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# Regional Cattle Price Differences and Their Impact on CME Live Cattle Delivery Points

**Prepared For: The CME Group**

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# LIST OF EXHIBITS

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# Acronyms

| | |
|---|---|
| IEG | Informa Economics Group |
| CME | Chicago Mercantile Exchange |
| USDA | United States Department of Agriculture |
| MRP | Mandatory Price Reporting |



# Executive Summary

The CME Group recently proposed instituting a $1.50/cwt discount on live cattle futures deliveries tendered to the Worthing, SD delivery point during the month of October. The Exchange solicited comments and found that industry stakeholders had a number of concerns surrounding this proposal. Accordingly, the Exchange felt it would be useful to have an outside agency take a look at some of the major issues involved. This report contains the results of that study.

Task 1: Investigate regional price differences in the U.S. fed cattle market.

- USDA's five-area reports were used as a data source for this work.
- Spot (negotiated) prices in the IA/MN region are significantly lower than in other regions during the months of September, October and November. This result holds both when only live prices are considered and when both dressed and live prices are considered.

Task 2: Examine the impact of the Worthing delivery point on live cattle basis

- The basis during delivery months has become more negative since the addition of Worthing in August, 2009.
- The basis during delivery months has become less variable since the addition of Worthing.
- Hedging effectiveness has likely improved since the addition of Worthing.

Task 3: Compare the basis in each region with the volume of deliveries that have historically occurred

- Since becoming a delivery point, Worthing has seen an outsized share of deliveries.
- Many of these deliveries occur during the months when the basis in the region surrounding Worthing is weak in comparison to other regions.
- Worthing's ability to process more deliveries probably plays some role in this result, but basis levels are a more important driver.

Task 4: Provide an opinion on the likely material results if the discount were imposed.

- Many deliveries that would have been destined for Worthing would likely migrate to the Norfolk and Columbus points.
- The futures price will likely be higher relative to the cash market (weaker basis) in all regions.
- More deliveries will originate from other regions of the country, but these are not likely to offset the volume of lost deliveries at Worthing.
- The basis in all regions could become more variable during the October delivery period.
- The local cash price in the area surrounding Worthing would be largely unaffected.

Task 5: Provide an opinion on the likely impact on deliverable supplies

- The number of cattle within range of the delivery system will not change, so technically deliverable supply will be unaffected.
- The discount would reduce the number of cattle feeders that are both willing and able to participate in a futures delivery thus, from a practical perspective, the deliverable supply could be reduced.



## Background

The CME Group requested that Informa Economics IEG conduct a study of price differences for fed cattle in various regions of the U.S. as part of the due diligence surrounding the Exchange's recent proposal to apply a seasonal discount to live cattle futures deliveries occurring at the Worthing, SD delivery point in the month of October. This report details the results of that investigation. The CME Group understands that the performance of the live cattle futures market affects many diverse stakeholders and thought it prudent to seek an independent study to provide objective data on which to base its decision with respect to Worthing. Informa Economics IEG, formerly Sparks Companies, has been engaged in agricultural market research for nearly 40 years. The study team at Informa Economics IEG is deeply familiar with the livestock futures markets and understands well how important these markets are to both participants and non-participants alike. This report contains the results of our statistical work as well as our interpretations of the economic theory surrounding futures delivery points and seasonal price differentials.

## Data

The best price data in the U.S. fed cattle market originates from the U.S. Department of Agriculture's (USDA) mandatory price reporting (MPR) system. In April of 2001, USDA began collecting price information daily from beef packers who were required to report their transactions under the provisions of the Mandatory Price Reporting Act of 1999. These data are superior to other data sources in that beef packers who meet the reporting threshold (annual slaughter of at least 125,000 head) must report all fed cattle transactions thereby assuring that the aggregate prices reported under MPR are a true representation of the average transaction price in the fed cattle market. USDA gathers prices and aggregates them based on five separate regions of the country where the bulk of fed cattle are raised. These "five-area" prices are what were used in this study. The five regions are:

1. Colorado
2. Iowa/Minnesota
3. Kansas
4. Nebraska
5. Texas/Oklahoma/New Mexico

Exhibit 1 plots the five reporting areas along with the 13 live cattle delivery points. The data set runs from the onset of MPR in April, 2001 through the end of March, 2016. This study utilized monthly average prices from each of the five areas as reported on USDA's monthly negotiated regional direct slaughter cattle reports. [1] Prices originating from negotiated trade were singled out since they are most likely to representative the true spot market in a particular area. Many cattle are traded under formula or grid pricing arrangements and while USDA does report these under MPR they may differ from what is observed in the negotiated spot market due to a number of factors. The decision to use monthly average price data was driven by the need to deliver objective information that would answer the questions posed in this study with a minimal degree of complexity.

[1] Report identifiers are: LM_CT184 (Colorado), LM_CT185 (Iowa/Minnesota), LM_CT182 (Kansas), LM_CT183 (Nebraska), LM_CT181 (TX/OK/NM).



Cattle are a very heterogeneous commodity. Fed cattle have a wide array of attributes such as sex, grade, weight and breed that can have an influence on pricing. This complicates the price reporting function and results in a diverse set of prices being reported. This study focuses on the weighted average price for steers, in large part because for most of the period under study, only steers were deliverable against the futures contract. Within the steer category, we make use of the weighted average price for all grades of cattle traded. A wide range of quality grades of fed cattle are deliverable against the live cattle futures contract, with premiums and discounts applied for cattle that deviate from a par specification.

Perhaps the biggest challenge in conducting this study arose from the fact that fed cattle are traded and priced in both live and in carcass form. There are geographic preferences for pricing methods, with transactions in the Northern Plains often taking place on a dressed basis while transactions in the Southern Plains are primarily consummated on a live basis. Data from both pricing methods are reported in the five-area reports, but those data are often sparse for dressed transactions in the south and live transactions in the north. In order to fully represent pricing in any given area, it is best to convert prices from one method into prices for the other. Typically, dressed prices will be converted to live by multiplying the dressed price by the hot yield.[2] In practice this is process is hampered by the lack of hot yield data on the animals that were transacted on a dressed basis. Packers and producers may know the hot yield on animals that they processed or sold, but outside observers have no way to know this vital piece of information.

The par hot yield on the live cattle contact is 63% and this is a candidate for use in converting dressed prices to live. However, another way to estimate hot yield comes from past live cattle deliveries. A significant number of deliveries are carcass-graded and in the process data on hot yield is passed back to the Exchange's clearing house. The study team requested this data and then averaged it by delivery point and month. Exhibit 2 below provides below provides these aggregates from 2004-2015.

[2] Hot yield is calculated as pounds of carcass divided by pounds of live animal.



