Understanding the Market for Holstein Steers

By

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Abstract

A semi-structured interview process was combined with an econometric analysis to document the newly changed structure of the Holstein sector, to evaluate existing quality perceptions, and to assess the impact that recent changes in production practices have had on prices of Holstein steers. Results suggest that finished Holstein steer prices are driven by many of the same market factors as native steers, overturning some common quality misconceptions. The shift towards the calf-fed production model appears to have greatly affected the market for backgrounded Holstein steers, but had little impact on the prices for light Holstein feeder steers.

Background, Motivation, and Objectives

The Holstein beef market is a fascinating and integral part of the beef supply chain. It has been estimated that there are approximately 3.73 million Holstein steers born in the United States each year (estimated from Buhr, 1996). Despite accounting for approximately 10% of the United States calf crop, Holstein steers have been largely overlooked in academic research. The primary motivation behind this study is to develop an understanding of, and document the driving forces that are active in, the markets for Holstein feeder steers and finished steers.

Beef from Holstein steers has always suffered from perceptions of poor quality. The Holstein beef market is seen by many industry outsiders primarily as a ground beef market similar to that of cull cows. It is not clear how this perception started, but there are a few possibilities. First, many plants that slaughter Holstein steers also slaughter cull cows, however, the meat is separated and sold in different market channels (van Lannen, Kohlbeck). Also,

Holstein trimmings were used in the past to upgrade trimmings from cull cows (Tritle). Whatever the reason, recent evidence is changing the poor quality perception associated with beef from Holstein steers.

Another major trend in Holstein production has been the shift towards a calf-fed production model. Traditionally, Holstein steers have been backgrounded to heavy feeder weights of 800 to 1000 pounds and then placed on full feed. The result was an extremely heavy carcass between 1400 and 1800 pounds. Cuts of meat from these carcasses were simply too large for many retail and foodservice markets. In order to keep portion size at industry standard levels, steaks were being sliced extremely thin. The calf-fed model was started in response to this concern (van Lannen).

In a calf-fed system, calves are placed on feed directly after weaning weighing between 300 and 400 pounds. Although calf-feds may be on feed for a longer period of time, the backgrounding stage is eliminated completely. By placing a younger, smaller calf on feed, the resulting carcass is lighter, usually between 1200 and 1400 pounds. More importantly, the cuts are similar in size to what has become commonplace in the industry (Chester-Jones).

The most documented example of a calf-fed production is system is Ralph's California Beef program. In an effort to respond to quality concerns expressed by consumers, Ralph's Grocery Company created a vertically coordinated production system to supply beef for their retail meat departments. After evaluating several breeds of cattle for the system, Holstein steers were chosen for their consistency, tenderness, and high yields. Calves are finished in feedlots in Southern California and harvested at Sunland Beef in Tolleson, Arizona according to the guidelines set forth in the program. Consumer response to the program has been quite positive

and eliminated many of the problems that Ralph's perishable division had been previously dealing with (Tronstad).

In the process of documenting the driving forces that are active in the markets for Holstein steers, this study will address two specific questions. First, it will explore whether the long held perception of poor quality associated with Holstein steers has been justified. This will be determined primarily by examining the market for finished Holstein steers. Secondly, the study will evaluate the impacts that the shift towards calf-fed production may have had in the Holstein market. This impact will be evaluating largely by studying the market for Holstein feeder steers.

Literature Review

According to the January 2004 USDA Cattle report, there are slightly less than nine million dairy cows in the United States. Based on breed composition of the US dairy herd and estimated calving rates, it is likely that between 3.5 and 4 million Holstein steers are born in the United States each year, representing slightly less than 10% of the US calf crop (APHIS). In many ways, these Holstein steers are a byproduct of the dairy industry. Between one-fourth and one-third will enter calf slaughter programs while the rest will enter the beef markets as finished steers (Buhr).

Understanding and predicting livestock price relationships has always been a difficult task for the agricultural economist. One of the most common price forecasting methods used by economists is futures based estimation. Futures based estimates, using a five year weighted average basis, have been shown to be as accurate as many complex price prediction methods at predicting livestock prices (Kastens). Due to convergence and the threat of delivery and/or cash

settlement, futures prices represent a reasonable estimation of livestock prices at a specified future point in time.

