Prediction Markets: A Case Study of Forecasting Cattle on Feed

SES Seminar Series

February, 2010

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Abstract

Prediction markets are increasingly popular forecast tools given its flexibility and proven accuracy to forecast a diverse array of events. This study illustrates how prediction markets can be implemented to forecast the number of cattle on feed reported by the USDA. We created a market comprised of students who were asked to buy and sell contracts based on the accuracy of their beliefs for the number of cattle on feed to be reported by USDA on a future date. The market under-predicted by 1.6% the actual USDA number and did slightly worse than analysts' predictions which over-estimated it by 1%.

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Introduction

Prediction markets are becoming a widely used tool to predict outcomes as diverse as presidential election results, movie box office receipts, corporate earnings, and football scores. Prediction markets allow individuals to buy and sell, in an active market, contracts that pay money if an event occurs on or before a specified date. Probably the most well known prediction markets are the Iowa Electronic Markets, which are primarily used to forecast the outcomes of political elections. For example, people trade contracts that pay $1 if Candidate A wins and $0 if Candidate B wins. Participants in the market buy and sell the contracts depending on the expected success of each candidate. If the "going price" of the contract is $0.60, this indicates, under certain assumptions, a 60% chance that Candidate A will win the presidential election.

The rationale of prediction markets rests on the efficient market hypothesis, which posits that in a truly efficient market the price is the best predictor of the future event and on Hayek's (1945) insight that market prices reflect more information than is available to any individual trader. Berg and Rietz (2004) argue that prediction markets provide valid forecasts based on four claims: (1) the dynamic nature of forecasts, (2) the aggregation of information across traders through the price formation process, (3) empirical evidence that prediction markets' forecasts are unbiased and relatively accurate, and (4) the performance of prediction market forecasts compared with alternatives, such as polls, econometric models, and marketing surveys. Likewise, Hahn and Tetlock (2006) argue that prediction markets' accuracy is due to the aggregation of disparate pieces of information that occurs when experts trade among each other; something that is often missing with predictions from expert opinion or surveys. Although prediction markets (also referred to as betting markets or ideas markets) have only grown in popularity in recent years, they have a long history (see Rhode and Strumpf, 2004).

Several previous papers have shown the superior accuracy of prediction markets. For example, Berg, Nelson, and Rietz (2003) compared the results from traditional polls and prediction markets to forecast the winner for presidential elections in 1988, 1992, 1996, and 2000. On average, the poll predicted "wins" correctly 27% of the times whereas the accuracy rate for prediction markets was 73% (see also Forsythe et al., 1992). Pennock et al. (2001) described the use of prediction markets to assess probabilities of concern to the scientific community and policy makers and showed that prices from prediction markets accurately predicted whether particular scientific discoveries will occur in a given time period. Other studies have shown that prediction markets are successful in forecasting the outcome of football games (Servan-Schreiber et al., 2004), firm sales (Plott and Chen, 2002) and sales receipts from opening weekends of Hollywood movies (Wolfers and Zitzewitz, 2004).

On one hand, it might be argued that there is nothing particularly unique about prediction markets as applied to agriculture. After all, people have been trading commodity futures contracts for centuries. In a sense, futures markets are simply one kind of prediction market. The term prediction markets, however, is more encompassing in that it refers more broadly to the institutions that have arisen primarily for the purpose of trading beliefs about future outcomes (rather than commodities at future dates) for the purpose of prediction (rather than risk management). Moreover, prediction markets can be set up anywhere and on any scale and are not limited to the major exchanges in Chicago or New York. Seen in this light, there is a surprising dearth of applications of prediction markets to agricultural topics despite the wide range of important applications in which they could be employed: BSE, foot and mouth disease, soybean rust, agro-terrorism, etc. Information on the probability of these events would be extremely valuable, as it would allow producers and agribusinesses to prepare for the future and protect themselves against risk. Improved information on the likelihood of uncertain agricultural events would allow for the emergence of insurance for catastrophic events. At present, it is difficult for insurance markets to develop because probability assessments are too uncertain.

This paper presents a case study of a unique application of prediction markets to an agricultural topic that has received significant attention in the literature: forecasting the number of cattle on feed (COF). The USDA releases monthly reports indicating the number of cattle in U.S. feedlots. The information originates from surveys conducted by USDA's National Agricultural Statistics Service (NASS) among feedlots with at least 1,000 head of cattle in 17 major cattle feeding states. The information released in the cattle on feed report is widely anticipated by the livestock industry, market analysts, and futures traders because it allows estimating current and future slaughter cattle supplies which affect commercial beef production and prices (Mark and Small, 2007). Given the importance of this information, a number of companies provide pre-release estimates or forecasts of the USDA COF numbers. The methods used by these companies to derive the forecasts are, however, largely unknown, and the accuracy of such forecasts has been the subject of debate and research. Indeed, a former analyst who helped provided such forecasts on a subscription basis suggested that many times the forecasts were simply derived by making a couple of phone calls to large feedlots or by casual visual inspection of a few lots. Such anecdotes make one wonder whether there might be a more systematic method for forecasting COF.