## Exhibit 1: Five Price Reporting Areas and the Current 13 Delivery Points

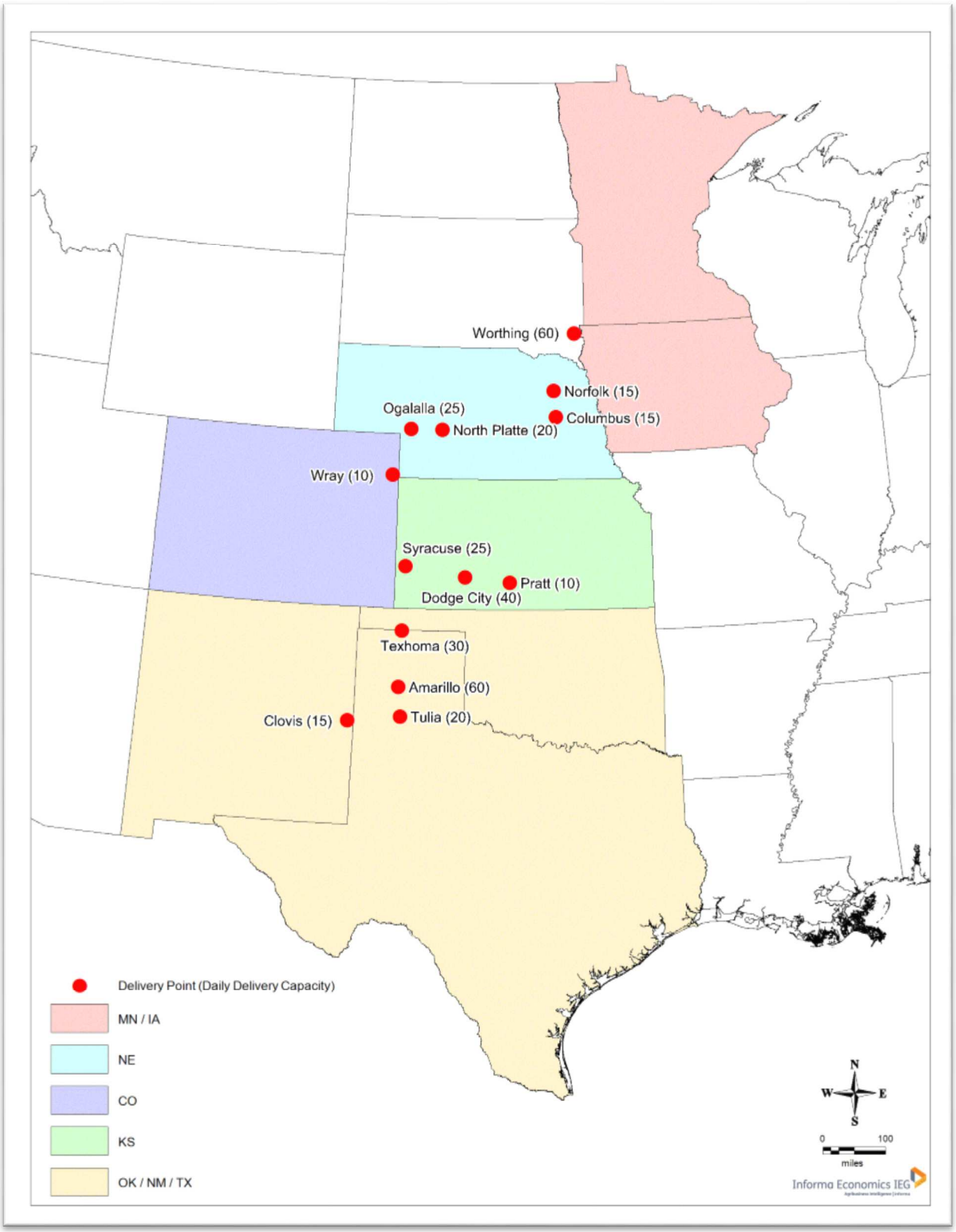


**Exhibit 2: Average Hot Yields From Carcass Graded Deliveries, 2004-2015.***

| | Amarillo, TX | Clovis, NM | Columbus, NE | Dodge City, KS | Guymon, OK | Norfolk, NE | Platte, NE | Ogallala, NE | Pratt, KS | Syracuse, KS | Texhoma, OK | Tulia, TX | Worthing, SD | Wray, CO | AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Feb** | 0.621 | | 0.619 | 0.629 | 0.628 | 0.625 | 0.628 | 0.625 | 0.621 | 0.629 | | 0.620 | 0.615 | 0.639 | **0.622** |
| **Apr** | 0.627 | | | 0.629 | 0.641 | 0.618 | | | 0.617 | 0.621 | 0.619 | 0.616 | 0.634 | | **0.623** |
| **Jun** | | 0.613 | | 0.623 | | 0.629 | 0.642 | 0.628 | 0.618 | 0.625 | | 0.626 | 0.643 | | **0.626** |
| **Aug** | 0.634 | 0.638 | | 0.619 | | 0.626 | 0.622 | | 0.633 | 0.631 | 0.631 | 0.636 | 0.631 | 0.625 | **0.631** |
| **Oct** | 0.626 | 0.627 | 0.629 | 0.634 | | 0.620 | 0.616 | | | 0.615 | | 0.625 | 0.632 | | **0.624** |
| **Dec** | 0.623 | | 0.634 | 0.620 | | 0.622 | | 0.626 | | 0.621 | | | 0.610 | 0.606 | **0.617** |
| **AVG** | **0.627** | **0.634** | **0.626** | **0.627** | **0.630** | **0.622** | **0.625** | **0.626** | **0.622** | **0.625** | **0.621** | **0.629** | **0.627** | **0.617** | **0.625** |

***Data from deliveries on the short-lived January live cattle contract are included in the February totals.**

Source: CME Group

While these data are not perfect for developing an estimate of hot yield in order to convert dressed prices, at least they are objective, unbiased and reflective of cattle delivered against the futures contract. A couple of insights emerge from this information. First, hot yields tend to be higher in the summer and lower in the winter. This makes sense because in the winter, particularly in the northern areas, cattle hides tend to be a bit thicker and thus heavier and cattle are much more prone to carry mud to slaughter. Both would work to reduce hot yield. Second, while there is some variability in yields by delivery point, the degree of variability is not huge. Average hot yield across all carcass-graded deliveries was 62.5%.

## Section 1: Comparison of Prices Across Regions

The objective in this first task is to determine if significant differences exist between cash prices in the five reporting regions. To do this, we first calculated the "blended price" in each region as the weighted average between live prices and dressed prices, where dressed prices were converted to live using an average hot yield of 62.5%. These data were then organized by month of the year and the difference between the averages was computed (Exhibit 3). For example, in Exhibit 3 for the month of January, the IA/MN average blended price was $0.175/cwt lower than the average blended price for the Colorado region. In all of these sub-tables the difference reported is computed by subtracting the row region price from the column region price.

Given the rather small samples involved, it is important to determine if these observed price differences are meaningful. There were 15 observations for each month (April 2001 through March 2016). The appropriate statistical process in this case is to test whether or not the price difference is equal to zero. The null hypothesis in this situation is that the prices in the two regions are the same. If the hypothesis is rejected, this is taken as evidence that the prices in the two regions are indeed different. The appropriate test statistic comes from the Student's t distribution with 14 degrees of freedom. Exhibit 4 gives the p-values from these t-tests. The p-value can be viewed as the probability that the null hypothesis (the price difference equals zero) is being incorrectly rejected. If the p-value is 0.05 or less, this is strong evidence that the observed price difference does not differ from zero merely due to chance and/or a small sample size. We have highlighted all p-values at or below 0.05 in Exhibit 4 in red.



Most of the statistically significant price differences are concentrated in September, October and November. In October, there is strong evidence that the blended price emanating from the IA/MN region is different from the prices in all other regions. In fact, in those months there is a clear split: prices in the two southernmost regions (TX/OK/NM & KS) are different from prices in the more northern regions (CO, NE, IA/MN).

While we believe the blended prices are the best way to compare price levels between regions, this approach does require use of an estimated hot yield that may or may not be representative of the actual hot yield for the cattle transacted. The results are sensitive to the hot yield assumed. For example, if the hot yield is raised to 63% instead of 62.5%, most of the p-values come out close to, but not below the 0.05 threshold. Given this intractable reliance on hot yield and its influence on the results, the study team ran the same analysis using only live prices. Exhibit 5 provides the live-only price differences and Exhibit 6 reports the associated p-values. Again, September, October and November are where the significant price differences arise. In October, live prices in IA/MN are significantly different from those in all other regions. Given the similarity of results from using both blended prices and live-only prices, we are confident that the results are robust and not an artifact of different selling methods or the assumed hot yield used in converting dressed prices to live.



## Exhibit 3: Blended Price Differences ($/cwt live), 62.5% Hot Yield, Column Minus Row

### January

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | -0.175 | | | |
| KS | -0.439 | -0.264 | | |
| NE | -0.103 | 0.072 | 0.336 | |
| TX/OK/NM | -0.755 | -0.580 | -0.316 | -0.652 |

### February

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.262 | | | |
| KS | -0.557 | -0.819 | | |
| NE | 0.162 | -0.099 | 0.720 | |
| TX/OK/NM | -0.764 | -1.026 | -0.207 | -0.927 |

### March

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.340 | | | |
| KS | 0.555 | 0.215 | | |
| NE | 0.140 | -0.200 | -0.416 | |
| TX/OK/NM | 0.588 | 0.248 | 0.032 | 0.448 |

### April

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | -0.175 | | | |
| KS | 0.505 | 0.680 | | |
| NE | -0.043 | 0.132 | -0.548 | |
| TX/OK/NM | 0.632 | 0.807 | 0.127 | 0.675 |

### May

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | -0.004 | | | |
| KS | 0.367 | 0.371 | | |
| NE | 0.093 | 0.097 | -0.274 | |
| TX/OK/NM | 0.391 | 0.395 | 0.025 | 0.298 |

### June

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.168 | | | |
| KS | 0.017 | -0.152 | | |
| NE | 0.174 | 0.005 | 0.157 | |
| TX/OK/NM | -0.265 | -0.433 | -0.281 | -0.438 |

### July

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.479 | | | |
| KS | 0.115 | -0.363 | | |
| NE | 0.145 | -0.334 | 0.029 | |
| TX/OK/NM | -0.149 | -0.628 | -0.265 | -0.294 |

### August

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 1.529 | | | |
| KS | 0.493 | -1.036 | | |
| NE | 0.786 | -0.742 | 0.293 | |
| TX/OK/NM | 0.229 | -1.300 | -0.264 | -0.557 |

### September

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 2.280 | | | |
| KS | -0.338 | -2.618 | | |
| NE | 1.267 | -1.013 | 1.605 | |
| TX/OK/NM | -0.085 | -2.365 | 0.253 | -1.352 |