Finished steers (live cattle) are sold to packers who then sell boxed beef; therefore boxed beef prices are known to be key drivers of the live cattle markets. The second component of the income stream for packers is the offal credit they receive. Live cattle basis has also been shown to be affected by corn prices, the Choice-Select price spread, and seasonality (Parcel).

Feeder cattle markets are similar to fed cattle markets in that both are margin industries. However, feeder cattle markets are characterized by longer time lags, leading to increased uncertainty. Feeder cattle prices have been shown to be largely dependent on fed cattle prices. Corn prices are also widely known to have a large impact on feeder cattle prices, as corn is the primary input into cattle finishing operations (Dhuyvetter).

Basis for Holstein steers has been found to be much more variable than basis for native cattle. Holstein basis reaches its strongest point in spring and is weakest during the winter (Holt). Much of this may be explained by the fact that Holstein steers do not winter as well as their non-dairy counterparts (Grant). Increased basis volatility left many questioning whether hedging was possible for Holsteins.

Despite the basis variation that exists in Holstein markets, efficient hedging opportunities were still found to exist. A 1996 study of three high volume markets for finished Holstein steers examined hedging effectiveness on a weekly basis. Hedge ratios in all markets were found to be statistically equal to one, which suggested the presence of efficient hedging opportunities (Buhr). Buhr's finding were taken to suggest that despite differences in the markets for Holstein steers and native steers, many of the same factors are likely to be active in both markets and the two markets tend to move in the same direction.

Data and Methodology

The primary objective of this analysis was to determine what factors drive the market and affect the prices of finished Holstein steers and Holstein feeder steers. These price relationships should yield valuable insights into the accuracy of Holstein quality perceptions and the impact of recent shifts in production practices. Also, differences should start to emerge between the market for Holsteins and the market for native cattle if fundamental differences are found to exist.

Since little work has been conducted examining the Holstein beef market specifically, model specifications were based on two primary sources. The first, and primary source, was semi-structured interviews of individuals who worked within the Holstein sector. These contacts included backgrounders, feedlot operators, managers of packing plants, and buyers of Holstein steers. Some interviews were conducted by telephone, while key interviews were made in person.

A common theme that surfaced through conversations with buyers inside the Holstein sector was that the Holstein market is driven largely by the market for native cattle. Therefore, the second information source for model specification was previous price analysis conducted on the native cattle markets. It was hypothesized that many of the same factors would be important, although their impacts could be different when considering their effect on Holsteins.

After reviewing previous work and discussing model specification with decision makers inside the Holstein sector, the following models of the Holstein beef market were developed:

P_{Hfat} = f (P_{CHcut}, *Prime*, P_{drop}, P_{trim}, *market structure*, *seasonality*) and

$P_{Hfeeder}$ = f (P_{fut6}, *CH/Sel*, P_{corn}, P_{trim} , *market structure*, *seasonality*)

where P_{Hfat} is the price of finished Holstein steers and $P_{Hfeeder}$ is the price of Holstein feeder steers. P_{CHcut} refers to the cutout value of Choice beef carcasses, P_{fut6} refers to the price of the fat cattle futures contract six months into the future, *Prime* refers to the average premium received for carcasses grading Prime, *Ch/Sel* represents the Choice / Select price spread, P_{drop} is the drop value (hide and offal) from a beef carcass, P_{trim} represents the price of beef trimmings, and P_{corn} represents the price of corn. *Market Structure* is intended to capture consolidation in the packing industry or major changes in production model such as the shift to the calf-fed program. *Seasonality* is intended to capture the seasonal effects that exist in beef markets.

Data for the analysis were obtained from several sources. Price data for finished Holstein steers (P_{Hfat}) were available through the USDA Market News Service in St. Paul, Minnesota. The service was able to provide weekly prices for finished Holstein steers at the South St. Paul auction market. These data were available beginning in January of 1995 and continuing into 2003. Price data were provided for Holstein steers weighing 1300-1500 pounds.

Weekly price data for Holstein feeder steers were not available for the same auction market. However, weekly Holstein feeder steer prices were available for the Lexington, KY market. These prices are collected and compiled by the Kentucky Department of Agriculture in their weekly Kentucky Livestock and Grain Market Report. Price data from this report were available from 1993 through 2003.

The price of the Choice cutout (P_{CHcut}), byproduct value (*Pdrop*), 85% beef trimmings, six months deferred futures (*Pfut6*), corn (*Pcorn*), Prime premium (*Prime*), and the Choice / Select price spread (*Ch / Sel*) were available on a weekly basis through the Livestock Marketing Information Center.

