Forward Contract Information Impacts on Pricing and Production Efficiencies

in a Simulated Fed Cattle Market

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Abstract

As policy makers strive to maintain competitiveness in agricultural markets, the impacts of altering market information sets must be evaluated. An experiment was designed to assess the price and production impacts of forward contract information. Results suggest that this information reduced price level and dispersion. Production efficiency was improved in the spot market.

Introduction

The evolution from centralized auction trading to private negotiations has been a source of interest and concern regarding price discovery in cattle markets (Koontz and Purcell). This change has resulted in less price information, and potentially less accurate market prices, being available to market agents as cash trade volumes decline. The USDA estimates that under the current market news reporting program 35 to 40 percent of cattle transactions are not reported (USDA AMS). As policy makers strive to maintain a competitive environment in agricultural markets, the impacts of changing information sets available to market actors must be evaluated.

Traditionally, research in agricultural markets addressing information questions has been conducted on markets such as futures markets, which can be characterized as largely competitive. Much of this research suggests that information can affect price discovery efficiency and price variability (Colling and Irwin; Colling, Irwin and Zulauf; Grunewald, McNulty and Beire). Such research provides little guidance as to the impact of new information in an imperfectly competitive market environment, as is found in fed cattle markets.

An example of policy makers changing regulations with the goal of improving competition through changing the available market information set is a recent amendment to the Agricultural Marketing Act of 1946, commonly referred to as "Mandatory Price Reporting," (USDA AMS). The intent of this legislation was to provide information on forward transactions in livestock markets. While policy makers and regulatory agencies struggle to implement this policy, research regarding the impact of

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forward contract sales information can provide useful insights for future market policy recommendations and implementation aimed at improving the bargaining position of sellers in agricultural markets becoming dominated by privately negotiated transactions. The objective of this research is to investigate the impact of forward contract information on price level, price variability and production efficiency (defined for our purposes as optimal timing of marketings as indicated by cattle weights) in a simulated fed cattle market.

Traditional methods using secondary data require a policy to be in place for a significant length of time before impacts can be estimated. A laboratory test market, which provides incentives for participants to exhibit behavior consistent with real world phenomena, allows different parameters to be controlled, observed and analyzed (Freidman and Sunder). For these reasons, the Fed Cattle Market Simulator (FCMS) developed at Oklahoma State University is used to provide the experimental market environment to achieve our research objective. This research is an extension of work reported by Anderson et al., which examined the effects of reducing public information in fed cattle markets. Transactions data from experiments incorporating forward contract information will be analyzed using econometric models. These models evaluate transaction prices, price variability, and production efficiency under the different experimental treatments.

Review of Studies Evaluating the Impact of Market Information

The efficiency of a market in discovering price is largely affected by the information available to market actors. Grossman and Stiglitz indicate that an increase in the quality of information will increase the information content of prices. Stigler indicates that price dispersion can be a result of ignorance on the part of market actors.

Research in agricultural markets suggests that information can affect price discovery and price variability. Colling and Irwin found that live hog futures prices adjusted to unanticipated information in the USDA *Hogs and Pigs* reports. Colling, Irwin and Zulauf indicated that nearby pork belly and live hog

futures prices were significantly affected by the release of the USDA *Cold Storage* report. Grunewald, McNulty and Beire reported that live cattle futures prices responded to unexpected information in USDA *Cattle on Feed* reports. All three of the above mentioned studies used analyses aimed at testing the efficiency of the futures market in incorporating information in government reports. Given that prices were impacted by unanticipated information, the authors conclude the reports do in fact contain important information, and they indicate these reports fulfill their public policy mission.