This paper illustrates how prediction markets can be implemented in regards to an agricultural event and conveys results from our initial attempt to implement a prediction market to forecast the number of cattle on feed. Moreover, we show how prediction markets can be used to estimate a statistic usually left to the realm of time series econometrics: the elasticity of demand for fed cattle. The purpose of this paper is not to provide conclusive evidence on the efficacy of using prediction markets to forecast COF, but rather to spark thinking among agricultural economists on the promises and pitfalls of a research method that has been relatively underutilized in the agricultural economics literature. In this regard, we are responding to the recent call of the president of the Agricultural and Applied Economic Association to increase the use of tools other than econometrics (Mittelhammer, 2009).

Research about Cattle on Feed Reports

Several previous studies address questions related to the relationship between forecasts and USDA market reports, and the relationship between market reports and commodity prices. What follows is a discussion of some of these studies.

Grunewald, McNulty, and Biere (1993) tested whether cattle futures markets were efficient by analyzing the effect of private market forecasts (aggregated by Knight-Ridder) on futures prices. According to the efficient market hypothesis, a market is efficient if it responds only to unanticipated information. They assumed the Knight-Ridder survey data of market analysts' forecast conveyed anticipated information, whereas the difference between the USDA reported COF and the private forecasts was unanticipated information. Grunewald, McNulty, and Biere (1993) concluded that the private market forecasts were unbiased estimates of the actual USDA COF numbers and that at an aggregate level unanticipated changes in COF did not affect prices (i.e., the market was efficient). When analyzing disaggregated information contained in COF, however, they found that marketing and placement information significantly affected deferred contract prices, but that unanticipated information was absorbed as the price response disappeared by the second day after a COF release. These results were largely supported by the findings of Dhuyvetter, Schroeder, and Parcell (1997) who also used private forecasts of COF to study the efficiency of feeder cattle future markets. However, they found evidence that unanticipated information (i.e., the difference in forecasted and reported numbers) was already reflected in feeder cattle futures prices through live cattle markets.

USDA market reports are often revised after the initial dissemination. Because industry transactions are actually based on the revised numbers, several authors have analyzed the relationship between forecasted, initial and revised COF estimates. Schaefer, Myers and Koontz (2003) investigated the role that information collected by the private company, Professional Cattle Consultants (PCC) played in price discovery within the US live cattle futures market. PCC surveys feedlots and provides pre-release forecasts of the USDA COF report to its members, and ultimately becomes a component of the aggregated Knight-Ridder (KR) surveys. Schaefer, Myers and Koontz (2003), first tested whether Knight-Ridder forecasts are rational with respect to PCC data. Second, they tested whether live cattle futures prices are unbiased and efficient with respect to PCC information. Results revealed that initial estimates and Knight-Ridder survey values are biased and inefficient forecasts of final revised USDA numbers; hence, privately collected information added to surveys can be useful in improving forecasting performance. Mills and Schroeder (2004) investigated whether industry analysts anticipate USDA cattle on feed estimate revisions prior to their occurrence. In this context, revision is the difference between USDA initial report estimates and final values. Their analysis tested whether unanticipated information was associated with report revisions by regressing forecast error against revisions. Results revealed no correlation between forecast errors and revisions, suggesting no evidence that industry analysts have the ability to anticipate USDA revisions.

Carter and Galopin (1993) evaluated whether traders were willing to pay a premium for having *a priori* information. This willingness-to-pay was measured by potential profits (losses) traders can make by having earlier access to the information. They found that traders do not make significant profits by having earlier access to information contained in USDA reports; however, Colling and Irwin (1995) challenged this result on the bases of the level of risk aversion assumed in the original study. Using a different modeling approach, the Capital Asset Pricing model, Colling and Irwin (1995) demonstrated that traders can make significant profits by knowing USDA reports *a priori*.

Colling and Irwin (1990) studied the effect of anticipated and unanticipated information on hog futures markets. Knight-Ridder survey data were used as the anticipated information and the difference between market hog inventories and analysts' expectations was the unanticipated component. They found that survey data were unbiased and had no effect on live hog futures price changes, implying that information was already incorporated into prices before the release of USDA reports.

Mann and Dowen (1997) also measured the impact of Knight-Ridder forecasts on hog and pig futures prices and their accuracy with respect to USDA reports. They conducted three tests: (1) excess returns, (2) changes in price dispersion, and (3) changes in level of trading volume. They found that the forecasts were unbiased with respect to USDA actual reports. However, they found that although the market did respond to the actual USDA report, it did not respond to the Knight-Ridder forecasts, a finding they attribute to a lack of trader confidence in the Knight-Ridder forecast.

Frank, Garcia, and Irwin (2008) analyzed a variety of measures of unanticipated information available in forecasts and in initial and final USDA releases on hog futures prices. They found that initial USDA estimates (and also forecasts) are not rational estimates of final USDA revised reports. They also found that survey forecasts were irrational estimates of the USDA reports. While unanticipated information had small impacts on futures prices, the authors concluded that the USDA reports provide information to the market.

Based on the studies reported on both cattle and hog markets, one can conclude that pre-release forecasts and surveys can be, but are not always, good forecasts of initial USDA reports. The forecasts are less accurate with regard to the final USDA revised numbers. Also, the economic value of surveys is in question; having unanticipated information might or might not add to traders' welfare. *What about prediction markets? Would they be a better forecasting tool than surveys?* In this paper we set up a procedure to forecast COF with prediction markets and provide a case study application of the procedure.

