SHORT-PERIOD PRICING MODELS FOR FED CATTLE AND IMPACTS OF WHOLESALE CARCASS BEEF AND LIVE CATTLE FUTURES MARKET PRICES

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Cattlemen have expressed concern about wholesale beef and fed cattle pricing and have antitrust lawsuits pending against supermarkets, meatpackers, trade associations, and a meat price reporting firm. Lawsuits allege manipulation of wholesale carcass beef prices to artificially depress spot prices for fed cattle (General Accounting Office, 1977). Congressional and administrative investigations have focused on wholesale carcass beef pricing and price reporting and their effects on fed cattle pricing (Committee on Small Business, General Accounting Office, 1978; National Commission on Food Marketing; Packers and Stockyards Program, 1978). Cattlemen also have expressed dissatisfaction with live cattle futures markets before congressional and administrative committees, alleging that futures market prices adversely affect spot prices for fed cattle (Leuthold and Tomek; Meat Pricing Task Force). However, economists have not empirically studied the impacts of wholesale carcass beef and live cattle futures market prices in short-period pricing models for fed cattle, that is, impacts on individual transaction prices.

Thomsen and Foote indicate that the first phase of price discovery is evaluation of supply and demand conditions and determination of the resulting general price level around which individual transaction prices fluctuate. The second phase consists of determining value of a specific sale lot relative to the general price level, and considering quantity, quality, time, and place dimensions. Much research has been devoted to determining variables that explain and forecast the general price level, but little research has dealt with explaining the second phase of the price discovery process. Tomek suggests that the lack of research is due to difficulties in modeling short-term prices. Research has attempted to explain futures market-spot price relationships over the life of futures market contracts, but little research has attempted to explain the impact of futures market prices on spot prices for a shorter time period, for example, from day to day (Ehrich; Leuthold and Tomek).

This paper reports an empirical study of the short-period pricing process. Alternative models are specified and estimated to explain the price variation among transaction prices for fed cattle, and to determine the impacts of wholesale carcass beef prices and live cattle futures market prices on fed cattle prices.

CONCEPTUAL FRAMEWORK

Price for a specific type of carcass reported by the National Provisioner's *Daily Market and News Service* (the so-called "yellow sheet") serves as a starting point in the pricing process (Ward, 1979). This base wholesale carcass price is an estimate of the current value of a given type carcass (i.e., SWGYG—sex, weight, quality grade, and yield grade). Base SWGYG carcasses for fed cattle are usually choice grade, yield grade 3 steer or heifer carcasses weighing 600–700 pounds. Premiums and discounts for other SWGYG carcasses (which can be determined from National Provisioner reported prices), plus the base price, enable meatpackers to estimate the value of other SWGYG carcasses. Meatpackers also estimate the value of by-products from the slaughtering function, for example, hide and offal.

The theoretical linkage between wholesale carcass beef prices and by-product values to fed cattle prices is based on the concept of derived demand. Thus, a change in the wholesale carcass beef price can be expected to affect the price of fed cattle.

Meatpackers daily develop a pricing policy for cattle (Ward, 1979). They estimate expected returns (at least the current value of beef and by-products) for a given base SWGYG cattle from sales of carcass beef and by-products, subtract slaughter costs and a profit target, and solve the profit equation for the price of cattle. Their pricing policy consists of the dressed weight price for a base SWGYG cattle, plus premiums and discounts for other SWGYG cattle. Meatpackers adjust their pricing policy as conditions warrant, for example, actual carcass and by-product sales as compared with reported wholesale carcass prices or by-product values; estimated changes in carcass beef prices since the last price was reported; estimated near future changes in car-

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cass beef prices; and individual supply and demand conditions.