Research in financial markets suggests that the transparency of the market (i.e., public disclosure of trade and quote information) is important in market efficiency and price discovery. Bloomfield and O'Hara tested the effects of trade and quote disclosure on market efficiency using experimental laboratory currency markets. They conclude that trade disclosure increases informational efficiency of transaction prices. Flood et al. examined the effects of price disclosure in a continuous experimental multiple-dealer market. Public price queues were compared with bilateral quoting. Flood et al. conclude that higher search costs reduced trade volume and induced aggressive pricing strategies that increased the speed of price discovery in markets with bilateral quotes. Pagano and Röell investigated differing levels of transparency in several market types. They conclude that greater transparency generated lower trading costs for uninformed traders. Overall, the above research indicates that increased information reduces risk or costs for market actors as they form price expectations and discover prices.

The above studies focus primarily on the efficiency of futures or stock prices when incorporating information rather than examining price impacts in cash markets associated with new information. Moreover, the above studies were conducted in market environments that more closely resembled a purely competitive market structure. Albaek et al. investigate the impact of published, firm-specific, transactions prices for ready-mixed concrete in three regions of Denmark. The authors conclude that publication of these prices allowed firms to reduce the intensity of oligopoly price competition, and this led to increased consumer prices for concrete rather than reduced prices as was intended by the regulatory

agency.

Anderson et al. examined specifically how a reduction in public cash market information affected fed cattle markets. They concluded that reducing public information increased price variance and decreased production efficiency for fed cattle. While the research by Anderson et al. provides an experimental and econometric framework with which to achieve our research objective, they do not specifically address the impact of marketing intentions data on fed cattle prices.

Wachenheim and DeVuyst use the economic literature to develop hypotheses about the impact of mandatory price reporting on livestock markets. They conclude that depending on how mandatory price reporting is implemented the price paid to livestock producers could be reduced with added market information. The authors have no empirical evidence to support their conclusion, however.

Theoretical Model of Bilateral Negotiation

An adaptation of the model reported by Menkhaus et al. using Robison and Barry's expected value-variance (EV) provides a theoretical baseline for understanding the research problem. Fed cattle markets are typified by bilateral negotiation between an agent for the packer and an agent for the feedlot. This can be modeled in a private negotiation framework where price becomes a function of q, given there is one buyer and one seller for each transaction. As such the expected price for the seller is $E(p(q) + \omega + \varepsilon) = p(q)$, where ω and ε are random variables with expected values of zero and variances of σ^2_ω and σ^2_ε. The distributions of ω and ε and are assumed to be such that price cannot be negative. The random variable ω represents the risk the seller faces associated with sunk costs incurred due to advanced production of the commodity, i.e., the seller risks losing all production costs if the commodity is not sold. The random variable ε represents the risk associated with reduced information, i.e., no forward contract information.

Under this price scenario, the expected profit for the seller is $E(\pi) = p(q)q - C(q)$ with variance $q^2\sigma^2_{\omega+\varepsilon} = q^2\sigma^2_\omega + q^2\sigma^2_\varepsilon + 2q^2\rho\sigma_\omega\sigma_\varepsilon$, where ρ is the correlation between ω and ε. The certainty equivalent of

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profit for the seller is

$$(1) \quad \pi_{ce} = p(q)q - C(q) - (\lambda_S/2)(q^2\sigma^2_\omega + q^2\sigma^2_\varepsilon + 2q^2\rho\sigma_\omega\sigma_\varepsilon),$$

where λ_S is the Pratt-Arrow measure of risk attitude for the seller. The first-order conditions for the seller requires

$$(2) \quad MR_S = p'(q)q + p(q) = C'(q) + \lambda_S (q\sigma^2_\omega + q\sigma^2_\varepsilon + 2q\rho\sigma_\omega\sigma_\varepsilon) = MC_S$$

Expected profit for the buyer is $E(\pi) = R(q) - p(q)q$ with variance $q^2\sigma^2_\varepsilon$. The certainty equivalent of the buyer's profit function is

$$(3) \quad \pi_{ce} = R(q) - p(q)q - (\lambda_B/2)(q^2\sigma^2_\varepsilon).$$

The first order condition for the processor/buyer requires

$$(4) \quad MR_B = R'(q) = p'(q)q + p(q) + \lambda_B (q\sigma^2_\varepsilon) = MC_B.$$