Methods

Participants in the prediction market consisted of 23 students enrolled in an upper-level undergraduate course on futures markets in the spring of 2008.[1] Students traded contracts in markets held weekly over a nine-week period. Once a week beginning on February 13, 2008, participants were asked to buy and/or sell contracts based on their expectations about the number of COF in U.S. feedlots on April 1, 2008 (as reported by the USDA in a report released on April 18, 2008). Prior to the first trading session, market participants were orally instructed (and given an instruction booklet) on how to make money by buying and selling contracts, and how market prices would be determined each week. To motivate traders, the two students with the highest accumulated profits over the semester were given cash prizes, and a portion of the students' grades in the course were determined by their rank-order of profits accumulated over the nine week trading period. Traders were explicitly encouraged to seek out information on COF outside class and were given web links to several sources of information on COF reports.

The Contracts

Each week, three different contracts were traded. In this sub-section, we briefly describe each contract and the reasons why we included the contracts in our experiment. The following sub-sections describe how profits were made and how trading occurred.

The first contract was the simplest and was designed to provide the market's expectation of the number of COF released in the April 18 report. In particular, the first contract, which we refer to as the COF1 contract, was designed such that the value of the contract was equal to $1 for each 10,000,000 head of cattle on feed reported by the USDA-NASS on April 18, 2008. The market operated like a cash-settled futures contract. For example, if the number of COF on April 18 were 11.5 million, a buyer at 11.3 million would be paid $0.02 for each contract in their position, and by contrast a seller at 11.3 million would owe $0.02 for each contract sold. Of course, prior to that date traders did not know the actual number of COF on April 18 and thus, they bought and sold contracts based on their *expectation* of the number that would be released by the USDA.

As described by Wolfers and Zitzewitz (2004), prediction markets can be used to determine causality and how they can be used as a decision aid by offering a series of contracts that pay off based on one event that are contingent upon the occurrence of another event. Because of the previous literature showing the close relationship between COF and live cattle futures prices, we sought to investigate this relationship via the use of prediction markets rather than through the use of time-series data observing how past changes in COF related to changes in futures contracts. In particular, we offered two additional contracts whose values depended on the relationship between the number of COF released *and* the nearby live cattle futures price. The second contract traded, which we refer to as COF/CME/LO, was worth an amount equal to the June Chicago Mercantile Exchange live cattle futures settlement price (in dollars per pound) *if* the USDA-NASS reports the number of cattle on April 18 was between 10 and 10.5 million head, otherwise the contract was nullified. The third contract, COF/CME/HI, was similar to Contract COF/CME/LO with the difference that the number of cattle is in between 11.5 and 12 million head.

Because the supplies of feedlot cattle are fixed in the short-run, having traders anticipate the futures price under low and high potential supplies, we can identify the traders' implied expected slope of the demand curve for cattle. For example, figure 1 shows two possible supply curves associated with the mid-points of the COF/CME/LO and COF/CME/HI contracts. By observing the prices of the two contracts, the slope of the inverse demand curve can be calculated, i.e., the slope is: $s = (P^{10.25} - P^{11.75})/(10.25 \text{ million} - 11.75 \text{ million})$, where $P^{10.25}$ and $P^{11.75}$ are the respective observed prices of the COF/CME/LO and COF/CME/HI contracts. Accordingly, the elasticity of demand evaluated at the means can be calculated as: $(1/s)*[0.5*(P^{10.25} - P^{11.75})/(11 \text{ million})]$. Even though there is a high probability that these conditional contracts will not pay out, participants still have an incentive to bid their expected values.

How Profits Were Calculated and How Money Was Made in the Market

Based on the outcome of the event, i.e., the USDA report released on April 18th 2008, participants realized profits to the number of contracts bought/sold. For a COF1 contract bought and held until April 18th, profits for each contract purchased were *COF Value – Purchase Price.* If the contract was sold and held until April 18th, profits for each contract sold were *Sales Price – COF Value*. The *COF Value* was equivalent to USDA reported number of cattle on feed on April 18th divided by 10,000,000. Students were allowed to buy contracts in one week and sell contracts in a future week or vice versa. If a contract was bought/sold one week and the position was offset by selling/buying in a future week, profits from offsetting positions were equivalent to *Sales Price - Purchase Price.* Profits on all contracts not offset by April 18th were determined as previously explained.

To help traders learn how to make money buying and selling COF1 contracts, traders were encouraged to look at all the available information and come up with his/her "best guess" of the number of COF to be reported by the USDA by April 18th. We suggested that the number of contracts on which traders offered bids/asks should be positively related to how accurate they believed were their "best guesses." To make money buying contracts, traders were advised to buy contracts that were less than their "best guess" of the number of cattle on feed reported on April 18th divided by 10,000,000. Conversely, to make money selling contracts, traders were advised to try to negotiate COF1 contract prices higher than their "best guess" of the number of cattle on feed reported on April 18th divided by 10,000,000.