Cattle buyers attempt to purchase cattle within the pricing policy or buy-order given to them. Most cattle are purchased on a live weight basis (Packers and Stockyards Program, 1980). In the process of computing live weight bids, buyers estimate the proportion of cattle in each pen or sale lot producing carcasses in different quality grade classes (usually choice vs. good), yield grade classes (usually 1–3's vs. 4–5's), and carcass weight classes (< 600 pounds or > 700 pounds vs. 600–700 pounds). They also consider cattle sex, estimated live weight and dressing percentage, and transportation costs from feedlot to slaughter plant, including weighing location and pencil shrink, which are mutually agreed to by the buyer and seller.

Buyers compute bids based on these factors. Bids vary according to the supply-demand position of individual meatpackers relative to competitors. Similarly, sellers offer prices that depend on their economic conditions. Thus, individually discovered prices fluctuate around the average of aggregated transaction prices, that is, the general price level.

Meatpackers do not directly incorporate futures market prices in computing either the pricing policy or price bids, but use futures market prices as a piece of information (Ward, 1979). Leuthold and Tomek note that relatively little theoretical attention has been devoted to the relationship between current futures market price movements and current spot prices for nonstorable commodities such as cattle and hogs. The futures-spot price difference has not been given an economic interpretation similar to the price of storage. Leuthold found a relationship between futures and spot cattle prices, but did not prove causality. Purcell, Flood, and Plaxico attempted to determine causality between fed cattle prices and live cattle futures prices. Initial results suggested causality from futures to spot prices. However, further study suggested bi-directional causality, from futures to spot prices and from spot to futures prices. Thus, they concluded that the evidence in favor of causality from futures to spot prices is not strong.

Observation of daily price movements suggests that futures market prices are related to spot fed cattle prices, despite the lack of a clear theoretical relationship between them. Tomek and Paul indicate that research has found that futures markets have not increased the random variability in spot prices for cattle, but no research has suggested whether futures market price changes have a non-economic, psychological impact on short-run spot price changes.

MODELS SPECIFIED

Three models were specified and four region-sex equations estimated for each model. Model A incorporated variables hypothesized to be important in the price discovery process for fed cattle based on previous research. Model A enables direct estimation of impacts of wholesale carcass beef prices reported by the National Provisioner and of live cattle futures market prices on the short-period pricing process. Model A was

(1) TPFC = f(BWCP, PDQG, PDYG, PDHC, PDLC, LCFP, LTSZ, DTSL, WLPS, DRPR, LVWT, DYFD, BARG, NMBD, NMPK, DMAR)

where

TPFC = Transaction price for each lot of cattle on a live weight basis ($/cwt.)

BWCP = Base wholesale carcass price reported by the National Provisioner for a choice, yield grade 3 steer or heifer carcass weighing 600–700 pounds ($/cwt.)

PDQG = Price differences for cattle estimated to be below choice quality grade, that is [(BWCP minus reported price for good grade carcasses of comparable sex, weight, and yield grade) × proportion of cattle estimated to be good grade or below] ($/cwt.)

PDYG = Price difference for cattle estimated to be yield grades 4 and 5, that is [(BWCP minus reported price for yield grade 4 carcasses of comparable sex, weight, and quality grade) × proportion of cattle estimated to be yield grades 4 or 5] ($/cwt.)

PDHC = Price difference for cattle estimated to produce carcasses weighing 700–800 pounds, that is [(BWCP minus reported price for 700–800–pound carcasses of comparable sex, quality grade, and yield grade) × proportion of cattle estimated to produce 700–800–pound carcasses] ($/cwt.)[1]

PDLC = Price difference for cattle estimated to produce carcasses weighing 500–600 pounds, that is [(BWCP minus reported price for 500–600–pound carcasses of comparable sex, quality grade and yield

[1]Price discounts for heavier carcasses (PDHC) were not applicable in heifer equations because wholesale carcass prices are not reported for 700–800 pound heifer carcasses.

grade) × proportion of cattle estimated to produce 500–600–pound carcasses] ($/cwt.)

LCFP = Live cattle futures market price for the nearby contract delivery month ($/cwt.)[2]

LTSZ = Number of head per lot

DTSL = Distance from feedlot to expected slaughter plant (miles)

WLPS = Weighing location and pencil shrink[3]

DRPR = Estimated dressing percentage of cattle per lot (percent)

LVWT = Estimated live weight of cattle per lot (lbs.)

