The Effect of Captive Supply Cattle on Live Cattle Basis

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Live cattle basis is used by cattle producers and beef packers to formulate price expectations. The most recent basis study was in 1979, structural changes in the cattle industry require updating the basis literature. Increasing deliveries of captive supply cattle weakened basis my a small amount in some states and had no impact in others.

Key Words: live cattle basis, captive supplies, fed cattle.

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Live cattle basis, the difference between a local cash price and live cattle futures price, is used by cattle producers and beef packers to formulate price expectations. Cattle producers and beef packers need accurate basis predictions to determine expected prices and make pricing, hedging, and forward contracting decisions. Inability to accurately predict basis results in higher risk associated with marketing decisions for both cattle feeders and beef packers. The purpose of this study is to estimate a model that explains variability in weekly fed cattle basis in the states of Colorado, Kansas, Nebraska, and Texas.

Although basis predictability is essential for making marketing and pricing decisions, little recent published research has specifically examined factors affecting live cattle basis. The most recent comprehensive study was byLeuthold in 1979. So many structural changes have occurred in the fed cattle market since then that an updated analysis is long overdue. In addition, one issue that has gained considerable attention, especially by cattle producers, is the effect of captive supplies on fed cattle prices. No previous study has explicitly considered how captive supplies may impact fed cattle basis.

Procurement of cattle well in advance of slaughter has provided packers with the opportunity to control supplies (Purcell 1990a). Beef packers undertake forward cash purchasing (contracted or formula priced) to ensure plants operate at capacity, thus reducing cost risk of operating below capacity (Purcell 1990b and Ward). Cattle feeders have indicated that forward cash selling enables them to reduce financial risk and lock-in a known buyer (Ward and Bliss). Thus, there are incentives for both cattle feeders and beef packers to enter into these agreements. However, many cattle feeders also contend that in the presence of captive supplies the packer has more information regarding current and expected supply and demand then cattle feeders because contracting activity is not public information. These feeders contend that this provides beef packers with leverage that places downward pressure on prices (Schroeder et al. 1997).

Several studies have incorporated captive supplies in modeling price determination (e.g., Elam; Eilrich et al.; Hayenga and O'Brien; Schroeder et al. 1993; Ward; and Ward, Koontz, and Schroeder). Of those studies, Elam; Schroeder et al.1993; and Ward, Koontz, and Schroeder found that increases in the quantity of captive supply cattle decreased cash prices by a small amount. This study builds on these studies and previous fed cattle basis studies to determine whether deliveries of captive cattle supplies influence live cattle basis.

Basis Model and Procedures

Price expectations formulated using the live cattle futures market depend on basis predictability. Live cattle basis is a function of the factors affecting local cash price and live cattle futures price over time. The basis at time *t* is defined as the live cattle cash price at location *i* minus the nearby live cattle futures price. For this analysis the *i*th location (i=1,2,3,4) refers to 1=Kansas, 2=Colorado, 3=Nebraska, 4=Texas. The empirical basis model is:

$$(1)\qquad BASIS_{it} = f(CHEAD_{it}, THEAD_{it}, CSSPREAD_t, CORNF_t, COF_t, CPI_t, LIVEF_t, MON_{tm}, CONCH_t),$$

where *i* refers to location ant *t* refers to week. $CHEAD_{it}$ is the percentage of contracted and marketing agreement cattle deliveries relative to total cattle marketed, $THEAD_{it}$ is total head of fed cattle marketed, $CSSPREAD_t$ is the Choice to Select price spread for 700 to 850 boxed beef cutout equivalent, $CORNF_t$ is the nearby corn futures price, COF_t is the monthly 7 state cattle on feed estimates, CPI_t is the monthly Consumer Price Index, $LIVEF_t$ is the nearby live cattle futures price, MON_{tm} is a set of monthly dummy variables to capture seasonality, and $CONCH_t$ is a dummy variable representing the change in the live cattle futures specifications effective with the June 1995 contract. Parameters to be estimated represent a weakening (negative coefficient) or a strengthening (positive coefficient) basis.

The expected impact of weekly captive supply shipments (*CHEAD*) on fed cattle basis is not certain. Based upon previous studies that have found small negative cash price impacts when captive supplies increased (Elam; Schroeder et al. 1993; Ward, Koontz, and Schroeder), as *CHEAD* increases cash price would be expected to decline without a discernable change in futures price, thus weakening basis. However, if captive supply shipments affect both local cash prices and nearby live cattle futures prices in similar ways, then *CHEAD* would be expected to have no impact. Total fed cattle marketings in a particular area ($THEAD_{it}$) would be expected to place more downward pressure on local cash prices than on futures price, causing this variable to have a negative impact on basis.