Both buyers and sellers incur risk due to the added cost associated with reduced information. The seller also has the additional cost of price risk resulting from production before the sale. The quantity traded in this scenario is expected to decline, and total surplus, and thus market efficiency, will be reduced relative to the purely competitive case with full information. The potential impact of increased information is uncertain from the model. The negotiated price will depend on the relative risk preferences of the buyer and seller and also on differences in the variances of price risk attributable to production before sale for the seller and price information risk for both the seller and buyer.

The theoretical model and intuition suggest that bargaining power plays a role in determining the level of price in this setting of private negotiation with less than full information. It can be argued that the buyer is in a stronger bargaining position than the seller as buyers must understand that sellers have the risk of losing the cost of production if produced cattle are not sold (Menkhaus et al.). This puts sellers at a disadvantage relative to buyers even in the case of full information. However, the reduced risk associated with more information may in fact improve the bargaining position of the seller, assuming that buyers may have more knowledge of forward contracts than sellers without public reporting of such

information. Due to the indeterminancy of impacts regarding the value of increased information for forward contracted cattle, empirical analysis is required to address our proposed hypotheses.

Hypotheses

Lack of information is clearly a source of risk when market actors discover price. Conceptually, the provision of forward contract information could reduce this risk in livestock markets by increasing the public information set. Specifically, publicly reported information on terms of trade and intended delivery dates for forward contracted cattle could affect the timing of marketings, volume of cattle sold in the cash market and cattle weights at the time of delivery. Several hypotheses are to be investigated in this study. The null hypotheses to be tested where information on forward contracts are made public are:

(1) H_0: Increased information will not affect price levels in forward or spot cattle markets.

(2) H_0: Increased information will not affect price variability in fed cattle markets.

(3) H_0: Increased information will not affect productive efficiency in cattle feeding.

Experimental Design and Procedure

Participants in the forward contract information sessions of the study were recruited from the agricultural commodities marketing class at Colorado State University during Fall 2000 semester. The participants were paid based on profitability of their team.[1] This was done to insure the conditions of monotonicity, salience and dominance, which induced agent incentives consistent with economic theory (Friedman and Sunder). Two daylong experiment sessions were conducted which allowed participants to make transactions over a simulated period of 40 weeks where for 32 weeks forward contract information was provided. Consistent with previous research using the FCMS (Anderson et al.), the first eight weeks were dropped from the analysis to allow for learning. The baseline information observations came from

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[1] Students were paid $40 per person to participate and $0.25 per $1 of profit on a pen of cattle bought or sold. Likewise, students were penalized $0.25 per $1 of losses on a pen of cattle bought or sold.

previously conducted trading sessions with personnel from Excel Corporation in Wichita, Kansas during the fall of 1999.

The key elements of the experimental design include practices and features of the market simulator, market information provided to the participants for the baseline portion of the study and market information provided to participants reflecting forward contracts. A brief description of the FCMS, as well as Figure 1 are provided to better understand the experimental market environment experienced by participants. A more complete description of the FCMS can be found in Anderson et al.

Participants in the FCMS are divided into eight feedlot teams and four meatpacking teams. Each team consisted of two-to-four persons. These teams bought and sold simulated pens of fed cattle during each trading week.

Each trading week consisted of a 15-minute cycle. During the first ten minutes, feeders and packers negotiated and finalized transactions. Trades were conducted in face-to-face bilateral negotiations. Each feedlot had a number of paper pens of cattle with each pen containing 100 animals on a show-list. Prices were negotiated and sales occurred for show-list cattle. Cattle weights ranged from 1,100 to 1,200 pounds in 25-pound increments. Transactions were recorded on sheets, which were scanned into a computer. Prior to the actual experiment the rules and practices of the simulator were explained and several practice sessions were held to familiarize participants with procedures (Figure 1).