DYFD = Number of days between sale and delivery of cattle

BARG = Buyer-seller negotiating range, that is, difference between seller's asking price and buyer's first bid ($/cwt.)

NMBD = Number of bids received per lot

NMPK = Number of meatpackers bidding on each sale lot, omitting more than one bid from the same buyer

DMAR = Dummy variable for areas within each region.

The base wholesale carcass price (BWCP) was included, based on derived demand theory, as was the futures market price (LCFP), because of a hypothesized relationship between current futures and spot prices. Price difference variables (PDQG, PDYG, PDHC, PDLC) accounted for the fact that not all cattle in a lot normally meet base SWGYG carcass specifications. Other cattle characteristics were also hypothesized to be important, that is, estimated dressing percentage and live weight.

Conditions of sale were believed to affect the price. A positive relationship between lot size (LTSZ) and price was hypothesized, similar to results for feeder cattle (Madsen and Liu; McCoy et al.). Distance from feedlot to slaughter plant (DTSL) was included as a proxy for transportation costs, and weighing location and pencil shrink conditions (WLPS) were included because they can affect buyers' bids (Ward, 1979).

The number of days on which meatpackers have purchased cattle forward of delivery (DYFD) was a proxy for individualized supply-demand conditions of meatpackers. Packers could be expected to bid less aggressively and pay lower prices when they have purchased a several-day inventory of cattle. However, as number of days between purchase and delivery decline, they were hypothesized to bid more aggressively and bid higher. Another proxy for the supply-demand position of individual meatpackers was the bargaining or negotiating range (BARG). It was hypothesized that a wider bargaining range indicated that packers were less interested in bidding higher and purchasing cattle than when the bargaining range narrowed. However, seller behavior reduces the ability of the bargaining range variable to measure only the buyer's willingness to purchase cattle. High collinearity was expected between these two variables, and both variables thus were not expected to be significant in the same equation.

Two variables proxied the influence of competition from competing meatpackers. The number of bids received per lot (NMBD) was hypothesized to be positively related to price, and a similar relationship was expected for the number of different meatpackers bidding on each lot (NMPK). High collinearity was expected between these two variables also, and both variables were not expected to be significant in the same equation.

Dummy variables were included to account for price differences in the following areas: Texas south plains (TXSP), Texas north plains (TXNP), Oklahoma Panhandle (OKPN), southwest Kansas (SWKS), eastern Nebraska (ETNE), northwest Iowa (NWIA), and central Iowa (CNIA).

Model B was specified according to the pricing process example described by Ward (1979), and was expected to yield improved statistical results relative to model A. Model B substituted a single carcass price variable for the base wholesale carcass price and price difference variables. However, inclusion of the adjusted carcass price precluded direct measurement of the impact of reported wholesale prices as in model A, although reported prices for the base SWGYG carcass and price differences were incorporated in the adjusted carcass price variable. Model B was

(2) TPFC = f(AJCP, LCFP, LTSZ, DTSL, WLPS, DRPR, LVWT, DYFD, BARG, NMBD, NMPK, DMAR)

where

AJCP = Adjusted carcass price, that is (BWCP + PDQG + PDYG + PDHC + PDLC from model A) ($/cwt.).

Other variables are the same as in model A.

The adjusted carcass price (AJCP) reflects the current, estimated dressed weight value of carcasses from a lot, given price differences for carcasses estimated not to meet base SWGYG specifications.

Cattle feeders could estimate sale price or

[2] The nearby contract delivery month (August, 1979, in this study) was hypothesized to be the most significant for cattle purchased during the preceding month.