Traders were able to make profits buying and holding the COF/CME/LO contract only if the USDA reported number of cattle on feed on April 18th was between 10 and 10.5 million head. Under this condition, all contracts that were bought and held were worth: *April 18th Chicago Mercantile Exchange Live Cattle futures settlement price for the June 2008 contract in*

$/lb - Purchase Price of COF/CME/LO. If a contract was sold and the position was not offset, profits were: *Sales Price of COF/CME/LO – April 18th Chicago Mercantile Exchange Live Cattle futures settlement price for the June 2008 contract in $/lb* as long as the actual number of COF was between 10 and 10.5 million. Of course, traders could also buy contracts in one week and sell them in a future week or vice versa, and the profits earned/lost from offsetting such positions were simply *Sales Price - Purchase Price* when the final COF was in the specified range, but would otherwise be zero. As with the COF1 contract, traders were advised to come up with a "best guess" to help them determine bid and ask prices, where, in this case, the "best guess" was the nearby Chicago Mercantile Exchange live cattle futures price on April 18th if the reported number of COF was between 10 and 10.5 million. Profits made trading the COF/CME/HI contract were computed identical to COF/CME//LO, with the difference that the USDA reported number of cattle on feed for April needed to be between 11.5 and 12 million.

How Trade Took Place in the Market

The market mechanism used to determine the price of each contract in each week was a sealed bid uniform price auction. A uniform price auction refers to the fact that, for a particular contract in a given week, all traders faced the exact same price. Each week, trading took place as follows: (1) traders were given a decision sheet on which they indicated the number of contracts they wished to buy and/or sell along with the bid (what they were willing to pay) and/or asking (what they were willing to accept) price[2], (2) traders completed the decision sheet for each of the four contracts: COF1, COF/CME/LO, and COF/CME/HI, (3) all bids and asks were entered into a spreadsheet and the price that "cleared the market" was determined, and (4) the market prices, number of trades, and information on each individual trader's buy/sells was disseminated back to the traders.

For each contract, the "market clearing price" was the price that maximized the number of trades. This price was determined by plotting all bids for a contract from highest to lowest to construct a "demand curve," and ranking all asks for a contract from lowest to highest to construct a "supply curve." The market price was simply the point at which the constructed supply and demand curves intersected. If a participant's bid was greater than the market-clearing price, he/she purchased the number of units indicated on the decision sheet; if the bid was less than the market clearing price, no purchases were made by that trader. If a trader submitted an ask less than the market clearing price, he/she sold the number of units indicated on the decision sheet. If the ask was greater than the market clearing price, no sales were made for that trader. For each trader and contract, we created an "account," which tracked the number of contracts bought and/or sold, the prices at which the trades occurred, and any profits accrued from offsetting positions. Each trader was given his/her own account statements each week. At the end of the experiment (after April 18), total earnings for each student in the class were calculated by summing the account balances across each of the four traded contracts.

Results

Table 1 presents the primary results of the study. By April 16th, two days before the release of the USDA report, the market price for the COF1 contract was $1.15005, which indicates that the market expectation of the number of cattle on feed was a little over 11.5 million. Prices of the COF1 contract price did not vary much over the nine-week trading period, but there was a general decline in prices.[3] As shown in table 1 and as plotted in figure 2, there was a marked increase in the volume of trades that took place over the nine-week trading period, a finding that is likely attributable to the increased familiarity and confidence that traders acquired as they gained experience each week.

The last columns in table 1 show the prices and trade volume for the COF/CME/LO and COF/CME/HI contracts. There was greater variability in prices for these contracts as compared to COF1. Moreover, note that as shown in figure 1, we would expect the price of COF/CME/LO to exceed that of COF/CME/HI, and while this condition was violated in the initial weeks of trading, the relationship became as expected as experience was gained and as the volume of trades increased.

The obvious question is: *how accurate is the prediction market?* On April 18th, the USDA released the COF report, indicating that 11,684,000 head on feed on April 1. As shown in figure 2, it is clear that our prediction market *under*-predicted this outcome by about 183,500 head (11,684,000 - 11,500,500) or by about 1.57%. Is this a high or low level of accuracy? Figure 2 also shows the average of the pre-release forecasts, which was put at 11.795 million on April 16, 2008 (CME Group, 2008). Thus, the private market analysts *over*-predicted this outcome by about 111,000 head (11,684,000 - 11,795,000) or by about 0.95%. More generally, Dhuyvetter, Schroeder, and Parcell (1997) showed that the mean absolute deviation (in units of million head) between actual and analyst forecasted number of COF from 1980 to 1995 was 0.114 (with min and max of 0.001 and 0.510). In our particular case of the April 2008 forecast, the prediction market exhibited an absolute deviation (in million head) of 0.1835 and the absolute deviation of the analysts' forecasts was 0.111. Thus, the results seem to suggest that, in this particular one-shot case, the prediction market was less accurate than analysts' predictions, but not markedly so and is within the norms observed by historical standards of analyst accuracy.

Interestingly, the prediction market under-predicted actual COF whereas the analysts over-predicted actual COF. In this one case, combining the analyst predictions with the prediction market would have resulted in a very accurate prediction (within 0.3% of the actual value with absolute deviation of 0.04).

Also, live futures cattle settlement price on April 18, 2008 was $92.825 and one day after on April 19, it was $92.725. The variation from one day to the other was 0.11%, suggesting no market reaction to the USDA COF report for this particular release date.