The five minute period following the trading period allowed teams to process market information, update show lists, calculate breakeven prices and develop strategies for the next trading period. An income statement for each team documenting transactions was provided after each trading period (Figure 1).

Each FCMS transaction represented a data point involving the sale and purchase of one pen of 100 animals between a feedlot and a packer. For each of these transactions the following data were recorded: week traded, packer purchasing cattle, feedlot selling cattle, weight of cattle, transaction price and type of

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transaction (cash or forward contract). Other weekly recorded data included: breakeven price for 1,150 pound animals, boxed beef price at which meat was sold, closing nearby futures price for cattle, total marketings and number of pens of cattle on the show-list at the beginning of each trading week.

The key feature of this experiment was the market information provided during each trading period. The baseline scenario (i.e, the Excel sessions) for the experiment was based on the market information available to agents in the fed cattle market prior to mandatory price reporting (i.e., no contract information). Two digital displays provided the following information throughout the trading period. One display showed continuously updated cash transactions that included trading volume and high-low price ranges, which is analogous to USDA Agricultural Marketing Service cash market information. The second display disclosed continuously updated trading volume and current prices for three futures market contracts which is analogous to the information available from the Chicago Mercantile Exchange. This information was available to participants throughout all experiment sessions.

During the experiment sessions forward contract information was provided to market participants in addition to the baseline information described. The forward market information included the volume of cattle purchased through forward contract by intended delivery week and the negotiated price range by delivery week. During this information treatment, the forward contract information summarized from the trading period was provided during the five-minute period interval between trading periods.

Econometric Models

The econometric models used to evaluate the impact of forward contract information on price level, price variability and production efficiency follow the work reported in Anderson et al., as developed from Jones et al., Schroder et al., and Ward 1981, 1982 and 1992. The transaction data from the experiments were used to estimate the models.

The price-level model is specified as follows:

(5) $PRICE_{it} = \beta_o + \beta_1\,BBP_{t-1} + \beta_2\,FMP_{t-1} + \beta_3\,TSL_{t-1} + \beta_4\,TLST_{t-1} + \beta_5\,PPL_t$

$$+ \, 3_{j=1}{}^8 \, \beta_{6j} \, FDLT_{ijt} + 3_{j=1}{}^4 \, \beta_{7j} \, PACKER_{ijt} + \beta_8 \, FWD + \beta_9 \, INFO_t + \beta_{10} \, INFO{\times}FWD_t + \nu_{it}$$

where PRICE is the transaction price for one pen of fed cattle, BBP is the boxed beef price, FMP is the

fed cattle futures market price, TSL is the total pens of fed cattle slaughtered, TLST is the total number of

pens on the show list, PPL is the potential profit or loss available to the industry, FDLT denotes binary

variables identifying the feedlot involved in the transaction (base = Feedlot 1), PACKER denotes binary

variables identifying the packer involved in the transaction (base = Packer 1), FWD denotes the binary

variable identifying type of sale (0 – cash; 1 – forward), INFO denotes the binary variable identifying the

provision of forward contract information through mandatory price reporting (0 – no information; 1 –

information) and INFO×FWD is an interaction variable between INFO and FWD.

The price variance model is specified with the same independent variables, but the dependent

variable is $\ln(\nu^2{}_{it})$ where ν the residual from the price-level model. The price variance model is specified

as follows

(6) $\ln(\nu^2{}_{it}) = \beta_o + \beta_1 \, BBP_{t\text{-}1} + \beta_2 \, FMP_{t\text{-}1} + \beta_3 \, TSL_{t\text{-}1} + \beta_4 \, TLST_{t\text{-}1} + \beta_5 \, PPL_t$

$\qquad + \, 3_{j=1}{}^8 \, \beta_{6j} \, FDLT_{ijt} + 3_{j=1}{}^4 \, \beta_{7j} \, PACKER_{ijt} + \beta_8 \, FWD + \beta_9 \, INFO_t + \beta_{10} \, INFO{\times}FWD_t + \varepsilon_{it}$

where variables are as defined before.

