^2 statistic for testing the joint significance of the coefficients was highly significant. Moreover, McFadden's likelihood ratio index was 0.418, and the model predicted pricing terms with an average accuracy of 80.4%.

Table 5. Descriptive Statistics of Variables in the Pricing Terms Model

Variable	Mean	Std. Dev.	Variable	Mean	Std. Dev.
p	0.580	0.494	*CTN*	0.182	0.386
Buyers:			*GL*	0.409	0.492
PONLY	0.257	0.437	*GNR*	0.179	0.383
UONLY	0.140	0.347	*NRBS*	0.179	0.383
PNU	0.245	0.430	*QTY*	0.102	0.260
GT10	0.058	0.233	*QTY2*	0.078	1.255
BTW5N10	0.103	0.304	*DELLAG*	0.630	0.453
BTW2N5	0.143	0.350	*EUBBP*	1.856	3.195
BTW1N2	0.023	0.150	*EUBBU*	0.979	2.452
NE	0.229	0.420	*EUBSP*	3.523	3.553
SE	0.082	0.274	*EUBSU*	0.130	0.961
MW	0.242	0.428	*USPROD*	7.178	0.236
SC	0.109	0.311	*JANFEB*	0.193	0.395
NW	0.017	0.131	*MARAPR*	0.186	0.389
Sellers:			*MAYJUN*	0.154	0.361
PONLY	0.502	0.500	*JULAUG*	0.162	0.368
UONLY	0.018	0.134	*SEPOCT*	0.148	0.355
PNU	0.307	0.461			
GT10	0.073	0.260			
BTW5N10	0.164	0.370			
BTW2N5	0.132	0.339			
BTW1N2	0.031	0.173			
NE	0.185	0.388			
SE	0.049	0.216			
MW	0.658	0.475			
SC	0.083	0.275			

Note: Variables are defined in table 2.

decreased the probability of the transaction quoted in market-adjusted terms by 0.095. Thus, larger trades were more likely priced in spot terms. Also, at the sample mean of a 6.3-day lag, an additional delay of one day increased the probability of market-adjusted pricing by 0.017, consistent with expectations.

Loads involving producers were more likely to be priced with market-adjusted terms when higher UB quotes were expected. In particular, the probability that eggs sold by producers were market-adjusted increased by 0.187 when the UB quote was expected to increase by 10 cents per dozen, holding all else constant. While the marginal effect on *PONLY* implies producers were at a negotiating disadvantage on average, this result suggests that producers were more likely to obtain preferred pricing terms for their sales. Eggs bought by users were more likely priced in spot terms when the UB quotes were expected to increase, all else equal, consistent with the expected buyers' preferences. Thus, users in a buying position were likely to obtain their preferred terms.

Regarding general market conditions, pricing terms were not statistically impacted by U.S. egg production in a given month. Also, the likelihood of transactions consummated in market-adjusted terms was slightly but statistically significantly higher in bi-months when the quantities traded were higher, ceteris paribus.

Table 6. Estimated Coefficients and Marginal Effects for Pricing Terms (dependent variable = *p*)

Explanatory Variable	Coefficient	Standard Error	Marginal Effects [a]	Coefficient	Standard Error	Marginal Effects [a]
PRIMARY INDEX FUNCTION						
Constant	-2.549**	1.198				
Trader Characteristics:	<——— Buyers ———>			<——— Sellers ———>		
PONLY	-0.843*	0.463	-0.050	-3.496**	0.674	-0.306**
UONLY	8.662**	1.720	0.312**	-2.188	2.588	-0.231
PNU	-0.265	0.167	0.120*	0.073	0.149	0.111**
GT10	1.019**	0.196	0.120**	0.017	0.187	-0.169**
BTW5N10	13.211*	7.089	-0.039	0.246	0.151	-0.137**
BTW2N5	0.395**	0.100	0.090**	-0.772**	0.133	-0.122**
BTW1N2	1.602**	0.510	-0.114**	-0.084	0.122	0.014
Terms of Trade:	<——— Destination ———>			<——— Origin ———>		
NE	2.651**	0.285	0.094	2.370**	0.444	0.329**
SE	2.119**	0.253	0.109	3.474**	0.459	0.478**
MW	0.833**	0.162	-0.059	3.492**	0.421	0.502**
SC	1.233**	0.160	0.143**	2.991**	0.405	0.458**
NW	1.903**	0.408	-0.065			
CTN	0.974	0.711	0.008			
GL	-4.691**	0.741	-0.258**			
GNR	-4.371**	0.732	-0.218**			
NRBS	-6.727**	0.852	-0.579**			
QTY	-10.713**	1.322	-0.949**			
QTY2	2.002**	0.266				
DELLAG	1.862**	0.191	0.172**			
EUBBP	0.141**	0.061	0.037**			
EUBBU	-0.714**	0.221	-0.108**			
EUBSP	0.479**	0.095	0.187**			
EUBSU	0.309	0.354	0.006			
Market Condition:						
USPROD	0.255**	0.127	0.024			
JANFEB	0.311**	0.117	0.032**			
MARAPR	0.611**	0.118	0.060**			
MAYJUN	1.049**	0.161	0.093**			
JULAUG	0.153	0.105	0.016			
SEPOCT	0.552**	0.133	0.055**			
VARIANCE TERM						
Trader Characteristics:	<——— Buyers ———>			<——— Sellers ———>		
PONLY	-0.474**	0.085		0.054	0.077	
UONLY	0.118	0.143		0.421	0.263	
PNU	-0.811**	0.127		-1.106**	0.135	
GT10	0.167	0.163		0.801**	0.158	
BTW5N10	2.966**	0.594		0.724**	0.129	
BTW2N5	-0.085	0.089		0.187**	0.090	
BTW1N2	1.876**	0.328		-0.102	0.163	