[3] Weighing location was at the feedlot, slaughter plant, or some other location, for example, local grain elevator. Each location was given a numerical value (1–3, respectfully) and combined with pencil shrink (in percent) to form a single quantitative variable (e.g., 14.0, 20.5, 33.0).

compute their offer price by multiplying the adjusted carcass price times the estimated dressing percentage for cattle in the lot. Estimated and actual sale prices were compared. Model C was specified to explain differences in estimated and actual prices. Differences were hypothesized to be dependent on variables relevant to the pricing process, but not incorporated in the price estimate. Thus, the purpose of model C was to estimate the importance of other variables, especially those relating to meatpackers' supply-demand position and competition among buyers. Model C was

(3) ETPR = f(LCFP, LTSZ, DTSL, WLPS, LVWT, DYFD, BARG, NMBD, NMPK, DMAR)

where

ETPR = Price difference between actual and estimated sales price, that is [TPFC − (AJCP × DRPR)] ($/cwt.).

Other variables were defined previously.

As in model B, this model did not estimate the wholesale price impact directly. Model C incorporated the base wholesale carcass price and price differences, as well as cattle characteristics (except live weight) in the dependent variable.

DATA AND PROCEDURE

Data were collected from 26 commercial feedlot operators in Texas, Oklahoma, and Kansas (Plains region), and from 3 marketing agents representing cattle feeders in Nebraska and Iowa (Midwest region). Feedlot operators in the Plains provided data on 282 pens of cattle, or 48,021 head, and marketing agents in the Midwest provided data on 62 pens of cattle, or 3,565 head (from 49 feeders) during July, 1979.

Feedlot operators and marketing agents were asked to record data on each pen of cattle offered for sale. Data were requested: (1) before buyers bid on cattle (e.g., sex, number of head, estimated proportion of choice grade or above and good grade or below, estimated proportion of yield grade 3 or above and yield grade 4 or below, estimated proportion of carcasses less than 600 pounds, 600–700 pounds, and more than 700 pounds, and estimated live weight and dressing percentage); (2) during the marketing process, which may have been a several-day period (e.g., feeder's asking price, plus first and highest bids by time of day for each bidder); and (3) after cattle were sold (e.g., sale price, meatpacker-buyer, estimated delivery date and expected slaughter plant location, and weighing location and pencil shrink conditions). The relatively short data collection period was chosen because of the burden on respondents to record requested data.

Data on cattle characteristics were estimated by the seller, whose estimates probably varied from buyers' estimates. Both sellers' and buyers' estimates probably varied from carcass data. Bids and resulting sale prices are based on buyers' estimates rather than sellers' estimates, and the extent to which differences are negotiated.

Reported wholesale carcass prices were collected twice daily from the National Provisioner (midday and close), and live cattle futures market prices for the August contract were collected three times daily (open, mid-session–10:15 A.M., and close). Wholesale carcass and live cattle futures price data were matched with data for each pen of cattle by time of day. It was assumed that buyers were immediately informed when the National Provisioner midday and closing price reports, as well as futures market price reports, were released, since most larger meatpackers maintain contact with their buyers via mobile, microwave radio-telephones.

Fed cattle marketing and meatpacker procurement practices vary somewhat between the Midwest and Plains region (Ward, 1979). Thus, data were divided by region and sex.

Data were analyzed by ordinary least squares (OLS) regression. Independent variables in equations reported here were selected on the basis of economic theory and hypothesized relationships, theoretically correct coefficient signs, and statistical significance of the coefficients.

EMPIRICAL RESULTS

Estimation results for each model are shown in Table 1. Specification of models A and B were similar, as were estimation results. Model B performed better in terms of explaining variation in individual sale prices for fed cattle (except the Midwest-heifers equation).

As derived demand theory and meatpackers' pricing practices suggest, the base wholesale carcass price (BWCP) coefficient was positive and statistically significant in model A equations. Similarly, the adjusted carcass price (AJCP) coefficient in model B equations, which incorporated the base wholesale carcass price, was positive and significant.

The coefficient on live cattle futures market prices (LCFP) was positive and significant in all model A and B equations, despite lack of a clear theoretical basis for the futures-spot price relationship. It was hypothesized that transaction prices would be more closely correlated with wholesale carcass prices than live cattle futures prices, but opposite results were found (Table 2).