Market Structure is included to capture the effect of the merger between Smithfield Foods and Packerland Packing. This merger not only affected market shares in the Holstein sector, but also represented a shift from the traditionally fed Holstein steers to calf-fed Holstein steers for a significant portion of the market. The merger between Smithfield and Packerland was finalized on October 25, 2001. A dummy variable is used to capture the effects of all observations following that date. A second binomial variable is used to represent the time period between September 11, 2001 and the merger between Smithfield and Packerland. This is done to separate the effects of the terrorist attacks on the World Trade Center and the merger, since they occurred within six weeks of each other and are hypothesized to have similar effects.

The following five empirical equations were estimated using an OLS regression in SAS.

1) P_{Hfat} = f (P_{CHcut}, *Prime*, P_{drop}, P_{trim}, *terr*, *smpac*, *summer*, *spring*, and *fall*),

2) P_{H34} = f (P_{fut6}, *CH/Sel*, P_{corn}, P_{trim}, *terr*, *smpac*, *summer*, *spring*, and *fall*),

3) P_{H45} = f (P_{fut6}, *CH/Sel*, P_{corn}, P_{trim}, *terr*, *smpac*, *summer*, *spring*, and *fall*),

4) P_{H78} = f (P_{fut6}, *CH/Sel*, P_{corn}, P_{trim}, *terr*, *smpac*, *summer*, *spring*, and *fall*) and

5) P_{H8up} = f (P_{fut6}, *CH/Sel*, P_{corn}, P_{trim}, *terr*, *smpac*, *summer*, *spring*, and *fall*),

where P_{Hfat} refers to the price of 1300 pound to 1500 pound Holstein slaughter steers at South St. Paul, MN and P_{H34}, P_{H45}, P_{H78}, P_{H8up} refers to the price of 300 to 400 pound, 400 to 500 pound, 700 to 800 pound and 800 pounds and above Holstein feeder steers at Bluegrass Stockyards in Lexington, KY.

Terr is a binomial variable representing the time period between September 11, 2001 and October 25, 2001, *smpac* is a binomial variable representing the time after October 25, 2001. *Summer* is a binomial variable representing the months of June, July, and August, *spring* is a binomial variable representing the months of March, April, and May, and *fall* is a binomial

variable representing the months of September, October, and November. Descriptive statistics for all data used in equations (1) through (5) are provided in Table 1.

Results

Before these pricing models were examined using SAS statistical analysis software, numerous diagnostic tests were employed. Errors estimated in equations (1) through (5) were found to be normally distributed with mean zero, a key assumption of the OLS model. Further, Variance Inflation statistics did not suggest the presence of severe multi-collinearity. Multi-collinearity exists when two or more of the dependent variables are linearly related to one another.

A RESET test was performed to determine if a linear model was appropriate. The models failed the RESET test, which suggested that either a linear model was inappropriate or that a key explanatory variable was missing from the equations. Two alternative models were considered, a log-linear model and a double log model, but neither improved the test statistic. Alternative specifications for explanatory variables were also considered such as squared and cubed terms, but were not found to improve the test statistic. Therefore, it was assumed that the RESET test was most likely suggesting omitted variable bias. It was assumed that the lack of quantity numbers at each weekly sale could be causing this problem. Since the R^2 values on each model were seventy-five percent or greater, analysis went forward despite this potential problem.

Data were found to be auto-correlated through a Durbin-Watson test. All five models exhibited first order autocorrelation and this was corrected in each model by using a first order lag variable of the disturbances. Once this was done, Durbin-Watson statistics were found to be

within acceptable ranges for all five models and analysis was able to proceed. Data were not found to exhibit hetereoskedasticity.

Finally, data was tested for stationarity using a Dickey-Fuller Unit Root Test. Results of this test indicated possible nonstationarity and the first differencing procedure was implemented to correct this problem. However, results and predictive power of the model were greatly affected by the first differencing process. Many variables with good theoretical reasons for inclusion became insignificant, coefficients of determination became lower, and in some cases, signs on parameter estimates changed. Therefore, it was decided not to correct for the problem, but rather to recognize the potential bias as the analysis proceeded. With this in mind, Generalized Least Squares was used to estimate equations (1) through (5) as previously presented.

