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NCCC-134

APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

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Suggested citation format:

Schroeder, T. C., and M. L. Hayenga. 1986. "Short-Term Vertical Market Price Interrelationships in the Livestock Meat Sector." Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. St. Louis, MO. [http://www.farmdoc.uiuc.edu/nccc134].

Short-Term Vertical Market Price Interrelationships in the Livestock Meat Sector

by Ted C. Schroeder

and Marvin L. Hayenga*

The intertemporal relationships between live, wholesale, and retail beef and pork prices are important issues in effectively analyzing and monitoring the conduct and performance of the meat processing and retailing industry. Knowledge of how these prices react to one another is useful for private as well as public policy decision making. Market analysts generally agree that the retail, wholesale, and live beef and pork prices are not determined simultaneously, however, there is a lack of agreement on the specific nature of the relationships. Although the physical time required to transfer the beef and pork from the feedlots to the retail shelf, including time for transporting, processing, and packaging, is one factor causing the lag in market price response at various levels, the attempts of retailers to curtail large short-term price fluctuations at the retail level may somewhat cloud the response.

The lack of general agreement among analysts of the response time for changes in live and wholesale beef and pork prices to be reflected in the retail prices may be, in part, a result of the data being analyzed. Heien, using monthly price data from 1960 through 1976, found that wholesale beef prices in the current month and the previous month positively affected the current month's retail beef price, although wholesale beef prices lagged 2 and 3 months negatively affected the current month's retail beef price[1]. Heien also found that current and previous month's average wholesale pork prices positively affected the current retail pork price. Lamm and Westcott, using quarterly data covering the period from 1968 through 1977, found that an index of the current quarterly average retail beef price was positively related to the current and previous quarterly average live cattle prices received by farmers. Lamm and Westcott found that the current live hog price positively affected the current quarter's and the subsequent quarter's retail pork price.

These studies tend to support the claim that retailers are somewhat rigid and reluctant to change meat prices at the retail level as the prices at the wholesale and live levels change. It seems as though retailers set current month's prices based upon current and long-past (as much as 3 months or more) prices at the lower levels of the market channel. However, these results are not necessarily consistent with retailers' typical pricing behavior. These prior studies have not examined the short-term behavior in these markets, and the results may be reflecting only longer term trends in the monthly or quarterly time series.

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Retailers purchase meat this week, take delivery, perform final processing and packaging, and sell the meat about a week or so later. Virtually no aging of beef or pork takes place after slaughtering; as a result, the physical process of transferring beef and pork from the farm feedlot to the retail shelf typically takes less than 2 weeks. Thus, one would expect that, if retailers are operating on some form of markup pricing scheme, they will rapidly adjust the retail price to reflect changes in what they have to pay for meat at the wholesale level. This is consistent with Parham's and Duewer's findings that comparing wholesale beef prices lagged 2 to 3 weeks with current retail beef prices created a more consistent and stable margin series than one determined by simultaneous price comparisons. They also found that lagging wholesale pork prices by 4 weeks created a more consistent margin series than simultaneous price comparisons. Ross echoes the results of Parham and Duewer and adds that if the wholesale price is not lagged (in determining the wholesale to retail price margin), retail prices, which are based on supplies established 2 to 4 weeks earlier, are being compared with live and carcass prices, which are based on today's supply.

King used weekly beef price data from November 1973 through September 1975 to evaluate the lead-lag relationships between retail, wholesale, and live beef. He employed Almon polynomial-distributed lag models with 3- and 6-week lags and cubic and quadratic functional forms for both carcass-to-farm value and retail-to-carcass value. He found that, during this period, changes in the farm value led changes in the wholesale value by an average of less than 1 week. The retail price was found to have an average lag of 1.6 to 2.3 weeks behind the wholesale price, depending on the model used.

Miller (1979 and 1980) used univariate residual cross correlation analysis on weekly beef and pork data covering the period 1974 through 1978. He found that pork farm prices lead wholesale pork prices by 3 weeks and wholesale pork prices lead retail pork prices by 3 weeks. He also found that farm beef prices lead wholesale beef prices by less than 1 week and wholesale beef prices lead retail beef prices by less than 3 weeks. Sims argues that testing the significance of cross correlation coefficients between residuals (as Miller has done) and using that to determine lead-lag relationships is valid only when the independence of the two series is being tested. Boyd and Brorsen used an autoregressive process and Granger-causality analysis to determine the weekly lead-lag relationship between the three market channels for beef and pork using 1974 through 1981 data. They found that the farm pork price led the wholesale pork price by 1 to 2 weeks and that the wholesale pork price led the retail pork price by 5 to 6 weeks. They also found that changes in the farm beef price led changes in the wholesale beef price by 4 to 5 weeks and changes in the wholesale beef price led changes in the retail beef price by 3 to 5 weeks.