### October

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 2.366 | | | |
| KS | -0.025 | -2.391 | | |
| NE | 1.372 | -0.994 | 1.397 | |
| TX/OK/NM | -0.379 | -2.746 | -0.354 | -1.751 |

### November

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 2.209 | | | |
| KS | 0.360 | -1.849 | | |
| NE | 1.295 | -0.913 | 0.936 | |
| TX/OK/NM | 0.116 | -2.093 | -0.244 | -1.180 |

### December

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.804 | | | |
| KS | 0.348 | -0.457 | | |
| NE | 0.577 | -0.227 | 0.229 | |
| TX/OK/NM | -0.081 | -0.885 | -0.429 | -0.658 |

Source: IEG calculations from USDA data

## Exhibit 4: P-values for Blended Price Differences, Column Minus Row (Red Indicates < 5%)

### January

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.431 | | | |
| KS | 0.332 | 0.404 | | |
| NE | 0.427 | 0.437 | 0.315 | |
| TX/OK/NM | 0.062 | 0.304 | 0.081 | 0.195 |

### February

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.397 | | | |
| KS | 0.290 | 0.228 | | |
| NE | 0.387 | 0.413 | 0.154 | |
| TX/OK/NM | 0.060 | 0.185 | 0.175 | 0.114 |

### March

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.368 | | | |
| KS | 0.291 | 0.421 | | |
| NE | 0.402 | 0.329 | 0.275 | |
| TX/OK/NM | 0.112 | 0.413 | 0.441 | 0.276 |

### April

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.431 | | | |
| KS | 0.308 | 0.267 | | |
| NE | 0.470 | 0.385 | 0.217 | |
| TX/OK/NM | 0.096 | 0.239 | 0.282 | 0.187 |

### May

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.498 | | | |
| KS | 0.358 | 0.367 | | |
| NE | 0.434 | 0.415 | 0.347 | |
| TX/OK/NM | 0.205 | 0.363 | 0.455 | 0.345 |

### June

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.433 | | | |
| KS | 0.493 | 0.445 | | |
| NE | 0.379 | 0.495 | 0.410 | |
| TX/OK/NM | 0.288 | 0.351 | 0.105 | 0.280 |

### July

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.317 | | | |
| KS | 0.454 | 0.369 | | |
| NE | 0.399 | 0.232 | 0.483 | |
| TX/OK/NM | 0.376 | 0.290 | 0.118 | 0.348 |

### August

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.072 | | | |
| KS | 0.312 | 0.174 | | |
| NE | 0.089 | 0.058 | 0.336 | |
| TX/OK/NM | 0.314 | 0.130 | 0.119 | 0.230 |

### September

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.018 | | | |
| KS | 0.368 | 0.014 | | |
| NE | 0.019 | 0.019 | 0.017 | |
| TX/OK/NM | 0.428 | 0.025 | 0.129 | 0.044 |

### October

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.015 | | | |
| KS | 0.490 | 0.021 | | |
| NE | 0.013 | 0.021 | 0.030 | |
| TX/OK/NM | 0.213 | 0.013 | 0.060 | 0.016 |

### November

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.021 | | | |
| KS | 0.360 | 0.053 | | |
| NE | 0.017 | 0.029 | 0.095 | |
| TX/OK/NM | 0.403 | 0.040 | 0.137 | 0.065 |

### December

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.214 | | | |
| KS | 0.365 | 0.338 | | |
| NE | 0.157 | 0.308 | 0.370 | |
| TX/OK/NM | 0.431 | 0.218 | 0.032 | 0.193 |

Source: IEG calculations from USDA data



## Exhibit 5: Live-Only Price Differences ($/cwt), Column Minus Row

### January

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.015 | | | |
| KS | -0.481 | -0.497 | | |
| NE | 0.103 | 0.088 | 0.584 | |
| TX/OK/NM | -0.768 | -0.783 | -0.286 | -0.871 |

### February

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.811 | | | |
| KS | -0.311 | -1.122 | | |
| NE | 0.396 | -0.415 | 0.707 | |
| TX/OK/NM | -0.455 | -1.266 | -0.144 | -0.852 |

### March

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.248 | | | |
| KS | 0.378 | 0.130 | | |
| NE | 0.090 | -0.157 | -0.287 | |
| TX/OK/NM | 0.475 | 0.227 | 0.097 | 0.384 |

### April

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | -0.359 | | | |
| KS | 0.387 | 0.745 | | |
| NE | -0.179 | 0.179 | -0.566 | |
| TX/OK/NM | 0.588 | 0.947 | 0.201 | 0.767 |

### May

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | -0.149 | | | |
| KS | 0.453 | 0.602 | | |
| NE | 0.124 | 0.273 | -0.330 | |
| TX/OK/NM | 0.561 | 0.709 | 0.107 | 0.437 |

### June

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | -0.458 | | | |
| KS | 0.023 | 0.481 | | |
| NE | 0.076 | 0.533 | 0.053 | |
| TX/OK/NM | -0.168 | 0.289 | -0.191 | -0.244 |

### July

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.056 | | | |
| KS | 0.339 | 0.284 | | |
| NE | 0.120 | 0.064 | -0.220 | |
| TX/OK/NM | 0.195 | 0.139 | -0.144 | 0.075 |

### August

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.722 | | | |
| KS | 0.548 | -0.174 | | |
| NE | 0.151 | -0.571 | -0.397 | |
| TX/OK/NM | 0.409 | -0.313 | -0.139 | 0.258 |

### September

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 1.527 | | | |
| KS | -0.148 | -1.674 | | |
| NE | 0.392 | -1.135 | 0.539 | |
| TX/OK/NM | 0.287 | -1.239 | 0.435 | -0.105 |

### October

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 1.902 | | | |
| KS | 0.323 | -1.579 | | |
| NE | 0.396 | -1.506 | 0.073 | |
| TX/OK/NM | 0.084 | -1.818 | -0.239 | -0.312 |

### November

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 1.689 | | | |
| KS | 0.697 | -0.993 | | |
| NE | 0.724 | -0.965 | 0.027 | |
| TX/OK/NM | 0.499 | -1.190 | -0.197 | -0.225 |

### December

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.357 | | | |
| KS | 0.530 | 0.172 | | |
| NE | 0.883 | 0.525 | 0.353 | |
| TX/OK/NM | 0.159 | -0.198 | -0.371 | -0.723 |

Source: IEG calculations from USDA data



## Exhibit 6: P-values for Live-Only Price Differences, Column Minus Row (Red Indicates < 5%)

### January

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.493 | | | |
| KS | 0.280 | 0.285 | | |
| NE | 0.368 | 0.449 | 0.094 | |
| TX/OK/NM | 0.046 | 0.194 | 0.120 | 0.060 |

### February

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.166 | | | |
| KS | 0.353 | 0.105 | | |
| NE | 0.103 | 0.272 | 0.058 | |
| TX/OK/NM | 0.151 | 0.086 | 0.273 | 0.064 |

### March

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.382 | | | |
| KS | 0.323 | 0.440 | | |
| NE | 0.383 | 0.409 | 0.254 | |
| TX/OK/NM | 0.142 | 0.400 | 0.342 | 0.239 |

### April

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.332 | | | |
| KS | 0.320 | 0.198 | | |
| NE | 0.279 | 0.396 | 0.101 | |
| TX/OK/NM | 0.094 | 0.150 | 0.202 | 0.084 |

### May

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.428 | | | |
| KS | 0.291 | 0.246 | | |
| NE | 0.343 | 0.345 | 0.224 | |
| TX/OK/NM | 0.104 | 0.216 | 0.327 | 0.211 |

### June

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.290 | | | |
| KS | 0.489 | 0.291 | | |
| NE | 0.402 | 0.219 | 0.451 | |
| TX/OK/NM | 0.349 | 0.373 | 0.213 | 0.325 |

### July

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.473 | | | |
| KS | 0.340 | 0.372 | | |
| NE | 0.348 | 0.462 | 0.305 | |
| TX/OK/NM | 0.327 | 0.438 | 0.273 | 0.444 |

### August

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.193 | | | |
| KS | 0.254 | 0.421 | | |
| NE | 0.311 | 0.203 | 0.182 | |
| TX/OK/NM | 0.176 | 0.363 | 0.281 | 0.316 |

### September

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.040 | | | |
| KS | 0.429 | 0.035 | | |
| NE | 0.106 | 0.056 | 0.111 | |
| TX/OK/NM | 0.255 | 0.090 | 0.042 | 0.423 |

### October

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.017 | | | |
| KS | 0.348 | 0.043 | | |
| NE | 0.104 | 0.020 | 0.433 | |
| TX/OK/NM | 0.424 | 0.029 | 0.161 | 0.282 |