The price level and price variance models were estimated as weighted random effects models

(WREM), given observations in the data set include numerous transactions each week for which some

variables have the same values for every transaction within each week. Ward et al. use the same

procedure for estimating econometric models using data from the FCMS. These models correct for two

forms of heteroscedasticity in the error term. One type is associated with random effects, as there are

periods in the simulation where bargaining power varies between feedlots and packers across trading

weeks (Ward et al.). The second source of heteroscedasticity comes from market agents having common

information each week of trading while negotiating prices. For example, all market actors receive the

same previous week's boxed beef price quote for a week of trading. Thus, errors associated with the

transaction prices for a given week are not independent (Ward et al.). The price variance model then uses

the residuals from the WREM price level model for the dependent variable ($\ln v^2_{it}$). The price variance

model is then estimated as a random effects model for unbalanced panel data.

Production efficiency is measured by weight deviations from the optimal market weight for fed

cattle of 1,150 pounds. An ordered logit model with absolute weight deviations from 1,150 pounds as the

dependent variable was used to determine the effect of forward market information on participants'

production efficiency. The dependent variable is a categorical variable with a value of 0, 1, or 2

representing the 0, 25, and 50 pound weight deviations from the optimum weight of 1,150 pounds. These

are the only weight deviations allowed as cattle not sold gain 25 pounds each week until they reach a

maximum weight of 1,225 pounds in the FCMS.[2] The weight deviation model is specified as

(7) $\quad WTV_{it} = \beta_o + \beta_1 BBP_{t-1} + \beta_2 FMP_{t-1} + \beta_3 TSL_{t-1} + \beta_4 TLST_{t-1} + \beta_5 PPL_t$

$\quad\quad + 3_{j=1}{}^8 \beta_{6j} FDLT_{ijt} + 3_{j=1}{}^4 \beta_{7j} PACKER_{ijt} + \beta_8 FWD + \beta_9 INFO_t + \beta_{10} INFO \times FWD_t + \mu_{it}$

where WTV_{it} is the categorical weight-deviation variable.

Results

Descriptive statistics for selected variables across and for the two information treatments are

reported in Table 1. Evident from Table 1 is that boxed beef, futures market and average price are all

slightly lower in the with information case. PPL also is noticeably lower (Table 1).

These tendencies are analyzed in more detail through the econometric models.

Results for the price-level, price-variance, and weight-deviations models are presented in Table 2.

The price-level model yields results consistent with a priori expectations. The lagged boxed beef price

coefficient is positive and significant in explaining price level (Table 2). The same also is true for the

lagged futures market price coefficient (Table 2). The total show-list and slaughter variables lagged show

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[2] An analysis of the volume of cattle marketed by weight category during the two sessions
indicated there was no need for a 75 pound weight deviation category.

negative and significant relationships with transaction price. The potential profit coefficient has a

positive sign, but it is not significant. As we might expect from our theoretical model individual market

participants have significant effects on transaction price as seen in the individual firm coefficients. This

result is expected given the bilateral nature of the price discovery process in this simulation.

All or some combination of the coefficients associated with the FWD and INFO variables are

significant in all three of the models. The price impacts, elasticities associated with the price impacts, and

marginal effects from the ordered logit model are reported in Table 3. The reference point for measuring

the impacts is a spot market transaction without the forward contract information provided.

The forward contract transactions exhibit lower prices than spot market transactions when no

information on forward contracts is provided. Transaction prices are $0.266/cwt. or 0.34% lower than

spot prices without the information. This result may be related to a discount associated with the risk of

future delivery, and it is consistent with Krogmeier et al. findings. They found forward prices to be lower

than spot prices in experimental markets.