The objectives of this study are: 1) to determine the lead-lag relationship between retail, wholesale, and live beef and pork prices in recent years; 2) to compare traditional econometric methods with time series transfer function modeling in analysis of multivariate time series; 3) to evaluate the implications that these results may have on monitoring the conduct and performance of the meat processing and retailing industry.

A crucial part of the analysis used in this study relies on a unidirectional causality of price from one market level to the next. Meat retailers typically follow some form of a markup pricing system. Meat is purchased from wholesalers, and the retailer adjusts the price up enough to cover marketing costs and provide the desired profit per unit. Therefore, it seems appropriate to assume that retail meat price changes are caused by fluctuations in meat prices at the wholesale and farm levels. Heien, utilizing a time-series method of testing for causal direction, found that monthly beef and pork prices both followed a "unidirectional upward" wholesale-to-retail relationship. Boyd and Brorsen likewise found the same unidirectional price relationships using weekly beef and pork price data.[2] That is, beef and pork prices at the farm level affected the wholesale prices which in turn affected retail beef and pork prices with no significant feedback being detected. Thus, the farm price (of beef and pork) unidirectionally causes the wholesale price which unidirectionally causes the retail price. Thus, standard econometric and time-series (transfer function) methods are appropriate to analyze the data.

Model Alternatives

In modeling the relationship between retail, wholesale, and live hog and cattle prices, a number of alternative statistical techniques could be considered. In causal relationships, economists frequently rely on simple ordinary least-squares regression (possibly with some transformations performed on the data such as differencing or logarithmic transformations etc.) to explain a given phenomenon. However, in many instances (and this one in particular) in time-series data, problems occur with spurious correlation and multicollinearity among the regressors (and possibly serial correlation of the residuals), making the estimates inefficient and possibly inconsistent if one has lagged endogenous variables included as the regressors. The Almon polynomial distributed-lag model, which was used by King, is one method frequently employed to reduce multicollinearity among regressors. The problems with the Almon polynomial is that one must know (or assume) either the degree of the polynomial or the proper lag length, and the results of this analysis can be highly dependent on the assumptions made. This Almon polynomial process can easily resort to a search procedure of many polynomial degrees with varying lags, and an excessive number of combinations must be analyzed, thus decreasing the robustness of the model. The problem of serial correlation can be handled through some form of generalized least squares, or one can also oftentimes eliminate much of this problem by using first differences. Likewise, differencing may reduce problems of multicollinearity and spurious correlation. An alternative to econometric modeling in time-series data is to use autoregressive integrated moving-average models (ARIMA). These models are most frequently used for short-term forecasting. Oftentimes, an exogenous (input) variable exists, which can help to explain the dynamic variation of the variable of interest (output). Transfer-function models are one type of time-series analysis that allows one to analyze an endogenous output variable (retail beef or pork prices) based on intertemporal values of itself, an exogenous input variable (wholesale beef/pork or live cattle/hog prices), and model residuals (Jenkins).

The procedure involved in transfer-function modeling as outlined by Box and Jenkins is briefly as follows:

1. Choose the tentative model that involves:

   a) Identify and estimate the "best" ARIMA model for the input series. "Best" infers that the model has the smallest standard error of the residuals and that all model diagnostic checks are satisfied (such as residual independence, stationarity, etc.).

   b) Prewhiten the input and output series using the "best" model estimated for the input series.[3]

   c) Obtain a cross-correlation function of the residuals from the two prewhitened series.

   d) Compare the calculated cross-correlation function with theoretical cross-correlation functions, and identify a transfer function model that is implied.

2. Estimate the model implied by the cross-correlation function.

3. Perform diagnostic checks of the model for residual independence, low mean squared error of the residuals, significant parameter estimates, etc. Then, if necessary, iterate back into step 1 and repeat the sequence until a satisfactory model is obtained.