### November

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.027 | | | |
| KS | 0.201 | 0.132 | | |
| NE | 0.015 | 0.085 | 0.475 | |
| TX/OK/NM | 0.130 | 0.098 | 0.206 | 0.338 |

### December

| | CO | IA/MN | KS | NE |
|---|---|---|---|---|
| CO | | | | |
| IA/MN | 0.332 | | | |
| KS | 0.261 | 0.421 | | |
| NE | 0.005 | 0.222 | 0.209 | |
| TX/OK/NM | 0.357 | 0.412 | 0.067 | 0.096 |

Source: IEG calculations from USDA data



## Section 2: Basis Considerations

One of the primary functions of the live cattle futures contract is risk transfer. This applies to commercials involved in the cattle and beef industry who, through the normal course of business, are exposed to price risk and utilize the live cattle futures as a tool to reduce that risk. These companies and individuals are commonly referred to as hedgers and they are often engaged in anticipatory hedging, which involves using the live cattle futures as a substitute for a transaction they anticipate to consummate later on. In order for the hedging activity to be successful, these hedgers need to be assured the net price resulting from an anticipatory hedge is very close to what they expect at the time the hedge is initiated. This will happen as long as there is a tight and predictable relationship between the cash price they are exposed to and the live cattle futures price at the time they exit the hedge. This relationship between the cash price and the futures price is commonly referred to as the basis and is calculated by subtracting the futures price from the cash price. Cattle feeding operations are perhaps the largest group of commercials that utilize live cattle futures for hedging purposes. These businesses place young (feeder) cattle into feedyards and, after a five or six month finishing period, sell slaughter-ready (live) cattle to processors. Once cattle are placed in feedyards, the business owners (cattle feeders) are exposed to the risk that, by the time the feeding period has ended, the cash price of live cattle may have declined to a level that creates a serious financial hardship on the business. Hedging that future sale of cash live cattle with a futures contract is an important way to mitigate that risk.

It is important to recognize that ***it is uncertainty in the basis, not the absolute level of the basis***, that degrades the hedging function. For example, if a cattle feeder expects his local cash price at the time the cattle are sold to be -$1 (cash $1 less than futures), but it actually turns out to be -$10, then the hedge has performed poorly because the net price he receives for the cattle will be far different from what he expected when the hedge was placed. It is a common misperception that the basis needs to be near zero for a hedge to be successful. This is not true. The basis merely needs to be highly predictable. If the basis in a cattle feeder's local cash market is almost always -$5, then he can factor this into his hedge calculations and enjoy a successful hedge as long as when he goes to sell the cattle this basis is not far different from the -$5 he expected when the hedge was placed. Given importance of basis variability to successful hedging, it is proper to place more emphasis on basis variability than on absolute basis levels.

In this task, the IEG team looked at fed cattle basis performance with the aforementioned concepts in mind. To accomplish this, we first calculated the basis in each of the six delivery months for each cash marketing region. The futures price used was the monthly average settlement price of the expiring live cattle futures contract. Exhibit 7 through Exhibit 12 below provide the basis in each region from April 2001 through February 2016, with the mean and standard deviation calculated for the years before Worthing became a delivery point and the years after. To test whether or not the basis has become more variable (unpredictable) since Worthing was added, a test for equality of variances in the two periods was conducted. The appropriate test involves the F-distribution and the last line in each table reports the



p-value from this test. Values less than or equal to 0.05 are taken to indicate significant differences in basis variability between the two periods.

**Exhibit 7: Monthly Average Basis, February ($/cwt.)**

| | CO | IA/MN | KS | NE | TX/OK/NM |
|---|---|---|---|---|---|
| 2001 | | | | | |
| 2002 | -1.71 | -1.80 | -1.71 | -1.89 | -1.88 |
| 2003 | -0.97 | 0.43 | -0.97 | -0.51 | -1.26 |
| 2004 | -4.31 | -5.29 | -3.80 | -4.89 | -3.20 |
| 2005 | 2.81 | 2.71 | 2.74 | 3.00 | 2.61 |
| 2006 | 2.93 | 1.37 | 1.58 | 2.69 | 1.15 |
| 2007 | 6.41 | 6.22 | 6.19 | 6.49 | 5.97 |
| 2008 | -2.09 | -3.78 | -1.82 | -3.03 | -1.77 |
| 2009 | 2.89 | 3.16 | 1.98 | 3.49 | 1.65 |
| 2010 | -1.29 | -2.84 | -0.45 | -1.87 | -0.67 |
| 2011 | 2.16 | 2.25 | 2.66 | 2.38 | 2.50 |
| 2012 | -2.09 | -4.92 | -0.95 | -3.12 | -1.16 |
| 2013 | -1.30 | -1.70 | -1.84 | -1.59 | -1.75 |
| 2014 | -2.95 | -4.85 | -1.76 | -3.61 | -1.50 |
| 2015 | -0.51 | -0.39 | -0.93 | -0.39 | -0.70 |
| 2016 | -4.08 | -7.33 | -3.74 | -6.11 | -3.11 |
| Pre-Worthing Mean: | 0.74 | 0.38 | 0.52 | 0.67 | 0.41 |
| Post-Worthing Mean: | -1.44 | -2.82 | -1.00 | -2.04 | -0.91 |
| Pre-Worthing Std Dev: | 3.55 | 3.83 | 3.20 | 3.85 | 3.02 |
| Post-Worthing Std Dev: | 1.98 | 3.21 | 1.94 | 2.67 | 1.72 |
| P-value for variance difference:* | 0.088 | 0.342 | 0.121 | 0.194 | 0.096 |

* Red indicates statistically significant at the 5% Level.

Source: IEG calculations from USDA and CME data



**Exhibit 8: Monthly Average Basis, April ($/cwt.)**

| | CO | IA/MN | KS | NE | TX/OK/NM |
|---|---|---|---|---|---|
| 2001 | 0.70 | 1.00 | 0.55 | 0.86 | -0.23 |
| 2002 | -0.13 | -0.65 | -0.37 | -0.65 | -0.55 |
| 2003 | -0.05 | 2.09 | 0.08 | 1.12 | 0.77 |
| 2004 | -3.60 | -4.00 | -2.93 | -4.02 | -2.58 |
| 2005 | 2.23 | 2.25 | 1.43 | 1.86 | 1.33 |
| 2006 | 3.32 | 5.54 | 1.33 | 3.47 | 0.51 |
| 2007 | 2.61 | 3.72 | 2.62 | 3.60 | 2.40 |
| 2008 | -2.34 | -4.90 | -1.73 | -3.45 | -1.74 |
| 2009 | 1.32 | 2.66 | 1.80 | 2.11 | 1.54 |
| 2010 | -2.36 | -3.47 | -1.31 | -2.81 | -1.40 |
| 2011 | 1.17 | 1.32 | 0.96 | 0.78 | 1.36 |
| 2012 | -1.61 | -3.62 | -0.71 | -2.26 | -0.46 |
| 2013 | 0.05 | 0.42 | -0.34 | 0.10 | -0.32 |
| 2014 | -3.10 | -6.54 | -2.32 | -4.94 | -2.06 |
| 2015 | 0.09 | 0.50 | -0.53 | 0.84 | -0.74 |
| 2016 | | | | | |
| | | | | | |
| Pre-Worthing Mean: | 0.45 | 0.86 | 0.31 | 0.54 | 0.16 |
| Post-Worthing Mean: | -0.96 | -1.90 | -0.71 | -1.38 | -0.60 |
| | | | | | |
| Pre-Worthing Std Dev: | 2.28 | 3.46 | 1.77 | 2.75 | 1.60 |
| Post-Worthing Std Dev: | 1.65 | 3.11 | 1.09 | 2.33 | 1.16 |
| | | | | | |
| P-value for variance difference:* | 0.247 | 0.425 | 0.150 | 0.372 | 0.248 |

* Red indicates statistically significant at the 5% Level.