Perhaps most interesting is the negative impact the new information has on spot transaction prices.

With forward contract information, spot prices are $1.058/cwt. (or 1.37%) lower and forward contract

transactions are $0.40/cwt. (or 0.52%) lower than spot transaction without the new information (Table 3).

This result may be indicative of decreased information risks for both the buyer and seller, which

ultimately increases the overall negotiation advantage for the buyer relative to the seller. The buyer

knows the quantity that is forward contracted, and this reduces risks associated with allocating volume for

the plant for the current or upcoming time period. The forward price and quantity information reduces

risks for the seller associated with the competitiveness of forward contracting offers. This leaves the

seller with the risk of not covering costs associated with production (advance production risk) during spot

price negotiation.   Thus, as these information costs are reduced coupled with the buyer having a

bargaining advantage over the seller due to advance production risk, the forward contract market becomes

more attractive and sellers are willing to accept a lower forward price to reduce their advance production risk that exists for spot trading. Those cattle which are not forward contracted must either be held for later sale which incurs additional production costs or sold on the spot market. During spot negotiation the buyer knows quantity of forward cattle to be delivered during that trading period through the information presented on forward contracts. This information clearly puts the buyer at an advantage when negotiating spot price which is reflected in a lower spot price relative to the forward price when information is presented (Table 3). Forward contract transactions are $0.658/cwt. higher.

With the added forward contract information, it is expected that price dispersion will decrease. The results from the price-variance model provide some evidence supporting this hypothesis (Table 2). The coefficient on the information variable is not significant, but it does have the expected negative sign. The coefficient on the interaction variable between information and forward is significant and indicates a negative relationship to price (Table 2). This suggests price variance at least for forward prices is reduced with this information. The results also suggest that forward contract transaction have higher dispersion than spot transactions. But, the difference is not significant. However, we do see that increased information reduces price dispersion and has the greatest impact on forward contract transactions. The percent reduction reported in Table 3 is close to 100% but is based on all the estimated coefficients. If we use just the significant coefficient then dispersion of forward contract transactions is reduced 85.1%.

The weight deviations model indicates that the futures price coefficient has a significant and negative relationship with the dependent variable (Table 2). This indicates the potential temporal allocation effect associated with futures prices in the FCMS. The coefficient on potential profit has a significant and negative relationship suggesting that as potential profit decreases, the probability of selling at a non-optimal weight increases (Table 2). This likely indicates that market agents bargain more aggressively as the total profits in the system decrease. This bargaining behavior creates greater inefficiencies that will further reduce potential profits. Likewise, as the total show-list increases in size

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there are increased probabilities that marketings will occur at non-optimal weights. The forward contract variable coefficient is significant and negative. Information has the expected sign and is close to significant at the ten percent level (i.e., p-value = 0.109). There is also a significant interaction between INFO and FWD (Table 2).

The marginal effects reported in Table 3 indicate that forward contract transactions are more likely to be marketed at optimal weights than spot market transactions without the new information provided. Forward contracts are 9% less likely to be traded at 50 pounds away from the optimal weight and 9% more likely to be traded at the optimal weight (Table 3). With the added forward contract information we see that spot market transactions are more likely to be marketed at optimal weights (+3.6%). However, the increased information changes seller behavior regarding the timing of sales. The seller has less risks associated with selling in the forward market when information is present. Thus, sellers may be more likely to sell at weights that are not optimal in the forward market, given this information, to avoid advance production risk when selling cattle at non-optimal weights in the spot market. Forward contracts are only 2.6% more likely to be marketed at optimal weights, instead of 9% without the information.

A hypothesized result is that production efficiency should be improved by the forward contract information. It is expected that the timing of sales will be adjusted so that the number of cattle sold above the optimum weight will be reduced. These results suggest that will happen. But only if the volume of spot market transactions remains greater than the number of contracts. The information creates incentives for increasing non-optimal marketings in the contract market. Overall, these results point toward a potential improvement in production efficiency in the spot market, but perhaps not in the forward contract market with the new information.