Transfer-function modeling involves closely scrutinizing the data to reduce spurious correlation that the data are portraying, remove autocorrelation of the input series, and adjust for serial correlation of the estimated model residuals. Econometric procedures, on the other, hand will not help one to distinguish between spurious correlation and causation. In addition, econometric models that introduce a regression coefficient at each lag may result in overparameterization and possibly high multicollinearity, leading to estimates with poor statistical properties (such as insignificant estimates, improper signs etc.).

The transfer-function model, by being determined or driven by the data, allows for a more parsimonious model with better-quality estimates (in terms of statistical significance, Jenkins). With potential problems of spurious correlation among variables in an econometric relationship, a very high R^2 value may frequently occur due to the spurious behavior of the variables as opposed to the strength of the relationship between the independent and dependent variables. The transfer-function modeling procedure, on the other hand, allows a method by which to reduce the error structure to a white-noise process and also remove much of the spurious correlation between the data series of interest (Jenkins). A stronger statement can then be made about the lag structure implied as being nearer what the data actually are protraying than what an exploratory econometric model may show.

Data Analysis

The data analyzed in this study consisted of weekly average live interior Iowa slaughter steer (IIB) and barrow and gilt (IIP) prices, midwest river basis weekly average yield grade number 3 600- to 700-pound carcass steer prices (CS3), an approximate midwest river basis weekly average hog carcass price[4] (CH), and composite weekly average retail beef (RETB) and pork (RETP) prices covering the years 1983 and 1984.[5]

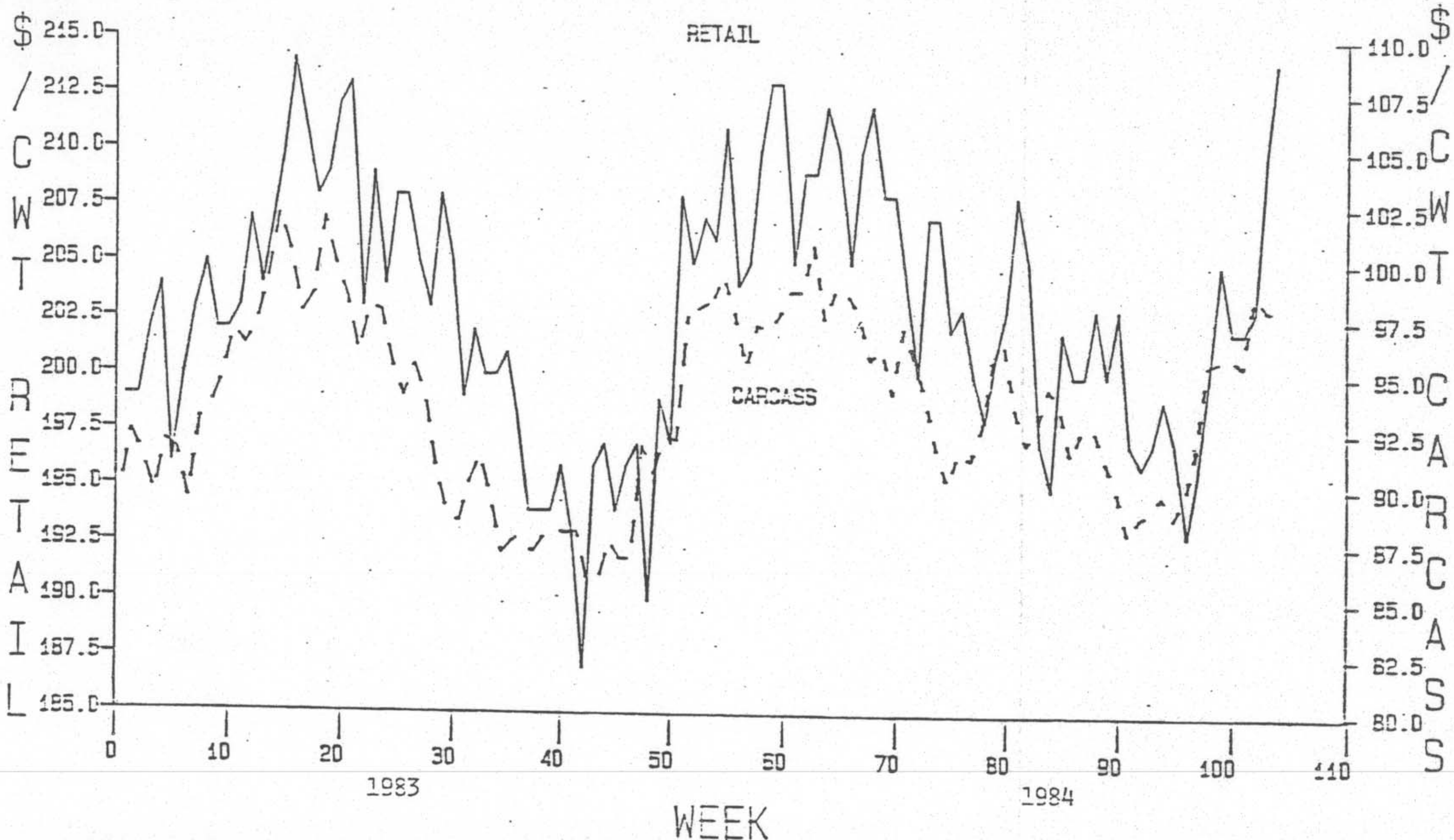
Of primary interest was the relationship between retail and wholesale meat prices. Figures 1 and 2, respectively, show the relationship between wholesale and retail beef and pork prices. In figure 1, it appears that the wholesale and retail prices of beef follow a very similar pattern. The wholesale (carcass) price of beef appears to lead the retail beef price by 1 or 2 weeks during most of the significant price fluctuations. The pork wholesale (carcass) prices and retail prices, as shown in figure 2, do not appear to be as closely related as the beef prices. The two pork price series do follow the same general trend, but the short-term fluctuations between wholesale and retail are not as visibly as closely related as were the beef price series. If one looks in particular at late 1983 and most of 1984, it does appear that the retail pork price lags behind the wholesale price by as much as 2 to 3 weeks, though it is difficult to make any conclusive statements about the relationship.