Table 2 reports the implied elasticity of demand for fed cattle based on the market prices in the CME/COF/LO and CME/COF/HI. As can be evidenced, the implied elasticity estimates became much more rational and in line with expectations as trading progressed over time. In the final week of trading, an elasticity of demand of -12.24 was obtained. Results for the first two weeks do not follow the rational relation between quantities supplied and prices. The next two weeks predicted demand was perfectly inelastic and for the next five weeks demand was predicted to be elastic. The average estimate for price demand elasticity was -12.24 (flexibility of -0.08.[4] This flexibility is considerably higher than that obtained from most time-series econometric estimates. For example, Marsh (2003) estimated a flexibility of -0.69.

As a final investigation into the behavior of traders and performance of the markets, we look at the bid-ask spreads over time for each contract. Because each trader submitted bids and asks for each contract each week, we can calculate the within-trade bid-ask spread. The average bid, ask, and spread for each week is presented in table 3. The spreads are calculated as ask price minus bid price. As expected, participants were, on average, rational in asking higher and bidding lower. Spread variability across time is shown in figure 4. In general, spreads shrunk over time for the four contracts. Early in the experiment, COF1 spread was 0.12 and on the last day, 0.03.

Discussion and Conclusions

Prediction markets are a forecasting tool that is increasing in popularity. To date, however, agricultural economists have yet to utilize prediction markets despite a host of interesting and important topics to which they could be applied. The purpose of this paper was to present a case study of a unique application of prediction markets to a widely studied topic in agricultural economics in an effort to both introduce the research tool and begin a dialog about the merits of prediction markets.

During the spring 2008, we constructed a market comprised of student traders in which they bought and sold contracts whose value was contingent on the number of cattle on feed to be reported by the USDA on April 18, 2008. Three types of contracts were presented to the student to estimate/forecast the number of cattle on feed and the effect of increased numbers of cattle on feed on live cattle futures prices. Trading took place over a nine-week period using a uniform price sealed bid auction mechanism.

Our results suggest that the prediction market had some success, but that its performance was less than stellar. The prediction market prices forecasted that there would be 11.5 million head on feed, which was about 1.6% lower than the actual number of cattle on feed (11.684 million). The prediction market also fared slightly worse than analysts' predictions, which on average suggested there would be about 11.795 million head (an over-estimate of about 1%).

There is evidence that many of the traders were confused or misinformed, especially in early trading periods. For the first three trading weeks, prediction market prices suggested an "irrational" expectation that cattle prices would rise if cattle supplies increased. However, by the end of the experiment, this result reversed itself and suggested an own-price elasticity of demand for fed cattle of about -12.24, a figure that is much more elastic than most time-series estimates.

These results from our initial attempt to implement a prediction market suggest that it can be done and that traders appear to gain expertise over time. However, much more research is needed to determine the extent to which prediction markets are more or less accurate than other methods. Moreover, one might question whether we might expect the prediction markets to be accurate given the particular traders involved in the market: students. While it is not necessary to have people intimately knowledgeable of the market for a market to perform well (e.g., the Iowa Electronic Market accurately forecasted national election outcomes for years using only students and faculty at the University of Iowa), having participants with disparate beliefs and information is needed, as is the motivation to trade when one has increased confidence in their beliefs. Ideally, a prediction market on this topic would include traders such as feedlot owners, analysts who forecast the number of cattle on feed, academic livestock economists, and the like. Alas, attracting a large enough sample of such individuals to participate in a prediction market to attain market liquidity would be no small (or cheap) challenge.

More generally, Wolfers and Zitzewitz (2003) have discussed a variety of challenges with prediction markets including: (1) attracting uninformed traders whose motivation to participate in the market is non-economic, (2) mechanism design, (3) market manipulation by highly informed participants, (4) potential miscalibration due to difficulties in distinguishing between small probabilities, and (5) separating correlation from causation.

In regard to mechanism design, most of the commercial prediction markets in operation (e.g., see www.intrade.com) use an on-line form of a continuous open outcry auction, where buyers and sellers post bids and asks which can be accepted at any time by any other buyer or seller. Most of the experimental economics research suggests that such continuous auctions are more efficient than the one-shot uniform price auctions that we used in our class-room experiment (Smith, 1991). In our case, we chose the sealed bid uniform price because it should provide adequate market liquidity since all traders had to enter bids and asks at a particular time each week. Moreover, the time involved in submitting the bids and asks using the uniform price mechanism was minimal and was accomplished in a matter of a few minutes each week. By contrast, a continuous auction requires market participants to take the initiative to log into a central web site, for example, to observe the outstanding bids and asks and decide whether to transact. With such a mechanism, the trader has to continually re-visit the trading platform to remain engaged in the market. Such a continuous market mechanism is likely to be more effective given the larger the number of potential traders leading to an increased motivation to trade.

While our results suggest that prediction markets are no magic bullet, we are optimistic that the results and discussion presented will spark additional research on the merits of the approach. The potential applications for prediction markets in agricultural economics are virtually limitless. For example, given the findings by Frank, Garcia, and Irwin (2008) that initial USDA market reports are irrational estimates of the final USDA numbers, it might be useful to utilize prediction markets to forecast the *final*, revised USDA numbers rather than the *initial* release figures. Alternatively, one could construct a prediction market to forecast the likelihood that an initial estimate will ultimately be revised within a given time frame. Just as we constructed contracts to measure the effect of cattle on feed reports, future research could construct contracts to measure the effects of policies, such as passage of mandatory price reporting or country of origin labeling, or other events, such as a BSE outbreak, on cattle prices.