TABLE 1. Regression Results of Alternative Model Specifications, by Region and Sex.

Variable	Model A				Model B				Model C			
	Plains		Midwest		Plains		Midwest		Plains		Midwest	
	Steers	Heifers	Steers	Heifers	Steers	Heifers	Steers	Heifers	Steers	Heifers	Steers	Heifers
Dependent	TPFC	TPFC	TPFC	TPFC	TPFC	TPFC	TPFC	TPFC	ETPR	ETPR	ETPR	ETPR
Independent												
Intercept	-6.313[a] (.57)	-26.682 (2.35)**	-33.297 (1.59)	-40.621 (2.11)*	-13.970 (1.28)	-27.674 (2.95)**	-53.640 (2.08)*	8.071 (1.49)	-1.679 (.27)	-5.75 (1.13)	-6.801 (1.48)	3.873 (5.52)***
BWCP	.184 (5.77)***	.175 (4.25)***	.296 (2.75)**	.218 (3.46)***	--	--	--	--	--	--	--	--
AJCP	b	--	--	--	.254 (9.16)***	.200 (5.72)***	.440 (3.17)***	.260 (3.72)***	--	--	--	--
LCFP	.593 (10.93)***	.625 (11 09)***	.566 (4.18)***	.600 (5.24)***	.635 (13.07)***	.610 (11.22)***	.373 (2.36)**	.467 (3.43)***	.221 (2.71)***	.182 (2.40)**	.208 (2.99)***	
PDQG	.830 (3.45)***	.371 (1.75)*			--	--	--	--	--	--	--	--
DRPR	.330 (2.39)**	.563 (3.82)***	.529 (1.71)*	.712 (2.46)**	.415 (2.95)***	.564 (4.22)***	.844 (2.36)**		--	--	--	--
LVWT	-.002 (1.67)*				-.009 (6.88)***				-.004 (1.92)*			
LTSZ	.002 (2.36)**			.008 (1.78)*	.002 (2.12)**							
DYFD	-.175 (3.36)***				-.314 (4.05)***				-.836 (6.36)***		-.338 (1.97)*	
BARG	c					-.447 (2.05)**						
NMBD												.347 (2.02)*
NMPK	.216 (3.75)***				.284 (4.00)***				.449 (3.30)***			
TXSP	-.592 (1.94)**		--	--	-1.033 (3.27)***		--	--			--	--
OKPN	-.810 (3.15)***	- 752 (2 77)***	--	--		-.667 (2.56)**	--	--		-1.097 (2.25)**	--	--
SWKS	-1.207 (5.75)***		--	--	-1.348 (6.07)***		--	--	-1.126 (2.44)**		--	--
ETNE	--	--			--	--		1.029 (2.57)**	--	--		
NWIA	--	--			--	--		1.351 (2.69)**	--	--		
CNIA	--	--		-.864 (2.62)**	--	--			--	--		
n	113	60	27	21	51	60	18	19	51	60	17	19
R^2	.867	.892	.866	.950	.963	.900	.898	.925	.719	.146	.438	.194

[a] Numbers in parentheses are absolute values of calculated t-statistics; and *** = .01 significance level, ** = .05 significance level, and * = .10

[b] Variable not included in this equation.

[c] Variable coefficient was not significant or had a theoretically incorrect sign and was dropped from the equation prior to estimating the equation reported here.

TABLE 2. Simple Correlation Among Fed Cattle Prices (TPFC), Wholesale Carcass Beef Prices (BWCP and AJCP) and Live Cattle Futures Prices (LCFP).

	Correlation coefficient (r)			
	Plains		Midwest	
Model	Steer	Heifer	Steer	Heifer
Model A				
TPFC - BWCP	.608	.737	.859	.904
TPFC - LCFP	.772	.872	.902	.894
BWCP - LCFP	.490	.686	.837	.829
Model B				
TPFC - AJCP	.631	.787	.877	.883
TPFC - LCFP	.772	.872	.902	.894
AJCP - LCFP	.500	.697	.857	.826

The correlation was expectedly higher between fed cattle prices and adjusted carcass prices in model B than between fed cattle prices and wholesale carcass prices in model A. However, in both cases, live cattle futures prices were unexpectedly more higher correlated with fed cattle prices than was either carcass price variable.