Despite the lack of available weekly volume data, explanatory power of all models was quite high. Explanatory power was greatest for the model examining finished Holstein steer prices and lowest for models equations explaining price variation for heavier Holstein feeder steers. Coefficients of determination ranged from 79% to 95% for the five equations.

Results from equation one suggested that prices for finished Holstein steers were largely driven by beef cutout prices, the Prime premium level, and byproduct values (see Table 1). These variables were found to have a positive relationship with finished steer prices. Boxed beef prices and byproduct prices are the two primary revenue streams for meat packers. As these two factors increase in price, packers bid the price of finished steers upward. The positive relationship found to exist between Prime premium level and Holstein steer prices is supportive of statements by industry stakeholders than Holstein steers are more likely to grade Prime than native steers. This finding dramatically contradicts the perception that Holstein beef is of low

quality. As the market reward for Prime carcasses increases, packers are responding by paying more for Holstein steers.

The time period following the merger between Smithfield and Packerland was found to be associated with lower finished steer prices by $1.29 per cwt. The wholesale price of 85% trim reported by USDA was not found to have a significant relationship with Holstein steer prices. This finding also cast doubt on the accuracy of the poor quality perception that has plagued Holstein steers for many years. Seasonal effects were not found to be present in the finished Holstein market (see Table 2).

Equations two and three examined the price relationships that exist in the market for light weight Holstein feeder steers. As expected with feeder calf prices, deferred futures prices for finished cattle appeared to be driving this market. Also as expected, corn price was found to have a strong negative correlation with light feeder calf prices. An upward movement in corn price by $0.25 per bushel was associated with a downward movement in light Holstein feeder steer prices by over $4.00 per hundredweight in both equations.

Spring was clearly associated with higher price levels than winter for these two weight categories. This is most likely the result of strong grass demand for all types of stocker cattle in April and May. There was moderate evidence to suggest that summer prices may be somewhat higher and fall prices somewhat lower than winter price levels.

The Choice / Select price spread was found to be significant in explaining variation in the price levels of 400 to 500 pound Holstein steers, but not for 300 to 400 pound Holstein steers. The negative sign on this parameter estimate was unexpected and contrary to the hypothesis. There was no evidence to suggest that as the reward to quality increased, the price of Holstein feeder steers would also increase.

Trim price was found to be highly significant in both equations and similar in magnitude. This result was somewhat unexpected since trim price was not found to be significant in explaining movement in finished Holstein prices. Perhaps, trim price serves as indicator of the overall health of the beef sector; simple correlation suggests a strong positive relationship between trim price and deferred fat cattle futures prices. Results from equations 2 and 3 are shown in tables 3 and 4.

Equations 4 and 5 examined the factors that drive the prices for heavy Holstein feeder steers. The weight categories available for examination were steers 700 to 800 pounds and 800 pounds and above. As stated before, explanatory power was weaker for these two equations, but remained above 79% for both. Parameter signs and magnitudes appeared reasonable, suggesting that the equations adequately captured the driving forces in the market.

Again deferred futures price was a strong factor. This effect was positive and similar in magnitude for both weight groups. Corn price again surfaced as a major factor, although the magnitude of the effect was smaller than what was seen in the market for lighter steers. Parameter estimates were roughly half what they were in the lighter steer models; a $0.25 per bushel increase in the price of corn was associated with a decrease in the price of heavy Holstein steers by a little more than $2.00 per hundredweight. The Choice / Select price spread was not found to exhibit significant influence on feeder steers in either of these two weight categories.

Seasonality was again present with effects similar to that of lighter steers. However, the seasonal effect was not as robust across the two equations. Again there was evidence to suggest that price levels were higher in the spring and summer than in the winter. There was some evidence to indicate that prices may actually reach lower levels in fall than in winter. The price

of trim once again surfaced as having a significant positive relationship with feeder steer price levels. Regression results from equations 4 and 5 can be found in tables 5 and 6.

The parameter estimates reported in tables 2 through 6 can be misleading when trying to understand the impact that certain variables can have on price levels. The existence of a larger parameter estimate does not necessarily indicate that a particular explanatory variable is likely to have a larger effect on the dependent variable over time. This likelihood and size of the impact depends on how much movement occurs in the level of the explanatory variable. A significant explanatory variable that has a high parameter estimate has the potential to greatly impact the dependent variable. However, if the value of the dependent variable is relatively constant over time, it may be unlikely to have much practical effect.