Source: IEG calculations from USDA and CME data



**Exhibit 9: Monthly Average Basis, June ($/cwt.)**

| | CO | IA/MN | KS | NE | TX/OK/NM |
|---|---|---|---|---|---|
| 2001 | 3.36 | 3.54 | 2.91 | 3.36 | 2.61 |
| 2002 | -1.60 | -1.24 | -2.42 | -1.27 | -2.55 |
| 2003 | 3.39 | 4.25 | 3.30 | 3.53 | 3.31 |
| 2004 | -3.60 | -5.31 | -3.27 | -4.21 | -3.34 |
| 2005 | 5.45 | 5.73 | 5.33 | 5.39 | 5.16 |
| 2006 | 5.50 | 6.71 | 4.85 | 6.01 | 4.76 |
| 2007 | 4.63 | 4.92 | 3.91 | 4.44 | 3.72 |
| 2008 | -0.97 | -3.08 | 0.54 | -1.67 | 0.53 |
| 2009 | 3.17 | 3.25 | 3.70 | 3.01 | 3.81 |
| 2010 | -0.67 | -2.96 | -0.85 | -1.78 | -1.01 |
| 2011 | 1.92 | 1.91 | 2.10 | 1.58 | 1.98 |
| 2012 | -0.09 | -2.04 | 0.50 | -0.93 | 0.95 |
| 2013 | 2.63 | 3.01 | 4.21 | 2.80 | 4.29 |
| 2014 | -2.08 | -4.91 | -1.58 | -3.56 | -1.83 |
| 2015 | -0.47 | -0.94 | -0.95 | -0.87 | -0.01 |
| 2016 | | | | | |
| | | | | | |
| Pre-Worthing Mean: | 2.15 | 2.09 | 2.09 | 2.07 | 2.00 |
| Post-Worthing Mean: | 0.21 | -0.99 | 0.57 | -0.46 | 0.73 |
| | | | | | |
| Pre-Worthing Std Dev: | 3.34 | 4.23 | 3.12 | 3.56 | 3.11 |
| Post-Worthing Std Dev: | 1.75 | 2.99 | 2.21 | 2.30 | 2.21 |
| | | | | | |
| P-value for variance difference:* | 0.086 | 0.230 | 0.234 | 0.176 | 0.234 |

* Red indicates statistically significant at the 5% Level.

Source: IEG calculations from USDA and CME data



**Exhibit 10: Monthly Average Basis, August ($/cwt.)**

| | CO | IA/MN | KS | NE | TX/OK/NM |
|---|---|---|---|---|---|
| 2001 | 0.66 | 2.06 | 0.51 | 1.24 | 0.67 |
| 2002 | -1.59 | -1.68 | -1.75 | -1.75 | -1.95 |
| 2003 | 0.46 | 0.56 | 0.78 | 0.56 | 0.97 |
| 2004 | -2.31 | -3.33 | -1.94 | -2.88 | -1.55 |
| 2005 | 3.22 | 2.26 | 2.72 | 2.12 | 2.66 |
| 2006 | 0.49 | 0.95 | -1.40 | 1.35 | -0.78 |
| 2007 | 0.98 | 0.86 | 1.04 | 0.74 | 1.22 |
| 2008 | -2.87 | -3.29 | -0.95 | -2.46 | -0.85 |
| 2009 | -0.38 | -0.77 | 1.07 | -0.33 | 1.52 |
| 2010 | -0.33 | 0.23 | -0.87 | 0.02 | -0.43 |
| 2011 | -0.54 | -1.10 | 0.88 | -0.97 | 1.19 |
| 2012 | -1.12 | -2.14 | -0.83 | -1.49 | -0.53 |
| 2013 | -1.23 | -1.72 | 0.69 | -1.97 | 0.95 |
| 2014 | -1.59 | -2.14 | -0.83 | -2.28 | -0.24 |
| 2015 | -1.39 | -1.91 | -1.39 | -2.05 | 0.06 |
| 2016 | | | | | |
| | | | | | |
| Pre-Worthing Mean: | -0.12 | -0.20 | -0.12 | -0.14 | 0.05 |
| Post-Worthing Mean: | -0.94 | -1.37 | -0.18 | -1.29 | 0.36 |
| | | | | | |
| Pre-Worthing Std Dev: | 2.01 | 2.26 | 1.64 | 1.93 | 1.58 |
| Post-Worthing Std Dev: | 0.51 | 0.87 | 1.02 | 0.89 | 0.84 |
| | | | | | |
| P-value for variance difference:* | 0.002 | 0.017 | 0.133 | 0.040 | 0.073 |

* Red indicates statistically significant at the 5% Level.

Source: IEG calculations from USDA and CME data



**Exhibit 11: Monthly Average Basis, October ($/cwt.)**

| | CO | IA/MN | KS | NE | TX/OK/NM |
|---|---|---|---|---|---|
| 2001 | -2.56 | -1.21 | -2.90 | -1.67 | -3.11 |
| 2002 | -4.38 | -4.13 | -4.57 | -4.27 | -4.35 |
| 2003 | -2.97 | -3.03 | -1.93 | -2.98 | -1.51 |
| 2004 | -3.68 | -4.31 | -2.67 | -4.17 | -2.37 |
| 2005 | 2.94 | 2.62 | 2.45 | 2.69 | 2.25 |
| 2006 | 2.31 | 2.92 | 2.93 | 3.19 | 3.00 |
| 2007 | -1.40 | -1.77 | -1.02 | -1.70 | -0.64 |
| 2008 | -1.39 | -1.28 | -0.10 | -1.48 | -0.07 |
| 2009 | -0.36 | -0.63 | 1.07 | -0.13 | 1.28 |
| 2010 | -2.11 | -2.10 | -0.91 | -2.26 | -0.51 |
| 2011 | -2.98 | -4.24 | -3.21 | -3.69 | -3.16 |
| 2012 | -5.11 | -4.40 | -4.40 | -4.62 | -3.45 |
| 2013 | -3.51 | -4.47 | -1.83 | -3.72 | -1.53 |
| 2014 | -1.08 | -0.98 | 0.17 | -0.71 | 0.45 |
| 2015 | -0.96 | -2.41 | -1.86 | -1.78 | -1.28 |
| 2016 | | | | | |
| | | | | | |
| Pre-Worthing Mean: | -1.39 | -1.27 | -0.98 | -1.30 | -0.85 |
| Post-Worthing Mean: | -2.30 | -2.75 | -1.57 | -2.42 | -1.17 |
| | | | | | |
| Pre-Worthing Std Dev: | 2.68 | 2.76 | 2.62 | 2.84 | 2.54 |
| Post-Worthing Std Dev: | 1.68 | 1.64 | 1.88 | 1.67 | 1.75 |
| | | | | | |
| P-value for variance difference:* | 0.136 | 0.111 | 0.218 | 0.109 | 0.191 |

* Red indicates statistically significant at the 5% Level.

Source: IEG calculations from USDA and CME data



**Exhibit 12: Monthly Average Basis, December ($/cwt.)**

| | CO | IA/MN | KS | NE | TX/OK/NM |
|---|---|---|---|---|---|
| 2001 | -1.96 | -1.19 | -1.74 | -1.25 | -1.72 |
| 2002 | -2.46 | -2.55 | -1.82 | -2.37 | -1.81 |
| 2003 | -2.52 | -2.19 | -2.07 | -2.20 | -1.73 |
| 2004 | -2.70 | -3.22 | -0.67 | -2.64 | -0.31 |
| 2005 | 1.15 | 0.46 | 0.28 | 1.21 | -0.03 |
| 2006 | 2.13 | 1.89 | 1.92 | 1.64 | 1.19 |
| 2007 | -0.78 | -2.11 | -1.05 | -1.37 | -0.70 |
| 2008 | -2.02 | -2.57 | -1.31 | -2.35 | -1.28 |
| 2009 | -0.55 | -1.25 | -0.34 | -0.69 | -0.06 |
| 2010 | -2.66 | -2.15 | -1.82 | -1.96 | -1.50 |
| 2011 | -1.10 | -3.25 | -1.49 | -2.11 | -1.24 |
| 2012 | -4.17 | -3.24 | -3.30 | -3.79 | -2.97 |
| 2013 | -1.30 | -2.41 | -0.55 | -2.00 | -0.35 |
| 2014 | -1.35 | -0.76 | -0.60 | -0.73 | -0.19 |
| 2015 | -2.79 | -3.45 | -3.08 | -3.33 | -2.50 |
| 2016 | | | | | |
| | | | | | |
| Pre-Worthing Mean: | -1.14 | -1.44 | -0.81 | -1.17 | -0.80 |
| Post-Worthing Mean: | -1.99 | -2.36 | -1.60 | -2.09 | -1.26 |
| | | | | | |
| Pre-Worthing Std Dev: | 1.84 | 1.75 | 1.33 | 1.68 | 1.05 |
| Post-Worthing Std Dev: | 1.26 | 1.05 | 1.21 | 1.17 | 1.15 |
| | | | | | |
| P-value for variance difference:* | 0.191 | 0.116 | 0.417 | 0.202 | 0.593 |

* Red indicates statistically significant at the 5% Level.