It was also hypothesized that wholesale carcass prices and live cattle futures prices would be highly correlated. Results supported this hypothesis. Thus, collinearity between these two variables in estimated equations is relatively high. Figure 1 illustrates the correlation among fed cattle prices, wholesale carcass prices, and live cattle futures prices.

Variables directly or indirectly describing cattle characteristics were significant in certain model A and B equations, for example, quality grade (PDQG), live weight (LVWT), and dressing percentage (DRPR). Meatpacker buyers convert the dressed value of a pen of cattle to be a live weight value by multiplying by the estimated dressing percentage. As was expected, the estimated dressing percentage coefficient was positive and significant in nearly all equations in models A and B.

The marketplace discounted yield grade 4 relative to yield grade 3 carcasses by $7.75–$13.75 per hundredweight during July, 1979. That was more than the discount for good relative to choice grade carcasses, $2.00–$8.00 per hundredweight. Yet the price difference variable for quality but not yield grade was significant in some equations. Cattle varied more in quality grade than yield grade, possibly explaining, in part, why quality grade discounts were more important.

The lot size (LTSZ) coefficient was positive and significant in three equations, as hypothesized. However, other variables characterized as terms of sale variables were not significant, for example, distance to slaughter and weighing location and pencil shrink.

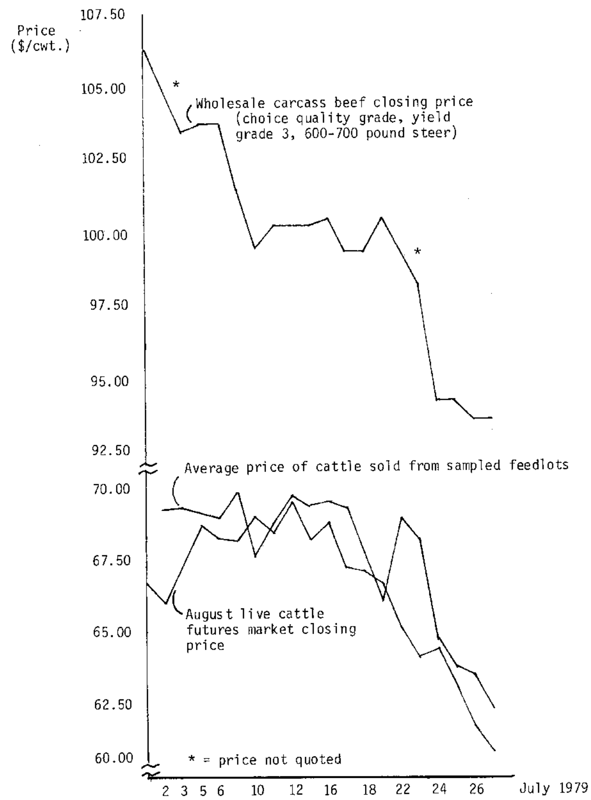

FIGURE 1. Closing Reported Wholesale Carcass Price, Closing August Live Cattle Futures Market Price, and Average Price for Cattle Sold from Sampled Feedlots, by Days, July 1979.

Variables reflecting individualized supply-demand conditions of buyers and competitive conditions were significant in certain equations. The proxy for number of days that meatpackers have cattle purchased forward of delivery (DYFD) was negatively related to transaction prices. This suggests either that meatpackers are less willing to bid higher on cattle if they have an inventory of cattle purchased but not yet delivered, or it reflects meatpackers' expectations of future carcass prices on a declining market. The negotiating range (BARG) coefficient was negative and significant in one equation. This suggests that either buyer or seller quote prices that result in a smaller negotiating range when one side is eager to consummate a transaction, as in the case of sellers on a declining market. The wider the range, the less need one or both parties have to finalize a trade. The number of different meatpackers bidding on cattle (NMPK) was positively related to transaction prices in one equation in both models A and B. A short-period theory of competition might suggest that as more buyers compete for a given supply, bids and sale prices will increase.