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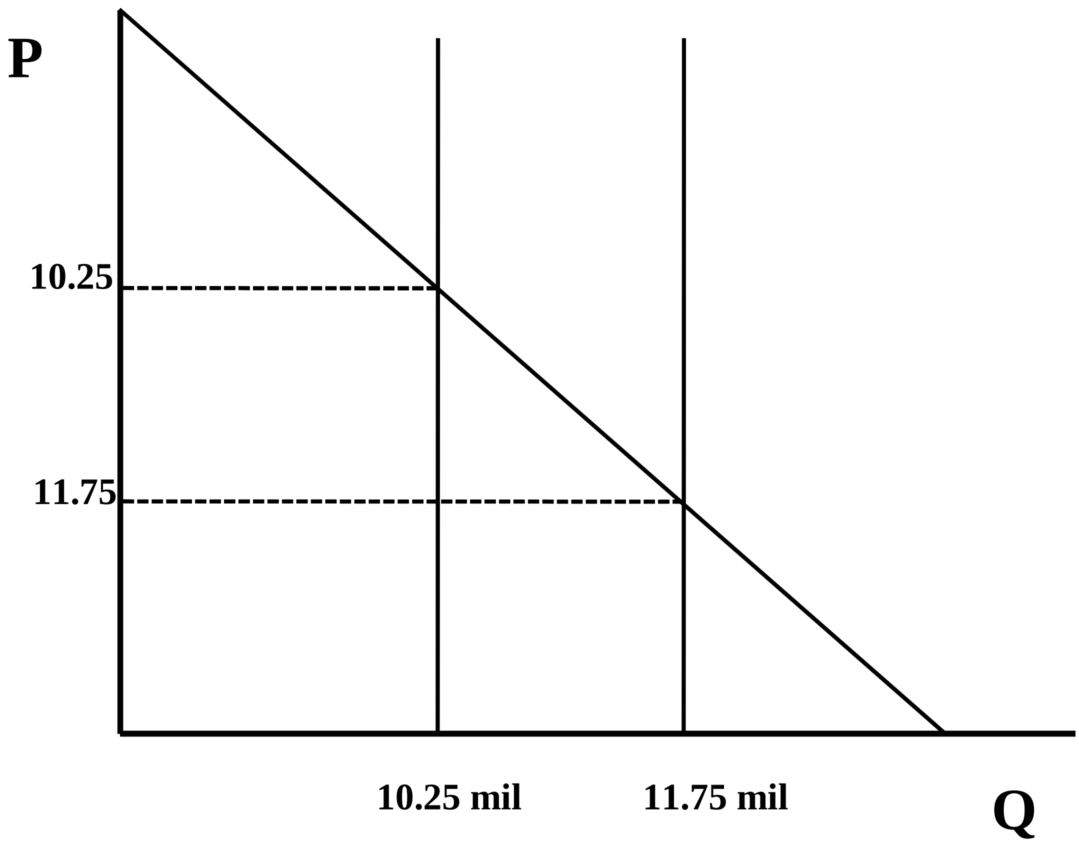