Source: IEG calculations from USDA and CME data

Some important patterns emerged from this analysis. First, it is clear that in nearly all regions and months, the basis became more negative post-Worthing. Second, variability in the basis was reduced after Worthing was added although we can claim statistical significance for this finding only in the month of August for the NE, CO and IA/MN regions. Moreover, the results suggest that the addition of Worthing did not result in a more unpredictable basis in any region/month combination. As a result, ***performance of the live cattle futures contract as a hedging tool for cattle feeders is no worse following the addition of Worthing and is likely better.***



## Section 3: Delivery Concentration

Another important element in this study was to examine the concentration of live cattle futures deliveries by region and relate these to the basis in each region. First, we report the number of deliveries that were tendered to each of the 13 delivery points since August, 2009 when Worthing was added. Next, we group delivery points by price reporting region. Finally, a comparison of the number of deliveries tendered versus the basis in each region is presented.

Exhibit 13 below provides the breakdown of all deliveries tendered since August, 2009 by delivery point. Just over half of all deliveries have been tendered to Worthing, with Norfolk being the next popular delivery location with around 15% of the total.

**Exhibit 13: Distribution of Deliveries by Delivery Point (in contracts)**

| | Amarillo, TX | Clovis, NM | Columbus, NE | Dodge City, KS | Norfolk, NE | North Platte, NE | Ogallala, NE | Pratt, KS | Syracuse, KS | Texhoma, OK | Tulia, TX | Worthing, SD | Wray, CO | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Aug-09** | 83 | | | 42 | 46 | 1 | | | 3 | 5 | 26 | 117 | 5 | **328** |
| **Oct-09** | | | 11 | | 343 | 2 | | | | | | 760 | | **1116** |
| **Dec-09** | | | | | 10 | | | | 38 | | | 25 | 4 | **77** |
| **Feb-10** | | | | | 18 | | | | | | | 16 | 7 | **41** |
| **Apr-10** | 5 | | | | 4 | | | | | | | 8 | | **17** |
| **Aug-10** | | | | | | | | | | | | 120 | | **120** |
| **Oct-10** | | | | | 3 | | | | | | | 51 | | **54** |
| **Dec-10** | | | | 15 | | | | | 15 | | | 48 | 15 | **93** |
| **Feb-11** | | | 29 | 24 | | | | 5 | 2 | 5 | 17 | 6 | 17 | **105** |
| **Jun-11** | | | | 8 | | | | | | | | 7 | | **15** |
| **Aug-11** | | | | 12 | | | | | | | 18 | | | **30** |
| **Oct-11** | | | | | | | | | | | | 80 | | **80** |
| **Feb-12** | | | | 12 | | 10 | | | | | 5 | 55 | 20 | **102** |
| **Aug-12** | | | | 11 | 58 | | | | | | 20 | 90 | | **179** |
| **Oct-12** | | | | | 12 | | | | | | | 47 | | **59** |
| **Dec-12** | | | | 140 | 14 | | | 4 | 158 | 3 | 3 | 43 | 17 | **382** |
| **Feb-13** | | | | 50 | 16 | | | 3 | 4 | | | 88 | | **161** |
| **Apr-13** | | | | | | | | | | | | 15 | | **15** |
| **Jun-13** | | 15 | | | | | | | | | 26 | | | **41** |
| **Aug-13** | 88 | 40 | | 9 | | | | | | | 45 | | | **182** |
| **Oct-13** | 10 | | | | | | | | | | | 35 | | **45** |
| **Feb-14** | | | | 2 | | | 10 | | | | 4 | 11 | | **27** |
| **Apr-14** | 9 | | | 17 | | | | | | | | | | **26** |
| **Aug-14** | | | | | | | | | | | | 6 | | **6** |
| **Oct-14** | | | | | | | | | | | | 21 | | **21** |
| **Jun-15** | | | | | | | | | 3 | | | | | **3** |
| **Aug-15** | | | | | | | | | | | | 39 | | **39** |
| **Oct-15** | | | 20 | 13 | 31 | | | | 4 | | | 143 | | **211** |
| **Dec-15** | | | | 16 | | | | | 1 | | 25 | 23 | | **65** |
| **Total:** | **195** | **55** | **60** | **371** | **555** | **13** | **10** | **12** | **228** | **13** | **189** | **1854** | **85** | **3640** |
| **Percentage:** | **5.4%** | **1.5%** | **1.6%** | **10.2%** | **15.2%** | **0.4%** | **0.3%** | **0.3%** | **6.3%** | **0.4%** | **5.2%** | **50.9%** | **2.3%** | **100%** |

Source: CME Group

Conceptually, the number of deliveries tendered in a particular price reporting region, depends upon at least two factors. The first is the amount of delivery capacity in the region which is related to the number of delivery points. The second is the basis in that price region. The 13 delivery points were assigned to price reporting regions based on their location within that region. The exception is Worthing, which does not technically fall within the boundaries of any of the five price reporting regions. However, Worthing is located very near the border of the IA/MN region and so we assign it there. The delivery point to price reporting mapping is given in Exhibit 14.



**Exhibit 14: Delivery Point Mapping to Price Reporting Regions.**

| Price Reporting Region | Associated Delivery Points |
|---|---|
| CO | Wray |
| IA/MN | Worthing |
| KS | Dodge City, Pratt, Syracuse |
| NE | Columbus, Norfolk, North Platte, Ogalalla |
| TX/OK/NM | Amarillo, Clovis, Texhoma, Tulia |

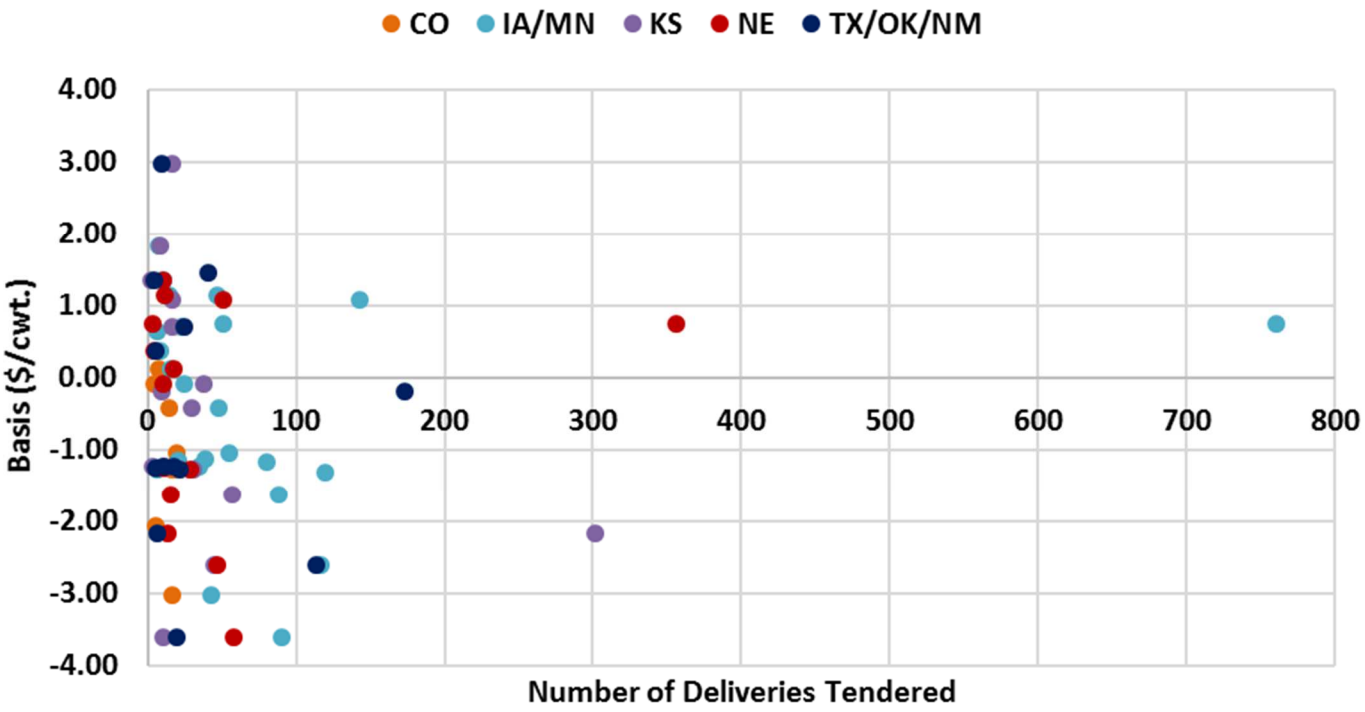
Source: Informa Economics IEG

Exhibit 15 plots the number of deliveries tendered relative to the basis for all 74 delivery month/reporting region combinations in which deliveries occurred since August, 2009. No discernable pattern emerges from this exercise, perhaps because of the monthly average nature of the data. It is possible, for example, that the basis is very negative in a region early in the month and a large number of deliveries get tendered. Then, as the month progresses, the basis becomes significantly more positive (perhaps due to the earlier deliveries) thus the month as a whole could show a large number of deliveries while the monthly average basis ends up being relatively strong (cash strong relative to futures). Theoretically, we would expect that more deliveries would get tendered in the regions where price is the lowest (i.e., basis is the weakest). This is consistent with the well-known "cheapest-to-deliver" theory of futures delivery. This theory is based on the idea that shorts will deliver to the location where the cash commodity price is the lowest because this is the action that will return the greatest financial reward.