The Choice to Select price spread for 700 to 850 boxed beef cutout equivalent ($CSSPREAD_t$) is expected to have varied effects for different states. The local live cattle cash price is dependent on the quality of cattle supplied. Alternatively, the live cattle futures price has specific fixed quality characteristics. Thus, basis changes occur with varying levels of cattle quantity and quality in particular areas. As the Choice to Select price spread widens it is hypothesized that those locations with higher (lower) quality cattle would receive a premium (discount) and the basis would strengthen (weaken).

An increase in nearby corn futures price ($CORNF_t$) is expected to increase the current supply of cattle as cattle producers find it more profitable to sell finished cattle at lighter weights. In the short run, this will weaken local basis. An increase in cattle on feed estimates (COF_t) is expected to have a positive effect on basis. Increasing the number of anticipated cattle in the market at a future date places downward pressure on live cattle futures price (Grunewald, McNulty, and Biere). Even if this occurred in deferred contracts there is a tendency for all futures contracts to trend the same way.

Other variables anticipated to have an effect on basis are Consumer Price Index (CPI_t) and nearby live cattle futures price ($LIVEF_t$). The consumer price index is an indicator of macroeconomic trends over time. As the Consumer Price Index increases, basis is expected decline due to the relative increase in procurement costs in the local cash market to that of the live cattle futures price. The increase in nearby cattle futures is expected to have a negative effect on the basis if cash prices do not respond.

Monthly dummy variables ($MONTH_{tm}$) were included to account for seasonality in basis. Leuthold found seasonality in basis from employing quarterly dummy variables. In addition, a separate binary variable was included to account for the change in live cattle futures contract specifications beginning with the June, 1995 contract ($CONCH_t$). Among other modifications to the live cattle contract, it switched from 100% Choice to 55% Choice. This change in quality would be expected to lower futures price, thus strengthening basis. Finally, a pooled sample of data are used for the estimation of equation (1) and state dummy variables ($STATE_{tm}$) were included in this model to determine if basis differs across locations.

Parameters were estimated by state and on the aggregate level. The aggregate model assumes factors affecting basis react in a similar way across states. The econometric package *SHAZAM* was used in the estimation of parameter estimates in equation (1). Residual autocorrelation is a concern when using weekly time-series data of this nature. Therefore, after transforming state level data for residual autocorrelation and the transformation of panel data using Kmenta's hetorskedastic and autocorrelated technique (Kmenta pp. 509-511) Generalized Least Squares were used in parameter estimation.

DATA

Weekly data for January 1, 1990 to August 30, 1996 were used for estimation of equation (1). Missing observations resulted in elimination of separate weekly data for each state. Data on captive supply in Nebraska were not available prior to January 1, 1994, thus, panel data for the period January 1, 1994 to August 30, 1996 were used in the pooled estimation of equation (1).

Weekly average fed cattle prices by state were calculated from daily Agricultural Marketing Service (AMS) prices as a weighted average of all steers and heifers sold on a live and dressed weight basis during that week. Table 1 provides summary statistics by state of basis, cash price, head marketed, and captive supply cattle. To calculate the nearby basis, the daily nearby live cattle futures prices were obtained from Bridge, converted to weekly averages, and subtracted from the weighted average cash price.

Total head marketed, captive supply cattle deliveries, and Choice to Select price spread for 700 to 850 lbs boxed beef cutout equivalent were collected from weekly AMS publications.[1] The quantity of captive supply cattle was expressed as a percent of total head marketed. Nearby daily corn futures prices were obtained from Bridge and converted to weekly average prices. Monthly cattle on feed were revised values reported by the National Agricultural Statistics Service. The monthly Consumer Price Index was taken from the *Survey of Current Business* with 1995 used as the base year.

Results

Parameters estimated using equation (1) are reported in table 2 and represent the change in basis from an incremental change in one of the factors affecting live cattle basis. Negative parameter estimates represent a weakening basis and positive parameter

[1]Local live cash prices, head marketed, and quantity of captive supply cattle delivered are subsets of total marketings during a given week.

estimates represent a strengthening basis. The models explained from 65% to 71% of the variation in basis. For the panel data model, 57% of the variation in basis was explained by the model.