Figure 1. Effect of high and low cattle supplies on live cattle prices

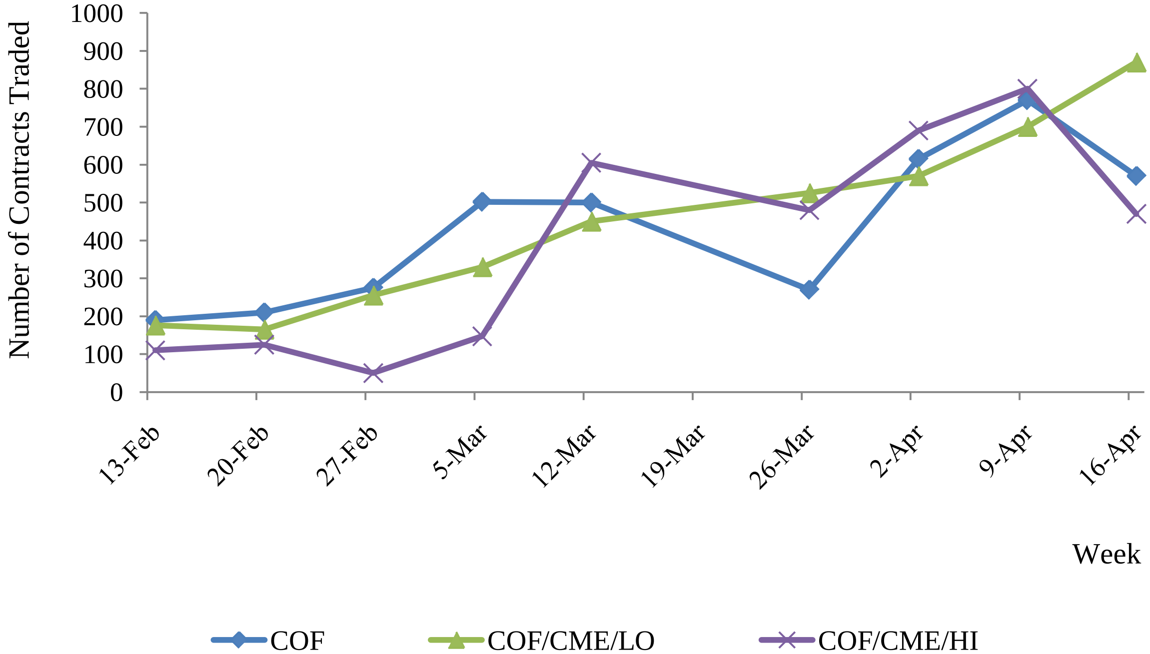

Figure 2. Volume of trade by contract over time

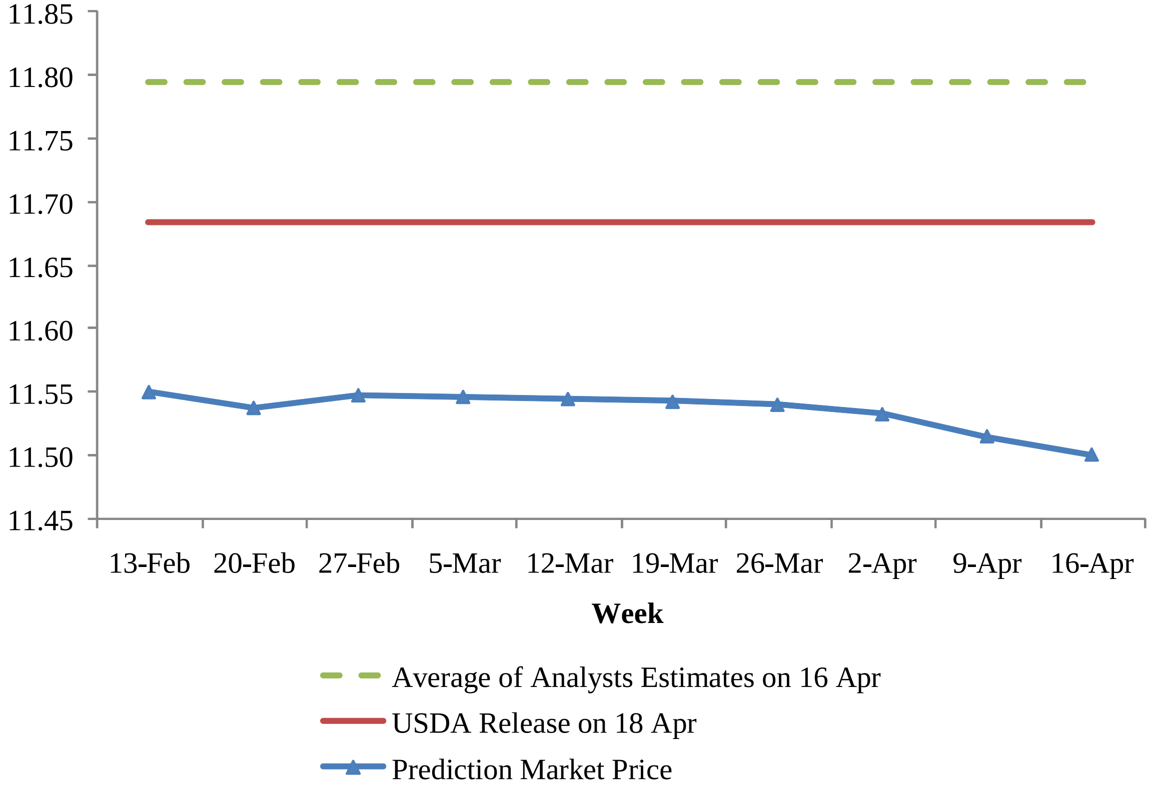

Figure 3. Predicted and actual number of cattle on feed

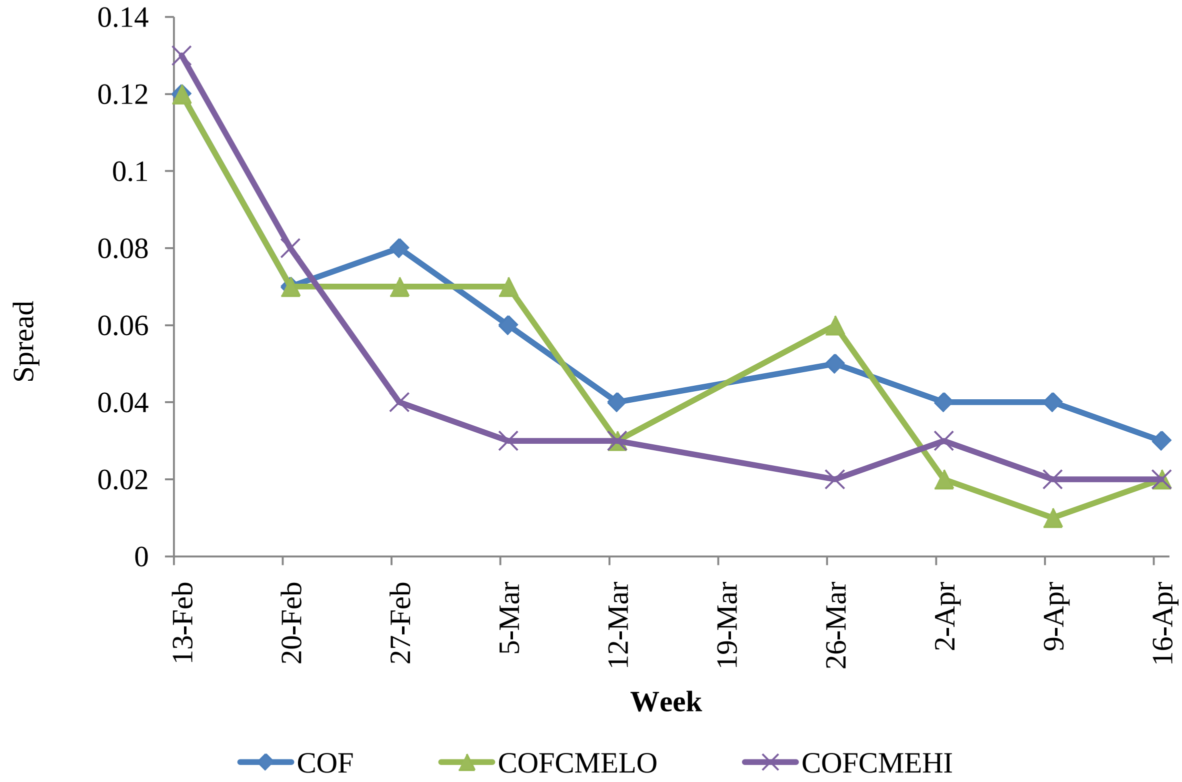

Figure 4. Spreads by contract over time

Table 1. Total number of transaction and market price for four types of cattle on feed prediction contracts

Week	COF1		COF/CME/LO		COF/CME/HI	
	Total Number of Transactions	Market Price ($)	Total Number of Transactions	Market Price ($)	Total Number of Transactions	Market Price ($)
Feb 13	190	1.15500	176	0.94500	110	0.95505
Feb 20	210	1.15375	165	0.94750	125	0.95000
Feb 27	275	1.15475	255	0.95000	50	0.95000
Mar 5	502	1.15462	330	0.95000	147	0.95000
Mar 12	500	1.15445	450	0.94735	605	0.94625
Mar 26	270	1.15400	525	0.94200	480	0.94000
Apr 2	615	1.15325	570	0.93400	690	0.92875
Apr 9	770	1.15150	700	0.93000	800	0.92000
Apr 16	570	1.15005	870	0.92525	470	0.91500
Average	434	1.15349	449	0.94123	386	0.93945
SD	205	0.00167	242	0.00921	283	0.01464

Table 2. Estimated price elasticity of demand inferred from prediction market prices

Week	Price Elasticity
Feb 13	12.48
Feb 20	50.19
Feb 27	--
Mar 5	--
Mar 12	-114.07
Mar 26	-62.74
Apr 2	-23.90
Apr 9	-12.55
Apr 16	-12.24

Table 3. Average bid and ask, spread for the cattle on feed prediction market experiment

Week	COF1			COF/CME/LO			COF/CME/HI		
	Bid ($)	Ask ($)	Spread	Bid ($)	Ask ($)	Spread	Bid ($)	Ask ($)	Spread
13-Feb	1.08	1.2	0.12	0.93	1.05	0.12	0.93	1.06	0.13
20-Feb	1.13	1.2	0.07	0.93	1.00	0.07	0.93	1.01	0.08
27-Feb	1.13	1.21	0.08	0.91	0.98	0.07	0.94	0.98	0.04
5-Mar	1.12	1.18	0.06	0.9	0.97	0.07	0.94	0.97	0.03