In an attempt to get better clarity, the analysis was performed on weekly data with the results presented in Exhibit 16. Here there is some evidence of an inverse relationship between the basis and the number of deliveries tendered, but the relationship is not strong. One likely cause for this is that in reality when a producer tenders for delivery, he is probably using his forecast of what the basis will be in the week following tender, since that is the week in which the cattle will actually be delivered and it is that week's cash-futures relationship that should drive the decision. If his forecast is incorrect, then he may wind up delivering under a basis situation that does not warrant it.

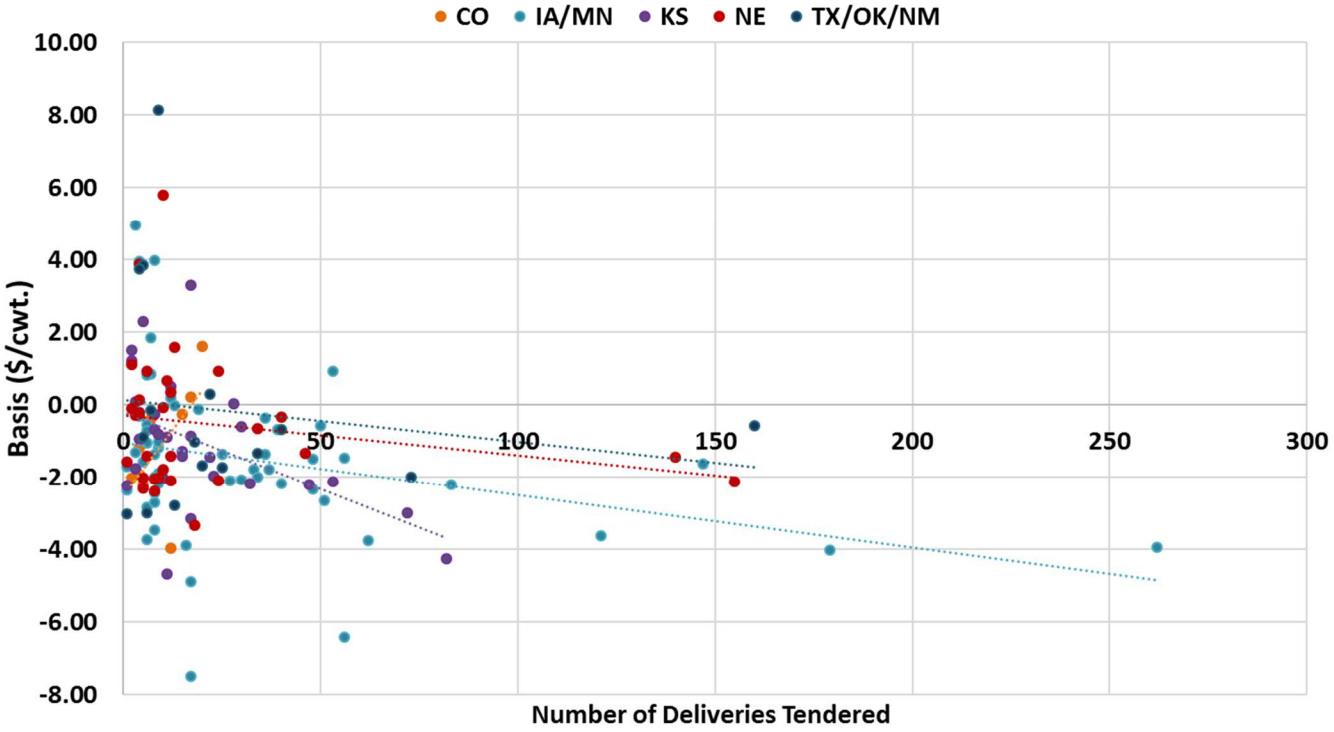


## Exhibit 15: Number of Deliveries vs. Basis, Monthly Data




Source: IEG calculations from USDA and CME data

## Exhibit 16: Number of Deliveries vs. Basis, Weekly Data




Source: IEG calculations from USDA and CME data

## Section 4: The Proposed $1.50 Discount on Worthing

The CME Group has proposed instituting a $1.50 cwt discount on all deliveries tendered to the Worthing delivery point during the month of October. In this section we consider the economic consequences of such an action, drawing on the team's experience with U.S. cattle markets, both cash and futures. Of course, it is impossible to know with certainty what will occur as a result of this change ahead of time, but we will offer our informed opinion of the likely outcome. First, it is useful to state some important facts as we have come to understand them:

1. The stockyard facility at Worthing, SD is one of the better facilities in the live cattle delivery system. This facility is newer and larger than most and is capable of processing more deliveries per day than many of the other 12 facilities.

2. Cash cattle prices in the IA/MN region that borders on Worthing are significantly lower than in other regions during the months of September, October and November. This flows from the price analysis in Task 1.

3. The basis in all regions appears to be better behaved (more predictable) since Worthing was added as a delivery point. This comes out of the work presented in Task 2.

The decision to initiate the delivery process lies in the hands of the seller as long as the contract is still trading. Economic theory suggests that the decision to deliver can be explained largely by financial incentives. Cattle feeders are economic agents and their actions are heavily influenced by expected financial outcomes. During a delivery period, any cattle feeder in possession of finished cattle that are ready to move to slaughter faces a decision. He may sell those cattle in his local cash market or tender them for delivery against the futures contract. If he does not have an existing position, he only needs to sell the futures during a trading session and then tender for delivery after the close on the same day. So, the option to deliver is always open. Thus, the decision often boils down to a comparison of the net price that he might reasonably expect to receive by selling in the cash market versus the net price he might reasonably expect to receive by going through the delivery process. The process may sound simple, but it is actually a very complicated decision problem. In addition to the base price offered by the futures and the local cash market, there are a number of other important variables that must be considered:

- The probability that the receiving long will request a carcass-graded delivery
- The estimated quality grade, yield grade and hot yield relative to the futures contract specifications and the expected premiums or discounts for each in both a futures delivery as well as from selling in the cash market.
- Transportation costs associated with both options.
- Likely cattle shrink resulting from both options.



- The number of "out cattle" in a delivered load (dark cutters, low graders, over- or under-weight carcasses, etc.) and the penalty for each under both options.
- And, importantly, the risk that the delivering short errs in estimating of any of the above.

A $1.50 discount on cattle tendered to Worthing in October will affect these calculations by lowering the net price resulting from a futures delivery by that amount. All else equal, it will discourage producers from tendering to Worthing during October. However, the nearby Norfolk, NE delivery point is only 125 miles south of Worthing and Columbus, NE is 168 miles south of Worthing. Further, Norfolk's approved packing plants contain all of those listed for Worthing. Columbus and Worthing share three approved packing plants. If a cattle feeder believes that there is a high probability that the receiving long will request a carcass-graded delivery, then it is very likely that he will incur no additional transportation cost from tendering to Norfolk (or possibly Columbus) instead of Worthing. Thus, there would be strong financial incentive for producers who would have normally tendered to Worthing to tender to Norfolk or Columbus instead. However, CME Rule 10104 requires that any seller wishing to tender for delivery must make sure that the delivery point stockyards can accommodate the delivery. This is where a potential problem arises. Both Norfolk and Columbus can only handle 15 loads of delivery cattle per day each, while Worthing is rated for 60 loads a day. This could limit cattle feeders' ability to tender for delivery at Norfolk or Columbus, even if the producer expects that the long will request a carcass-graded delivery at one of the approved packing plants. In essence, the $1.50 discount should shift deliveries toward Norfolk and Columbus, but the "funnel" is smaller in these locations and so it is likely that fewer deliveries are tendered during October from that region of the country.

A reduction in the ability to deliver from an area of the country where cash prices are clearly lower than in other regions will cause the futures price to be higher than it would be otherwise. And, a higher futures price should help to trigger deliveries from other areas of the country. So the discount applied to Worthing during October would likely have the effect of generating deliveries in other areas thus the cash-futures convergence should not be materially affected assuming that there are sufficient producers in other areas that are ***willing and able*** to become involved in the delivery process. This is where a second potential problem exists. A larger percentage of cattle in the southern delivery areas are priced via formula arrangements and are thus committed to be transferred to a pre-determined packer. Exhibit 17 provides a look at the number of cattle transacted via spot negotiation (uncommitted) compared to the number sold under other arrangements such as formula, grid or forward pricing (committed) during the first five months of 2016.