Table 1 provides summary statistics of the live, wholesale, and retail prices. These results indicate that the retail beef and pork prices have a much higher variance than either the wholesale or live prices. However, the coefficients of variation are much lower for the retail prices than for the wholesale and live prices. This appears consistent with the claim that retailers are reluctant in the short run to change prices proportionately to the fluctuations occurring at the live and wholesale levels. The coefficients of variation for live hog prices are about twice the magnitude of the retail pork-price coefficient of variation, indicating that the hog prices are proportionately twice as variable as retail pork prices. Similarly, live cattle prices are proportionately about 1.5 times as variable as retail beef prices. The wholesale beef and pork prices are likewise more variable in percentage terms than retail prices, but are, in general, slightly less variable than live prices. It is interesting also that the pork prices at the various levels are more variable (proportionately) than the respective beef prices. This could be partly because pork supplies usually are less stable within a year, and the price flexibilities for pork are typically greater than for beef.

Results

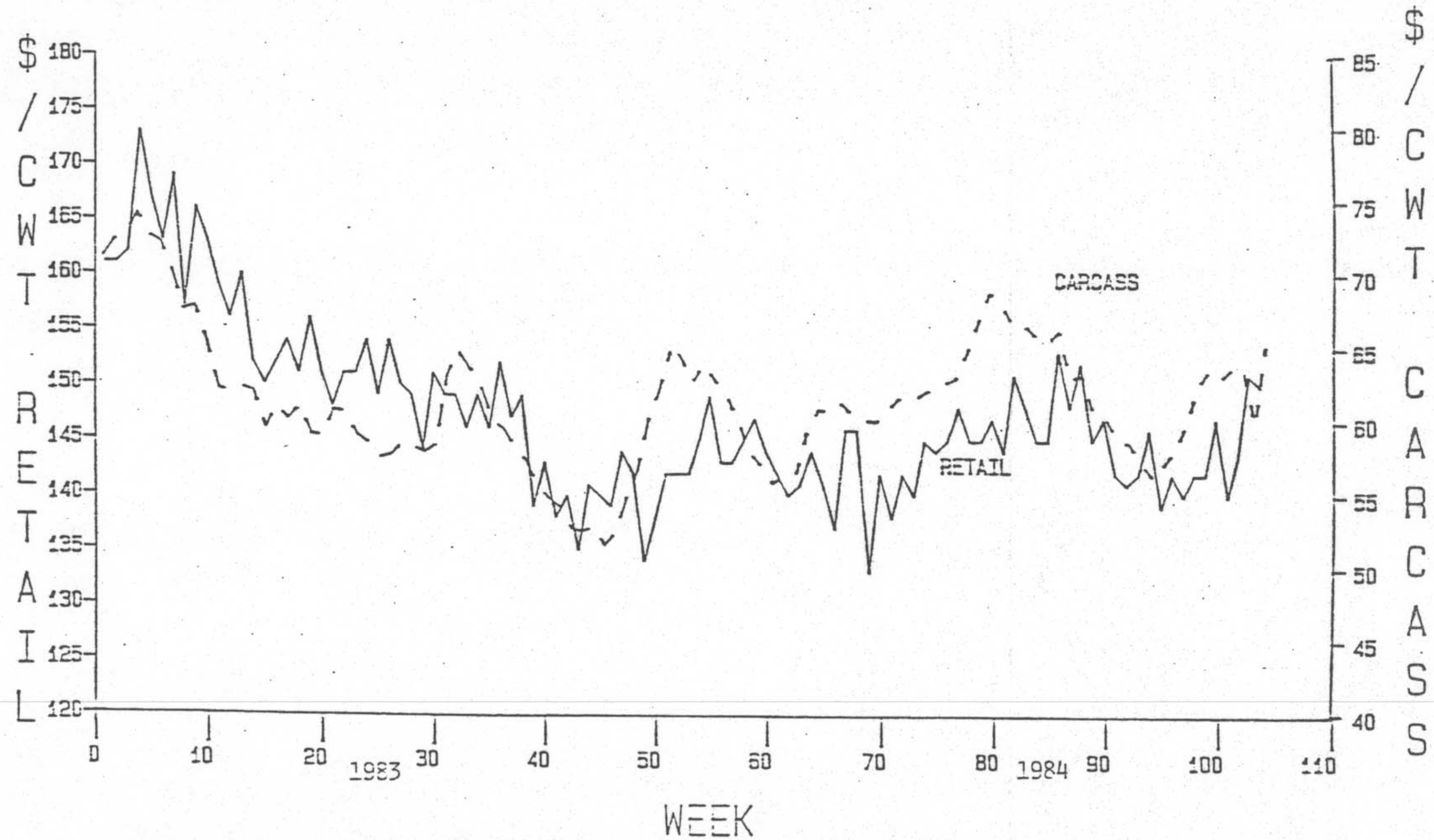
The wholesale-to-retail price relationships were estimated by two techniques, a regression model and a transfer-function model. In using a transfer-function model, one must make certain that the (transformed) data is stationary. Stationarity involves two general facets. First, the data should possess a "constant" mean; that is, the data series (to which the model will be fit) should not have a trend over time. Second, the data should have a constant variance over time. The techniques used to test for