A 1% increase in the number of captive supply cattle to total cattle marketings weakened basis statistically and significantly in Colorado and Texas. No statistically significant impact was found for Kansas, Nebraska, or the pooled data set. The $0.02/cwt. and $0.03/cwt. reductions in price observed for Colorado and Texas, indicate that basis weakens by this amount for each 1% increase in captive supply shipments. Elam found similar results for the effect of changes in captive supply cattle on local cash price. As head marketed increased, basis weakened in each model except for Nebraska. An increasing number of head marketed places downward pressure on the cash price. Leuthold found no significant impact on nearby basis from changing levels of cattle slaughtered. Thus, head marketed appears to be a better determinant for formulating basis expectations.

Choice to Select price spread for 700 to 850 boxed beef cutout equivalent was insignificant in determining basis variability in each of the models estimated. This is not consistent with expectations. However, if cattle are sold on averages with little differentiation in price associated with quality (Schroeder et al. 1997), then this result is not surprising.

Basis weakened with an increasing corn futures price, as hypothesized. Leuthold found the nearby basis to weaken by a similar amount ($1.33/cwt. per $1.00/bu. increase in corn price). As corn prices increase producers liquidate cattle early. The extra quantity of cattle pushes cash prices downward, and futures prices trend upward in anticipation of less cattle in the market at a future date. An increase in cattle on feed had a statistically significant impact on basis for only the pooled model and the effect was not as expected.

As the Consumer Price Index increased the basis weakened for the Kansas, Texas, and pooled models. A higher Consumer Price Index reflects an overall higher cost of services, thus increasing procurement costs. An increase in the live cattle futures price weakened basis in each model except for Colorado. Similarly,Leuthold found basis (futures less cash) to weaken for increases in the cash Choice steer price. This suggests that the local live cattle cash price may not adjust to changes in nearby live cattle futures price by a corresponding amount.

Monthly dummy variables having negative (positive) coefficient estimates represent a weakening (strengthening) basis relative to January. May basis was strong in each model, except Nebraska. Alternatively, a statistically significant weakening in basis occurred in September and October. Similarly,Leuthold found basis weaker in the third quarter, relative to the first quarter. May and September October represent periods during the year when prices are historically at their seasonal high and low, respectively. No statistically significant impacts on basis for location differences between states were found in the pooled model.

Changes in the live cattle futures contract specifications strengthened basis in each model, except Kansas. This contradicts the findings of Murphy that the live cattle futures basis has weakened. The difference in these results are attributable in part to different data sets used. This study uses weighted average cash prices of fed cattle marketed in the respective states whereas, Murphy used a five-region average choice fed cattle cash price. The decrease in the quality specified in the live cattle futures contract (100% choice to 55% choice) would lower futures price and increase basis, as observed in this analysis.

Conclusions

Live cattle basis is used by cattle producers and beef packers to formulate price expectations. Inability to accurately predict basis results in higher risk associated with marketing decisions for both cattle feeders and beef packers. The purpose of this study was to estimate a model that explained variability in weekly fed cattle basis in the states of Colorado, Kansas, Nebraska, and Texas.

Given the most recent comprehensive live cattle basis study was by Leuthold in 1979 and the many structural changes (e.g., captive supply) that have occurred in the fed cattle market, an updated analysis is long overdue. Additionally, no previous study has explicitly considered how captive supplies may impact fed cattle basis.

A $0.02/cwt. and $0.03/cwt. statistically significant reduction in basis was observed for Colorado and Texas for each 1% increase in captive supply shipments. This small decrease in basis is minimal in the cattle producers formulation of price expectations. Similarly, as the total number of head marketed increased, basis weakened in each model, except Nebraska.

A decrease in quality specifications in the live cattle futures contract (100% choice to 55% choice) strengthened basis. Basis weakened with an increasing corn futures price. An increase in the live cattle futures price weakened basis in each model except for Colorado.

Further analysis will focus on modeling basis risk. Similar to the basis research, previous research on basis risk is out dated due to structural changes that have occurred in the fed cattle market. A significant impact on basis risk from captive supplies would suggest increased variability in price expectations. Thus, affecting cattle feeder and beef packer hedging and marketing decisions.

Table 1. Summary Statistics of Selected Variables Used to Examine Live Cattle Basis, 1990-August, 1996.

Characteristic	No.	Avg.	S.D.	Min.	Max.
Price ($/cwt)					
Colorado	291	71.46	6.17	55.15	84.85
Kansas	278	71.45	6.35	55.68	85.00
Nebraska[a]	139	66.62	4.42	54.70	76.80
Texas	242	70.68	6.30	55.40	85.59
Basis ($/cwt)					
Colorado	291	-0.41	1.73	-4.79	5.83
Kansas	278	-0.22	1.79	-4.45	5.70
Nebraska[a]	139	-0.77	1.48	-4.91	4.43
Texas	242	-0.30	1.54	-4.71	5.44
Total head marketed					
Colorado	291	25267	6679	8900	45800
Kansas	278	69170	17382	20400	136400
Nebraska[a]	139	71173	18733	2500	124700
Texas	242	79194	23219	13600	155700
Captive supply cattle (% of total marketings)					
Colorado	291	28.48	15.17	0.79	75.27
Kansas	278	20.96	9.62	4.43	78.23
Nebraska[a]	139	9.09	10.35	0.00	100.00
Texas	242	14.66	11.29	0.14	85.59

[a] Captive supply data for Nebraska were only available from 1994-August 1996.