To better capture the magnitude of impact that explanatory variables are likely to have on Holstein prices, a sensitivity index is used. The index is calculated by multiplying the parameter estimate from the regression equation by the standard deviation of the explanatory variable. By calculating this index, the parameter estimated is scaled to estimate the expected impact on prices from a movement in the explanatory variable by one standard deviation. Observed values fall within one standard deviation of the mean about 68% of the time.

Table 7 reports these indices for finished Holstein prices; indices are only reported for continuous variables. It is clear that the price of the Choice Cutout is likely to have a larger impact on Holstein steer prices than the Prime premium level and the byproduct value when considering the amount of variability within each variable. A one standard deviation movement in the Choice cutout value was associated with a movement in steer prices of $3.28. Single standard deviation movements in the byproduct value and Prime premium level were associated with movement in steer prices of $1.93 and $0.30 respectively.

Similar analysis was conducted for light Holsteins and reported in tables 8 and 9. Corn price was shown to have the largest potential impact on light Holstein feeder prices when examining both 300 to 400 lb steers and 400 to 500 lb steers. Movements in corn price by one standard deviation were associated with opposite price movements of $14.02 for 300 to 400 lb steers and $12.11 for 400 to 500 lb steers.

After corn price, deferred futures price was found to have the second largest potential impact. A one standard deviation movement in deferred futures price was associated with a change in 300 to 400 lb feeder steer prices by $8.57, and a change in 400 to 500 lb feeder steer prices by $7.76. Trim price was found to have the smallest impact on the two weight groups. Movement in trim price by one standard deviation was associated with movements of $2.35 per hundredweight for 300 to 400 pound steers and $2.07 for 400 to 500 pound steers. The Choice / Select spread was not found to be a significant factor explaining both price levels, but a one standard deviation movement in the spread was associated with an opposite movement in the prices of 400 to 500 pound steers of $1.45.

Finally, indices were calculated for Holstein feeder steers in the heavier weight categories. These results are shown in tables 10 and 11. Deferred futures price and corn price showed similar sized impacts on heavy feeder steer prices. The impact of a one standard deviation movement in futures price was associated with a movement of $5.90 per hundredweight in the 700 to 800 pound feeder steer market and $6.25 per hundredweight in the 800 pound and above market.

Movement in corn price by one standard deviation was associated with a negative movement in 700 to 800 pound steer prices by $5.91 per cwt. The same movement in corn price was associated with a negative change in the price of Holstein feeder steers weighing 800 pounds

and above by $5.96 per cwt. The potential impact of trim price was smaller, but very significant. A single standard deviation change in the level or trim price was associated with a movement in 700 to 800 lb feeder steer prices by $2.00 and a $1.45 per hundredweight movement in the prices of feeder steers 800 lbs. and heavier.

Conclusions

Overall, and what may be surprising for some, was that the Holstein sector was not found to be greatly different than the traditional beef sector. Production and marketing differences clearly exist, but the same factors appear to be present in both systems. Holstein beef is being used to fill market needs that native beef can not readily fill. At the same time, marketers of Holstein beef are finding ways to stay competitive in markets that are typically dominated by native cattle. As individuals within the Holstein sector move forward the results of this study should prove useful.

The analysis found little evidence to suggest that the market for finished Holstein steers was being driven by the price of ground beef. The persistent perception that middle-meats from Holsteins are removed and the rest of the carcass is ground into hamburger does not appear to be very accurate. Rather, the market for finished Holsteins appears to be primarily driven by boxed beef prices much like the market for native steers.

If the perception of Holstein steers as a ground beef market were true, one would expect prices for finished steers to move in relation to trim prices. Instead, regression results suggest that trim prices do not affect the sale prices of Holstein slaughter steers, but that a strong relationship exists between the price of Holstein steers and Choice cutout price. Based on these findings, it is unlikely that this long time perception of Holstein beef has been justified.

Additional insight into this question was gained by considering the relationship found to exist between the premium level paid for Prime carcasses and the price of Holstein slaughter steers. The perception that Holsteins produce leaner cuts and a higher percentage of Select carcasses is not consistent with econometric results. This perception was also contradicted through personal interviews with industry personnel and tested through econometric modeling.

If the perception were accurate, one would expect buyers to back away from Holsteins as the premium levels for Prime carcasses increased. However, that is not what was found through modeling. Although the estimated impact was small, the positive relationship that was found to exist between the Prime premium level and slaughter Holstein price is an indication that buyers of Holstein steers recognize the fact that Holsteins are more likely to grade Prime and are paying more for them when this premium level increases. Holsteins have suffered from these perception problems for some time and this study has cast doubt on their validity.