Summary and Conclusions

Policy makers will continue to look for regulatory solutions designed to improve the competitive position of sellers in agricultural markets as they become dominated by privately negotiated transactions.

For example, the intent of mandatory price reporting is to provide forward contract information to the public and thereby increase competition (U.S. Senate; USDA Agricultural Marketing Service). This forward contract information represents marketing intentions information that was previously unavailable to agents in the fed cattle market. An experiment using the FCMS was designed to assess the potential impacts of forward contract information on price discovery and production efficiency for fed cattle.

Results from the econometric models suggest that the addition of publicly reported forward contract information may reduce price level, and reduce price dispersion. Our results suggest improved production efficiency in the spot market but perhaps not in the forward contract market. These results may not be popular among sellers in the market place. Forward contract information in this experiment seems to be more advantageous for buyers than for sellers when negotiating price.

Theory indicates that the impacts of increased information reduces risks for both buyer and seller, but it leaves us with an indeterminate prediction regarding transaction price in bilateral negotiation. Our results indicate that price level is reduced with forward contract information, which is counter to traditional thinking that more information is preferred to less in agricultural markets. Ultimately the information regarding quantity of forward contracted cattle gives buyers an advantage when sellers face advance production risk as they negotiate price in our simulated bilateral trading institution.

Conventional wisdom in agricultural market analysis is dominated by the purely competitive market structure paradigm. Theory and past research regarding added information in markets that closely resemble this paradigm would typically lead analysts to an apriori prediction of price enhancement for sellers given an expansion of publicly reported transactions. Perhaps the most important implication of this research is that as trading institutions change in agricultural markets policy makers and analysts can no longer make or accept blanket policy prescriptions without investigation tailored to the targeted market.

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Table 1. Descriptive Statistics for Model Variables.

Variables	Full Sample		No Information		Information	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
BBP	121.87	6.85	122.94	7.77	120.39	4.95
FMP	77.25	4.80	77.72	4.64	76.58	4.94
TSL	38.27	6.29	37.97	6.90	38.69	5.30
TLST	126.31	19.32	125.47	18.98	127.47	19.75
PPL	1.54	4.67	2.17	4.96	0.66	4.08
PRICE	77.16	4.97	77.44	4.95	76.77	4.97
WEIGHT	1156.51	16.94	1156.12	16.72	1157.05	17.22

Table 2. Estimated Coefficients for Price-Level, Price Variance, and Weight Deviation Models.

Variables	Price-Level		Price Variance		Weight Deviation	
	Coeff	t-Stat	Coeff	t-Stat	Coeff	t-Stat
BBP_{t-1}	0.250**	(4.152)	-0.031	(-0.553)	0.004	(0.929)
FMP_{t-1}	0.327**	(3.791)	0.078	(0.966)	-0.021**	(-2.436)
TSL_{t-1}	-0.103**	(-3.536)	0.011	(0.401)	-0.007	(-1.113)
$TLST_{t-1}$	-0.876**	(-4.676)	0.016	(0.940)	0.008**	(3.637)
PPL_t	0.098	(1.259)	0.024	(0.740)	-0.053**	(-4.738)
$FDLT_2$	0.268**	(4.128)	-0.454**	(-3.425)	0.041	(0.262)
$FDLT_3$	0.374**	(5.350)	-0.076	(-0.558)	-0.087	(-0.547)
$FDLT_4$	0.213**	(3.009)	0.117	(0.853)	0.069	(0.435)
$FDLT_5$	0.362**	(5.614)	-0.467**	(-3.477)	-0.168	(-1.053)
$FDLT_6$	0.196**	(2.949)	-0.306**	(-2.269)	-0.098	(-0.613)
$FDLT_7$	0.095	(1.393)	-0.339**	(-2.511)	0.115	(0.731)
$FDLT_8$	0.597**	(8.530)	0.003	(0.002)	-0.318**	(1.965)
$PACKER_2$	-0.074	(-1.480)	-0.128	(-1.233)	0.131	(1.071)
$PACKER_3$	-0.087*	(1.845)	-0.161	(1.640)	-0.030	(-0.257)
$PACKER_4$	0.159**	(3.435)	-0.041	(-0.427)	-0.016	(-0.141)
FWD	-0.266**	(-3.792)	0.166	(1.426)	-0.381**	(-2.790)
INFO	-1.058**	(-3.037)	-0.314	(-0.964)	-0.146*	(-1.603)
INFO×FWD	0.924**	(9.701)	-0.851**	(-4.274)	0.634**	(2.835)
Constant	36.314**	(3.986)	-4.455	(-0.525)	2.518**	(28.614)
N=2721	$R^2 = 88.7$		$R^2 = 3.9$		$\chi^2 = 50.59$	
Model Signif	0.0001		0.0001		0.0003	