these factors and/or for indicating the correct transformations to render the data series stationary vary. A test to determine whether the variance is constant is to construct a mean-variance plot[6]. By splitting the data into subperiods, calculating the mean and variance of the subperiods, and plotting them, one can determine if a relationship exists between the mean and variance. The 2 years of weekly data were split into 10-week subperiods, and the mean and variance of the subperiods were then plotted.

FIGURE 1: OVERLAY OF WEEKLY RETAIL AND WHOLESALE BEEF PRICES FOR THE YEARS 1983-84*



*RETAIL PRICES WERE OBTAINED FROM THE COMMODITY NEWS SERVICE (CNS). WHOLESALE (CARCASS) PRICES WERE TAKEN FROM THE NATIONAL PROVISIONER - YELLOW SHEET

FIGURE 2: OVERLAY OF WEEKLY RETAIL AND WHOLESALE PORK PRICES FOR THE YEARS 1983-84*



*RETAIL PRICES WERE OBTAINED FROM THE COMMODITY NEWS SERVICE (CNS). WHOLESALE (CARCASS) PRICES ARE A WEIGHTED AVERAGE OF INDIVIDUAL WHOLESALE PORK CUT PRICES TAKEN FROM THE NATIONAL PROVISIONER - YELLOW SHEETS.

TABLE 1: Annual Summary Statistics for Retail, Wholesale, and Live Beef and Pork Prices for 1983 to 1984

Year	Item[1]	Mean Price ($/cwt)	Minimum Price ($/cwt)	Maximum Price ($/cwt)	Variance	Coefficient of Variation
1983	RETP	150.56	134.00	173.00	81.74	6.01
	CH	61.86	52.18	74.68	34.06	9.43
	IIP	47.28	37.58	58.88	29.33	11.45
	RETB	202.04	187.00	217.00	39.68	3.12
	CS3	92.70	86.00	102.20	20.65	4.90
	IIB	63.22	58.13	69.55	10.64	5.16
1984	RETP	144.14	133.00	153.00	15.06	2.69
	CH	62.31	56.41	69.35	10.22	5.13
	IIP	48.74	43.20	54.85	8.78	6.08
	RETB	203.81	193.00	214.00	26.43	2.52
	CS3	94.85	88.17	101.00	11.20	3.53
	IIB	66.26	60.90	70.05	5.01	3.38

[1] RETP = weekly retail price of pork, an average of ten specific retail pork cuts from nine major U.S. cities from the Commodity News Service.