**Exhibit 17: Committed vs. Uncommitted Direct Transactions Through May 23, 2016**

| | Uncommitted (Hd) | Committed (Hd) | Pct Uncommitted |
|---|---|---|---|
| CO | 66,952 | 509,926 | 11.6% |
| IA/MN | 432,499 | 426,048 | 50.4% |
| KS | 467,932 | 1,238,020 | 27.4% |
| NE | 720,390 | 1,032,542 | 41.1% |
| TX/OK/NM | 128,518 | 1,667,946 | 7.2% |

Source: USDA MPR Direct Slaughter Cattle Dashboard

Clearly, a higher percentage of the cattle in the norther regions (IA/MN, NE) are uncommitted than in other regions. Looking at October specifically, the same data were collected for the month of October, 2015 and are presented in Exhibit 18. The same result holds: northern regions hold a larger percentage of uncommitted cattle. The lower proportion of uncommitted cattle in the three other regions could make futures delivery from these areas more difficult and producers in these regions might not be able to step up their delivery activity simply because they do not have a sufficient number of uncommitted cattle in order to do so.

Since Worthing was added in 2009, the delivery point has averaged 162 deliveries in October. Assuming 32 head per load, this amounts to 5,184 head of delivery cattle. The question then becomes, "How hard would it be for other regions to come up with 5,000 head of uncommitted cattle for deliveries during October?" Exhibit 18 indicates that in October 2015, the three other regions held roughly 84,000 head of uncommitted cattle and so it would be technically feasible during an "average" October delivery period. However, in October, 2009 there were 760 loads tendered to Worthing and this amounts to a little over 24,000 head of cattle. Months like October, 2009 create a much greater need for uncommitted cattle to be available to ensure convergence. Thus, for most October delivery periods it should not be much of a stretch for other regions to make up the shortfall in delivery activity resulting from a discount on Worthing. However, occasionally the cash-futures relationship will require a much larger delivery commitment than the southern regions may be able to fill. This raises the possibility that cash-futures convergence could be harmed after a $1.50 discount reduces deliveries in the Worthing region and other areas of the country do not participate enough to offset the loss of deliveries from Worthing.

All else equal, this also puts upward pressure on the futures price during October. It is fairly safe to assume that, should the discount be imposed, the futures price during October would be higher than if there were no discount at Worthing. On the surface, some cattle feeders might cheer a higher futures price, thinking that this would have the effect of raising their local cash price. While we recognize that in some situations the futures market does influence cash prices, inside a delivery period it is more likely to just make the basis weaker (futures higher relative to cash). This would be harmful to short hedgers. Cattle feeders who are hedged will not cheer a weaker basis.



**Exhibit 18: Committed vs. Uncommitted Direct Transactions in October, 2015**

| | Uncommitted (Hd) | Committed (Hd) | Pct Uncommitted |
|---|---|---|---|
| CO | 8,703 | 118,761 | 6.8% |
| IA/MN | 106,021 | 107,576 | 49.6% |
| KS | 56,681 | 241,644 | 19.0% |
| NE | 142,928 | 286,497 | 33.3% |
| TX/OK/NM | 19,467 | 334,158 | 5.5% |

Source: USDA MPR Direct Slaughter Cattle Data Mart

Finally, we consider the impact on cash prices in the area around Worthing in October if the discount is enacted. Since we expect a net decline in the number of cattle disposed of through the futures delivery process (fewer deliveries tendered to Worthing, but more to Norfolk and possibly Columbus) in the IA/MN region, this would leave more cattle to be marketed in the local cash market. How many is uncertain, but if we use the average number of delivery cattle tendered to Worthing, (5,000 head) and assume that Norfolk and Columbus will attract half of those, this leaves about 2,500 head more that will move through the local cash market. Theoretically, larger cash market supplies should translate to a lower price, all else equal. However, it is also reasonable to expect packer demand for cattle in the region to increase since packers in the area will be procuring fewer cattle via the futures delivery process and thus will have to look to the negotiated market to make up the difference. Increased packer demand for cattle should theoretically raise the cash price. Net, net these two effects should be largely offsetting and thus ***it is reasonable to expect little or no material impact on negotiated cash prices in the IA/MN region.*** Even if the supply effect dominated the demand effect, the resulting price decline would probably be very small given the relatively small number of cattle affected.

To summarize, we expect the following to result from a $1.50 discount on cattle tendered to Worthing during October:

1. Fewer deliveries tendered to Worthing
2. More deliveries tendered to Norfolk and possibly Columbus
3. More deliveries tendered in other areas of the country
4. Fewer overall deliveries due to a high proportion of committed cattle in other regions
5. A higher futures price and weaker basis
6. Potentially, a more variable basis
7. Little or no impact on cash prices in the IA/MN region

## Section 5: The Effect on Deliverable Supply

The supply of cattle available to be used in the delivery process is very important to the health of the live cattle contract. Too few cattle available for delivery makes it difficult for shorts to force convergence



between the cash and futures price and increases the potential for a market squeeze. Position limits are also very dependent upon the size of deliverable supply. Therefore, it is important to consider how the proposed $1.50 discount on Worthing during October might affect deliverable supply.

The proposed discount will not change the number of cattle physically located around the 13 delivery points in any way. Thus, it is easy to conclude that the discount will not affect deliverable supply in a technical sense. It is this technical sense that the Exchange uses when it is calculating deliverable supply for the purpose of justifying position limits. Normally, this involves using government survey data to estimate the number of fed cattle within a reasonable transportation distance to any of the 13 delivery points. Nothing about the proposed discount will change this calculation and thus technically there would be no impact on deliverable supply.

Informa believes that the Exchange should also be concerned about ***practical*** deliverable supply. This is defined as the number of cattle held by producers who are both ***willing and able*** to participate in the delivery process in any given time period. The discount on Worthing would almost certainly make fewer producers in that area of the country willing to participate in the delivery process simply because it will reduce their net price resulting from a delivery compared to the net price from their local cash market. However, the resulting higher futures price should increase the number of producers willing to deliver in other areas because it will make futures delivery financially more attractive relative to the local cash market alternative. But, just because more producers should be willing to deliver does not mean that they will be able to do so. If the bulk of their cattle are committed to a particular packer under a formula pricing arrangement, they may not be able to become more involved in the delivery process.

Moreover, the Worthing facility is capable of handling at least 60 deliveries per day, a significantly higher delivery capacity than the next closest delivery points, Columbus and Norfolk. Accordingly, even if the economic incentives are aligned and cattle feeders have uncommitted cattle to deliver, the delivery system itself may discourage some deliveries from occurring. Since we believe that the discount on Worthing will require greater participation from other areas of the country in order to achieve the same degree of convergence, practical deliverable supply will be unaffected only if there is a similar percentage of uncommitted cattle in those regions. Exhibits Exhibit 17 and Exhibit 18 indicate that this is clearly not the case. The discount would shift the delivery burden away from areas that have a high percentage of uncommitted cattle to areas that have a lower percentage. Thus, it is reasonable to conclude that practical deliverable supply would decrease to some degree in October if the discount on Worthing is enacted. Whether or not this change would be large enough to have a material impact on basis levels or basis variability is difficult to discern prior to the implementation of the discount.

## Summary

This study has focused on several issues surrounding the CME Group's recent proposal to impose a $1.50/cwt discount on cattle delivered to the Worthing, SD delivery point during the month of October. There has been a high degree of concern about this proposal from the industry since it was announced



and so we hope that this study helps to clarify, through a combination of data analysis and economic thinking, some of these issues. The important findings from this study are as follows:

1. Negotiated cash cattle prices are lower during the fall months in the IA/MN region near the Worthing delivery point relative to other major cattle feeding regions.
   This result was tested statistically and the results are robust.

2. The basis has become more negative in all regions since the introduction of the Worthing delivery point.

3. The basis appears to have become less variable since Worthing was added, although this result is statistically validated only for the month of August.

4. Worthing has seen an outsized share of deliveries, particularly in the October contract which coincides with the time of year when price levels there are lower than in other regions of the country.

5. Imposition of the discount will discourage deliveries to Worthing during October but will provide a financial incentive for producers in the area to shift deliveries to the Norfolk and Columbus delivery points.

6. The futures price for the October contract during its delivery period will be higher than it would be otherwise if the discount is imposed.

7. The higher futures price is likely to spur more deliveries at other delivery points.

8. Other regions have a lower percentage of uncommitted cattle available for delivery and thus the delivery gains in other regions may not offset the losses in Worthing.

9. As deliveries shift to other regions, the lower percentage of uncommitted cattle in those regions may result in fewer overall deliveries and a more variable basis in all regions as a result.

10. Local cash prices during October in the Worthing area are unlikely to be materially affected by the change, but the basis in that area and all other areas will become weaker as a result of the increase in the futures price.

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