12-Mar	1.13	1.17	0.04	0.93	0.96	0.03	0.93	0.96	0.03
26-Mar	1.12	1.17	0.05	0.89	0.95	0.06	0.92	0.94	0.02
2-Apr	1.14	1.18	0.04	0.91	0.93	0.02	0.90	0.93	0.03
9-Apr	1.14	1.18	0.04	0.92	0.93	0.01	0.91	0.93	0.02
16-Apr	1.15	1.18	0.03	0.92	0.94	0.02	0.91	0.93	0.02
Average	1.13	1.19	0.06	0.92	0.97	0.05	0.92	0.97	0.04
SD	0.02	0.01	0.03	0.01	0.04	0.04	0.01	0.04	0.04

[1] A successful prediction market need not have traders that are representative of the population at large (e.g., the Iowa Electronic Markets forecasted election outcomes better than polls even though the market was only initially comprised of students at the University of Iowa); only that the traders have diverse opinions and are motivated to trade. Another important characteristic of panelists is that they be reasonably knowledgeable of the issues at hand; however, research suggests they need not be experts. In fact, experts often forecast worse than non-experts due to overconfidence, e.g., see the review in Surowiecki (2004). In any event, 78% of the students were male , 9% were juniors, 65% were seniors, and 26% were graduate students. Although 61% stated they had a farm background, 61% said they had a limited knowledge of the cattle industry and futures markets.

[2] Traders could make bids and/or asks on up to 100 contracts for each of the four contract types in each week.

[3] The participants appear to have used the futures market to develop their price expectations, but may have used past market equilibrium to develop expectations about COF.

[4] If one had a longer time series of prediction market prices for the COF1 contract, an alternative way to calculate the elasticity of demand would be to regress live cattle futures prices against the COF1 prices.