Another crucial element of this study was the examination of the impact that the shift towards the calf-fed production model may have had on the market for Holstein steers. This shift has occurred gradually over time, but was truly publicized and implemented as a procurement practice by Packerland the day that Smithfield assumed operations of the company. This merger was finalized on October 25th, 2001, which basically represents the date when Packerland stopped buying traditionally heavy Holstein steers. This study provided an opportunity to examine changes in the Holstein market following this date.

The weeks following this merger were found to have been associated with lower fed Holstein prices. The average price of a finished Holstein steer in the dataset was $61.78. Based on parameter estimates, the time period following this merger saw prices more than 2% lower than expected prior to the merger holding the impact all other variables constant. To many

casual observers, this suggested the possibility of increased monopsonistic buying power. Many feared that any price impacts were due to Smithfield exercising increased market power on an already vulnerable market.

In truth, the possibility that part of this impact was due to increasing consolidation can not be ignored. However, there is another reasonable explanation that could also be extrapolated from the data. When Smithfield took over Packerland operations, the conglomerate stopped purchasing traditionally fed Holsteins altogether and made a clear shift to purchasing lighter, calf-fed Holsteins. Since the dataset being examined is for Holstein steers between 1300 and 1500 pounds, it is completely possible that the lower prices received after the merger were simply the result of losing a major buyer for cattle in this weight category. Cattle weighing 1300 to 1500 pounds would likely be on the upper-end of the weight spectrum from which Smithfield would be interested following this shift in purchasing patterns. The price impacts may simply reflect the loss of a major buyer of finished Holsteins in this weight range.

Further insight into this question is provided by considering the impacts of this merger on the market for Holstein feeder steers. There was no evidence to suggest that Holstein calf prices became lower following the Smithfield / Packerland merger. There was no statistical difference in price levels for light Holstein steers before and after the merger. Calves in these weight ranges, could have been placed directly on feed and reach finished weights in the range that Smithfield desired.

However, price impacts were found to exist in the markets for heavier Holstein feeder steers. Prices for these steers after the merger were found to be significantly lower than prices before the merger by about $2 per cwt. This sheds doubt on the thought that this union was putting downward pressure on Holstein prices by itself. Rather, it supports the argument that the

decline in fed Holstein prices was more a consequence of an industry shift towards calf-fed steers. Hence, prices of calves that were not backgrounded were unaffected while heavier feeder steers that did not fit into the calf-fed system saw significant impact.

Further differences in the markets for Holstein calves and backgrounded Holstein steers surfaced during this work. As in native markets, Holstein feeder steer prices are driven by the expectation of finished cattle prices in the future and the costs of inputs into the finishing process. However, the magnitude of the impact of these fundamental factors was quite different. Holstein calf prices show greater sensitivity to changes in deferred futures prices than heavier feeder steers. Some of this difference is no doubt due to nominal price levels being higher for lighter calves. However, longer feeding periods and greater market uncertainty are also likely to be influential.

An even greater difference is seen in the way that prices for the two categories respond to changes in corn prices. Light Holsteins, placed directly on feed, would certainly be on feed for a greater period of time. Hence, it is not surprising that prices of Holstein calves are more sensitive to the corn market. More time on feed means more total corn is fed, which means greater impact on potential feedlot profits and lower bids for these calves when corn prices increase.

The sensitivity indices reported in Tables 7 through 11 probably tell this story best. They suggest that the likely price impact from movement in corn prices and deferred futures prices are similar for backgrounded Holstein steers. However, the likely impact from movement in corn prices on price levels for Holstein calves was nearly twice the likely impact from movements in deferred futures price. It is clear that prices for Holstein calves are more sensitive to changes in these fundamental factors than prices for heavy Holstein feeders.

Implications

The market for Holstein steers is not a ground beef market. Holstein steers are fabricated in the same way that native cattle are. Separate markets for their products exist due to quality differences and differences in the size of middle-meat cuts. This hypothesis was derived from conversations with industry leaders and validated through pricing models. In fact, Holstein steers were found to be crucial to supplying the high-end Asian market with high quality, well marbled beef.