Actual sale price (TPFC) and an estimation sale price (ETPR) were found to be relatively closely correlated (r ranged from .634 to .928 in region-sex equations) as expected. Variables hypothesized in model C explained relatively little of the difference in actual versus estimated sale prices, especially for the two heifer equations. The reason for such a difference in explanatory results between steer and heifer equations is unknown. Model C results indicate that cattle feeders need to consider other factors besides the adjusted carcass price and dressing percentage (such as an estimate of hide and offal value and meatpackers' margins) in formulating their offer price.

Live cattle futures prices were significant in explaining actual-estimated prices differences in model C (except the Plains-heifers equation). At least one variable in three of the region-sex equations measured individual supply-demand conditions and competitive conditions of buyers. Number of bids per lot (NMBD) was significant in one equation, suggesting again that when several buyers want the same lot of cattle, they are willing to pay more for it.

IMPLICATIONS AND CONCLUSIONS

Results of this study support Tomek's view of the difficulty of modeling short-period prices. Variation among region-sex equations for the relatively short study period suggests the difficulty of developing accurate short-period forecasting equations. Modeling short-period prices (i.e., transaction prices around the general price level; second phase of the price discovery process) is more difficult than modeling the general price level. Economic variables are unable to measure psychological and sociological subtleties involved in discovering transaction prices in relatively small geographic areas and over short (intraday) time periods.

Two variables explained a significant proportion of the variation in transaction prices for fed cattle, despite differences in region-sex equations within each model. The current reported wholesale carcass price for a base SWGYG carcass was clearly related to transaction prices as the theory of derived demand suggests. Other reported wholesale carcass prices were significant when combined with specific cattle characteristics, that is, price discount variables. Thus, accuracy of reported wholesale carcass prices is important, especially in the National Provisioner, since this is the most-used carcass price reporting service. Further research on thin market impacts of meat price reporting and on the performance of wholesale and farm-level markets is suggested (Packers and Stockyards Program 1978; Ward 1980a, b).

Current wholesale carcass prices were significant in models estimated, but no attempt was made to incorporate leads or lags between transaction prices and wholesale carcass prices. For example, packers buying cattle on Monday may not slaughter them until Thursday and may not ship the beef to retail buyers until the following week. Thus, expected wholesale prices 7 to 14 days forward could be expected to influence meatpackers' current pricing policies. Perhaps some type of distributed lag on the base wholesale carcass price might approximate expectations regarding future directional carcass price movements and better explain transaction price variation.

The second variable consistently explaining variation in fed cattle prices was live cattle futures prices for the nearby contract delivery month. Results indicate relatively high correlation between the current futures price and current spot price, but do not prove causality. Further research is necessary to develop the theoretical relationship, if it exists, between current futures and spot prices for cattle and hogs, and to study the relationship throughout the contract period. Perhaps results vary between early and later months of the contract.

This study indicates that certain types of publicly available information are important in the pricing process, that is, wholesale carcass prices and live cattle futures prices. Meatpackers also consider economic impacts of cattle characteristics or conditions of the sale. Individual supply and demand conditions of meatpackers and competitive conditions also have an impact on the pricing process. Further research is necessary to determine and understand the dynamics of competition in both phases of the price discovery process.

Price differences among areas were unexpected. Additional research could determine whether such differences are transitory or based on fundamental economic conditions resulting in more permanent price differences.

Research also could study stability of results reported here over a longer time period, for a larger sampling base within the areas studied, and over a wider geographic area. Research to estimate daily or weekly general price levels, incorporating slaughter and by-product values by plant, estimated slaughter costs by plant, and boxed beef prices and movements, among other factors, may suggest other short-period model specifications that could be useful in forecasting short-period prices.

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