(continued . . .)

Table 6. Continued

Explanatory Variable	Coefficient	Standard Error	Marginal Effects[a]	Coefficient	Standard Error	Marginal Effects[a]
VARIANCE TERM (CONT'D)						
Trader Chars. (cont'd):	<—	**Buyers**	—>	<—	**Sellers**	—>
NE	0.698**	0.121		0.302**	0.104	
SE	0.478**	0.149		0.105	0.128	
MW	0.785**	0.086				
NW	1.228**	0.292				
Log Likelihood	= -3,375.56					
χ^2 Statistic[b]	= 4,844.27					
(p-Value)	(0.00)					
Lagrange Multiplier Test[c]	= 169.44					
(p-Value)	(0.00)					

Notes: Single and double asterisks (*) denote statistical significance at the 10% and 5% levels, respectively. Variables are defined in table 2.

[a] Marginal effects for continuous variables are computed as the derivative of the logistic cumulative distribution function with respect to the explanatory variables evaluated at their sample means. For binary variables, marginal effects are computed as the difference between the probability of $p = 1$ when the binary variable equals one and all other binary variables in the same category are equal to zero, and the probability of $p = 1$ when all binary variables in the same category are equal to zero.

[b] The null hypothesis is that all coefficients (not including the constant) are jointly zero.

[c] The null hypothesis is the presence of homoskedasticity.

Implications

The focus of the thin market literature has been on the declining function of its price discovery role. This paper sheds light on an alternative role for a marginalized marketplace—providing a means of inventory adjustment—by examining unpublished transaction data from Egg Clearinghouse, Inc. An open inventory adjustment process allows firms to post their excess inventory for sale and to find offers that would fill their shortfalls. Such a process reduces the cost of finding potential trading partners when inventory-adjustment needs arise.

Firms participating in a marginal market for inventory adjustment would buy and sell regardless of their operational types. Given the increase in obligations under contracts, it is reasonable that producers of the good may need to purchase more of the same good to meet client orders, while processors of the good may have excess input, which can be sold. Indeed, ECI transaction data document that these seemingly converse transactions are common.

It is well understood that successful marketplaces usually attract participation from all groups of firms in an industry through offering trading terms which do not favor one group over another. The presented analysis of participation in the ECI, as measured by quantities traded by individual firms, revealed that this attribute is one reason for ECI's success. Participation was balanced across all operational types, sizes, and regions, and ECI participants often became repeat users. Participation was not related to overall market conditions, but this is not essential for a market whose primary purpose is inventory adjustment. In addition, the results showed that a diverse offering of tradable commodity specifications is helpful, since it lowers the inventory adjustment costs for firms with a diverse product mix.

A marketplace inherently discovers price for the transactions, and thus, even if the price discovery role is not primary, it is important to ensure that the price discovered, no matter how infrequent, can serve as a check for the price used in non-market transactions. Of the two pricing terms available at ECI, spot terms contribute to price discovery while market-adjusted terms do not. Based on results from the analysis of the pricing term choices, the use of pricing terms in the sample was balanced across different groups of firms. However, the industry needs to be aware that for ECI to maintain its function as a check for UB quotes, it must maintain active and balanced use of spot terms across all firms.

Several options are available for agricultural sectors concerned with reliability of market prices. The cheese market is one model with a centralized thin marketplace discovering prices used to price the off-market transactions. Despite its long history, the cheese exchange continues to be plagued with efficiency problems, recently prompting a probe by the Commodity Futures Trading Commission (Martin, 2005). The livestock market has been exploring various directions. Some private entities are providing cattle inventory adjustment services for small-scale feeders, similar to ECI. Because spot prices are not being reliably discovered in all locations, aggregated prices across several major markets are newly designated as a base price for formulas and contracts. The egg industry has been successful with ECI. But it is important to recognize that one key ingredient to its success is the existence of industry-approved non-market-based UB quotes, which are used to price the vast majority of eggs. Unless an alternative price-setting method can be agreed upon, a marketplace, no matter how marginalized, may continue to be burdened with the role of price discovery.

[Received September 2002; final revision received August 2005.]

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