Table 2. Regression Results of Factors Affecting Weekly Live Cattle Basis, 1990-August, 1996.

		Dependent Variable			
Variable	Kansas	Colorado	Nebraska	Texas	Pooled
Captive supply	-0.007	-0.020**	-0.004	-0.033**	-0.005
	(-0.725)	(-3.048)	(-0.374)	(-4.631)	(-1.366)
Head marketed	-0.9E-05**	-0.3E-04**	-0.9E-06	-0.1E-04**	-0.4E-04*
	(-2.111)	(-3.119)	(-0.220)	(-3.534)	(-1.860)
Corn futures	-1.216**	-1.466**	-1.079**	-0.874**	-1.300**
	(-3.811)	(-4.506)	(-4.408)	(-4.235)	(-11.470)
Live cattle futures	-0.115**	-0.056	-0.100**	-0.045**	-0.081**
	(-3.011)	(-1.521)	(-2.392)	(-1.673)	(-4.230)
Cattle on feed	-0.2E-04	0.5E-03	-0.8E-03	0.5E-04	-0.9E-03**
	(-0.595)	(1.536)	(-1.266)	(0.212)	(-2.946)
Consumer price index	-0.143**	-0.025	-0.379	-0.128**	-0.415**
	(-2.500)	(-0.505)	(-1.549)	(-2.750)	(-3.595)
Choice/select spread	0.037	0.069	0.023	0.049	0.021
	(0.734)	(1.440)	(0.352)	(1.311)	(0.684)
Monthly dummy (default=January)					
February	-0.464	-0.686*	-0.115	-0.241	-0.203
	(-1.119)	(-1.691)	(-0.257)	(-0.717)	(-1.038)
March	-0.612	-0.453	0.028	0.042	-0.092
	(-1.271)	(-0.986)	(0.059)	(0.005)	(-0.456)
April	0.450	0.093	0.464	0.947**	0.608**
	(0.917)	(0.198)	(0.958)	(2.589)	(2.940)
May	1.532**	1.487**	0.687	1.806**	1.305**
	(2.857)	(2.887)	(1.047)	(4.649)	(4.513)
June	-0.023	0.193	-0.630	0.297	-0.577*
	(-0.041)	(0.359)	(-0.817)	(0.714)	(-1.750)
July	-1.407**	-0.855	-2.416**	-0.690	-2.609**
	(-2.084)	(-1.368)	(-2.312)	(-1.468)	(-5.923)
August	-1.485*	-0.592	-2.757**	-0.838	-2.874**
	(-1.948)	(-0.848)	(-2.442)	(-1.537)	(-5.909)
September	-2.806**	-1.562**	-3.652**	-1.513**	-3.636**
	(-3.680)	(-2.205)	(-3.260)	(-2.875)	(-7.862)
October	-1.956**	-1.257**	-2.040**	-0.942**	-2.148**
	(-2.915)	(-1.977)	(-2.241)	(-2.071)	(-5.781)
November	-0.770	-1.546**	-0.641	-0.465	-0.725**
	(-1.369)	(-3.053)	(-0.931)	(-1.157)	(-2.436)
December	-0.115	-1.246**	-0.383	-0.327	-0.360
	(-0.237)	(-2.888)	(-0.663)	(-0.940)	(-1.375)
State dummy (default=Kansas)					
Colorado					-0.255
					(-1.566)
Nebraska					-0.052
					(-0.347)
Texas					0.009
					(0.071)
Contract Change	0.163	1.080*	2.114**	0.726*	1.062**

	(0.272)	(1.933)	(3.257)	(1.825)	(3.213)
Constant	28.085**	6.991	53.927*	18.249**	57.351**
	(3.394)	(1.023)	(1.775)	(3.173)	(4.000)
No. of observations	278	291	139	242	520
R^2	0.66	0.65	0.71	0.71	0.57
rho	0.55	0.50	0.35	0.37	0.18

Note: Two asterisks denote coefficients which are significantly different from zero at the 0.05 level and a single asterisk denotes coefficients which are significantly different from zero at the 0.10 level.

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