Note: ** denotes significant at the 0.05 level and * denotes significant at the 0.10 level.

Table 3. Price Impacts, Elasticities, and Marginal Effects from the Price-Level, Price-Variance, and Weight Deviation Models.

	Price-Level	Price-Variance	Weight (optimal)	Weight (+25 lbs.)	Weight (+50 lbs.)
Spot w/o Info	Base	Base	Base	Base	Base
Forward w/o Info	-0.2660 (-0.0034)	(0.1660)	0.0903	0.0044	-0.0947
Spot w/ Info	-1.0580 (-0.0137)	(-0.3140)	0.0355	0.0011	-0.3650
Forward w/ Info	-0.4000 (-0.0052)	(-0.9990)	-0.0264	-0.0001	0.0265

Note: Figures in parentheses are elasticities.
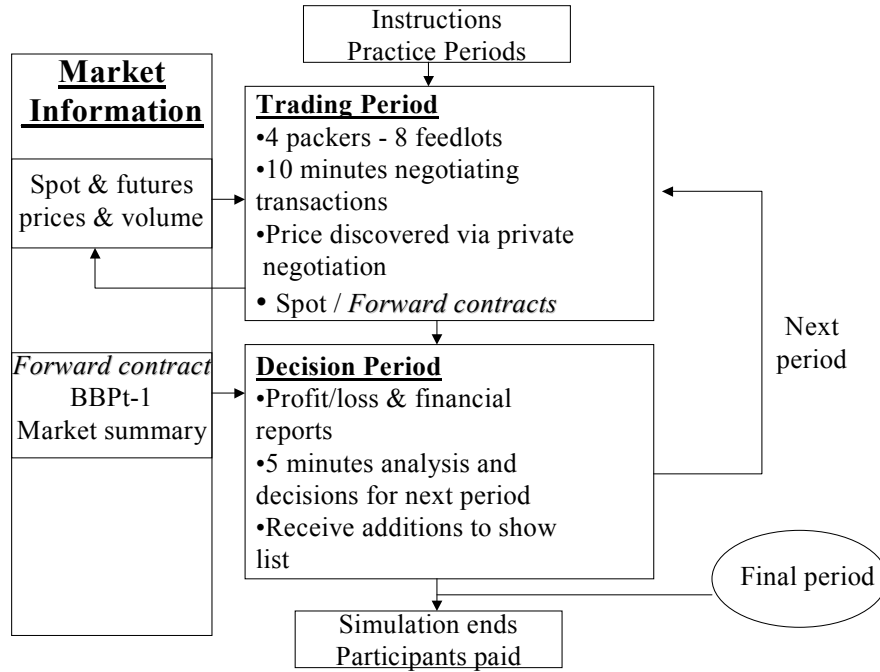
Figure 1. Organization of FCMS Trading Period