The shift towards the calf-fed model has affected the industry as one would expect. Heavy Holstein steers are being discounted on the market as a result of this change. Light Holstein calf prices have been largely unaffected. Concerns by individuals within the industry that consolidation was affecting these prices appear to be oversimplified. As market preferences change, cattle that do not meet the desire of the market will suffer market consequences.

Backgrounders and finishers of heavy Holstein calves must realize first and foremost that they are operating within a market that is shrinking. Although there will probably always be a market for traditionally fed Holstein steers, it is unlikely that the shift towards the calf-fed model will slow any time soon. If the west coast model is indeed a model for the future, the calf-fed system may soon dominate Holstein production in the East. Since the market for traditionally fed Holstein steers is heavily dependent on exports, backgrounders must understand the volatility that is likely to exist.

It has been shown following the finding of BSE first in Canada and then later in the United States that Asian consumers have high food safety standards and will quickly change their purchasing behavior when food safety appears to have been threatened. When the United States lost its beef market in the Pacific Rim, processors who slaughtered traditionally heavy

Holsteins were devastated. At the time of this writing, exports remain closed to this region. The export market is vital to the survival of the traditional system and those individuals who produce these types of cattle must keep these factors in mind.

Producers of starter calves and calf finishers are in a slightly different market environment. They are most likely operating within a market segment that will continue to grow. It is likely that Smithfield will attempt to put a vertically coordinated system in place on the east coast similar to what has been done on the west coast. A system like this can only have a positive effect on the market for calf-fed Hoslteins.

The negative aspect of the calf-fed market is that it is very sensitive to traditional market factors. Since calf-fed Holsteins are on feed for a longer period of time and more corn is needed to finish them, market effects seem to be amplified. An incremental increase in corn price or decrease in deferred futures price will have a dramatic effect on Holstein calves whereas the effect on heavier steers would be moderate. The market for light Holstein calves is mostly susceptible to changes in traditionally important market factors, while the market for heavy Holstein feeder steers is probably more susceptible to changes in market structure and consumer preferences.

This work was successful in its primary objective of evaluating the driving forces behind the Holstein beef market. The study combined two evaluation methods that are seldom used in conjunction with one another. Semi-structured interviews with stakeholders in the Holstein sector provided crucial insight to understanding the industry and developing the hypotheses that were tested through econometric modeling. Had this qualitative component not preceded the econometric analysis, models would have been inaccurate and results would have left more

questions than answers. However, since industry personnel were willing to share information from the beginning, a much clearer understanding of the sector was developed.

Table 1. Descriptive Statistics: Dependent and Explanatory Variables

Variable	Mean	St. Deviation	Low	High
$P_{Hfat\ (a)}$	$61.78	5.0949	$51.78	$75.60
$P_{H34\ (a)}$	$68.02	17.9827	$28.00	$101.38
$P_{H45\ (a)}$	$64.96	16.1820	$28.00	$96.75
$P_{H78\ (a)}$	$56.56	11.7554	$27.90	$78.00
$P_{H8up\ (a)}$	$54.98	10.3751	$28.50	$75.45
$P_{CHcut\ (a)}$	$110.78	11.1068	$91.61	$149.81
$P_{fut6\ (a)}$	$68.83	4.3131	$60.50	$83.26
$P_{trim\ (a)}$	$90.28	12.2208	$65.00	$122.31
CH/Sel (a)	$10.67	4.0952	$4.00	$21.00
Prime (a)	$5.55	0.6218	$3.69	$7.91
$P_{drop\ (a)}$	$8.06	0.9296	$6.28	$10.10
$P_{corn\ (b)}$	$2.48	0.7194	$1.68	$5.23
Terr (c)	0.0134	0.1152	0	1
smpac (c)	0.2058	0.4048	0	1
fall (c)	0.2174	0.4129	0	1
spring (c)	0.2723	0.4457	0	1
summer (c)	0.2586	0.4384	0	1

(a) values expressed in dollars per hundredweight

(b) values expressed in dollars per bushel

(c) binomial variable of value 0 or 1

Table 2. Regression Results: Finished Holstein Steers (Dollars / cwt.)

Variable	Parameter Estimate	Standard Error
Intercept	9.6359***	2.9275
P_{CHcut}	0.2957***	0.0218
P_{trim}	0.0065	0.0148
Prime	0.4886**	0.1930
P_{drop}	2.0815***	0.2910
terr	-1.0359	0.9235
smpac	-1.2895**	0.6313
fall	-0.2478	0.4016
spring	-0.2275	0.3862
summer	-0.4391	0.4443
R^2	0.9525	

*, **, and *** denote statistical significance at the .10, .05, and .01 levels, respectively

Table 3. Regression Results: 300 to 400 lb. Holstein Feeder Steers (Dollars / cwt.)

Variable	Parameter Estimate	Standard Error
Intercept	-40.6317***	14.4920
P_{fut6}	1.9859***	0.2282
P_{trim}	0.1927***	0.0750
CH/Sel	-0.2049	0.1922
P_{corn}	-19.4850***	2.4396
terr	5.5422	4.1743
smpac	0.7066	2.0333
fall	-2.1365	2.0541
spring	4.2539**	1.6898
summer	2.9056	1.9509
R^2	0.8654	

*, **, and *** denote statistical significance at the .10, .05, and .01 levels, respectively

Table 4. Regression Results: 400 to 500 lb. Holstein Feeder Steers (Dollars / cwt.)

Variable	Parameter Estimate	Standard Error
Intercept	-32.4746***	11.0251
P_{fut6}	1.8001***	0.1649
P_{trim}	0.1697***	0.0537
CH/Sel	-0.3547***	0.1309
P_{corn}	-16.8336***	1.7758
terr	3.1619	2.8807
smpac	1.6037	1.4912
fall	-2.7928*	1.4490
spring	2.7338**	1.2686
summer	3.1723**	1.4568
R^2	0.8972	

*, **, and *** denote statistical significance at the .10, .05, and .01 levels, respectively

Table 5. Regression Results: 700 to 800 lb. Holstein Feeder Steers (Dollars / cwt.)

Variable	Parameter Estimate	Standard Error
Intercept	-33.0601***	7.6254
P_{fut6}	1.3685***	0.1290
P_{trim}	0.1633***	0.0472
CH/Sel	0.0143	0.1006
P_{corn}	-8.2210***	1.2635
terr	1.2517	2.3440
smpac	-2.0189*	1.0294
fall	-1.3825	1.1642
spring	2.2917**	0.9172
summer	2.4035**	1.1058
R^2	0.7935	

*, **, and *** denote statistical significance at the .10, .05, and .01 levels, respectively

Table 6. Regression Results: 800 lbs. and Above Holstein Feeder Steers (Dollars / cwt.)

Variable	Parameter Estimate	Standard Error
Intercept	-35.9874***	8.1437
P_{fut6}	1.4487***	0.1304
P_{trim}	0.1183**	0.0467
CH/Sel	0.0657	0.1006
P_{corn}	-8.2807***	1.2784
terr	-0.7795	2.3816
smpac	-1.9283*	1.0703
fall	-2.8498**	1.1829
spring	0.1725	0.9820
summer	0.5902	1.0897
R^2	0.7922	

*, **, and *** denote statistical significance at the .10, .05, and .01 levels, respectively

Table 7. Sensitivity Index: Finished Holstein Steers

Variable	Standard Deviation	Impact on P_{Hfat} per cwt
P_{CHcut}	11.1068	$3.28
Prime	0.6218	$0.30
P_{drop}	0.9296	$1.93

Table 8. Sensitivity Index: 300 to 400 lb. Holstein Feeder Steers

Variable	Standard Deviation	Impact on P_{H34} per cwt
P_{fut6}	4.3131	$8.57
P_{trim}	12.2208	$2.35
P_{corn}	0.7194	($14.02)

Table 9. Sensitivity Index: 400 to 500 lb. Holstein Feeder Steers

Variable	Standard Deviation	Impact on P_{H45} per cwt
P_{fut6}	4.3131	$7.76
P_{trim}	12.2208	$2.07
P_{corn}	0.7194	($12.11)
CH/Sel	4.0952	($1.45)

Table 10. Sensitivity Index: 700 to 800 lb. Holstein Feeder Steers

Variable	Standard Deviation	Impact on P_{H78} per cwt
P_{fut6}	4.3131	$5.90
P_{trim}	12.2208	$2.00
P_{corn}	0.7194	($5.91)

Table 11. Sensitivity Index: 800 lbs. and Above Holstein Feeder Steers

Variable	Standard Deviation	Impact on P_{H8up} per cwt
P_{fut6}	4.3131	$6.25
P_{trim}	12.2208	$1.45
P_{corn}	0.7194	($5.96)

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