CH = weekly average hog carcass price, a weighted average of 8 specific wholesale pork cuts from the National Provisioner (Yellow Sheet).

IIP = weekly average Interior Iowa Market hog price.

RETP = weekly retail price of beef, an average of 15 specific retail beef cuts from nine major U.S. cities from the Commodity News Service.

CS3 = weekly average yield grade number 3 600 to 700 pound steer carcass prices from the National Provisioner (Yellow Sheet).

IIB = weekly average Interior Iowa Market steer prices.

The wholesale and retail beef price mean-variance plot showed no trend, indicating that no relationship existed between the mean and the variance; thus, the variance is assumed constant. The wholesale pork price likewise showed very little relationship between the mean and variance. The retail pork price, however, portrayed an upward-trending relationship between the mean and variance, indicating the need for a transformation to reduce the nonstationarity of the variance. For this reason, a natural logarithmic transformation of the pork prices was performed. Any possible trends in the data can be detected by observing the autocorrelation function (ACF) and partial autocorrelation function (PACF) of the (transformed) data. Required differencing schemes are then introduced into the respective models as they become necessary to make the mean of the data stationary. For all of the beef and pork models analyzed only (weekly) first differences were required.

A summary of the two models (regression and transfer function) for beef and pork is shown in table 2. The econometric model is reported for comparison purposes only. It was estimated using the lags implied by the cross correlation function of the residuals from the prewhitened data series. This was done to avoid the exploratory problems already discussed in econometric models of this type. Univariate Box-Jenkins ARMA models for the retail series are provided for comparison purposes to determine how much information about retail prices, if any, is provided by the wholesale price. The measure chosen to compare models is the root mean squared error (RMSE). The RMSE is used because it will not arbitrarily improve (decrease) as one adds parameters to the model as the R^2 (increase) will, and it can be used to compare models in which the R^2 is not a meaningful statistic, such as in models without an intercept. One can readily observe the decline in RMSE for both beef and pork in going from the ARMA models to the transfer function. For beef, the RMSE declines by more than 20 percent, and the RMSE for pork declines by 10 percent in going from the univariate ARMA models to the transfer-function model. Thus, the wholesale price does add information useful in explaining fluctuations in the retail price above and beyond the information contained solely in the price history of retail prices alone.

For beef, both the regression model and transfer-function model indicate that this week's retail price is a function of the wholesale beef price of 1 week and 2 weeks earlier. The coefficients in the model are both slightly lower for the transfer function than for the regression. The RMSE declines by about 20 percent in moving from the regression to the transfer model, indicating that the transfer function is a better-fitting model. The lagged error term (moving average term) in the transfer function indicates that beef retail prices are somewhat rigid. If the retail price last week was high relative to the wholesale price of 1 and 2 weeks earlier, it would be expected to remain high again this week.

A comparison of the pork regression and transfer-function models yields results similar to those of the beef models. The RMSE is reduced significantly in moving from the regression to the transfer model. However, the retail pork price is found to be most significantly related to the wholesale pork price of 2 weeks previous and slightly less significantly to the wholesale price 3 weeks previous. A significant portion of pork is further processed rather than sold as fresh pork, and this may be one factor contributing to the longer lags for pork. The wholesale pork price lagged 1

TABLE 2: Summary of Regression, ARMA, and Transfer Function Models of Wholesale to Retail Beef and Pork Price Relationships[1]

	Dependent Variable	Estimates[2]	Root Mean Squared Error
BEEF	REGRESSION[3]:		
	$\Delta RETB_t$ =	$.064 + .826\Delta CS3_{t-1} + .582\Delta CS3_{t-2}$	3.76
		(.17) (4.03) (2.85)	
	ARMA:		
	$RETB_t$ =	$.750 RETB_{t-1}$	3.92
		(11.04)	
	$\Delta RETB_t$ =	$.439\varepsilon_{t-1}$	3.91
		(4.75)	
	TRANSFER FUNCTION:		
	$\Delta RETB_t$ =	$.785\Delta CS3_{t-1} + .442\Delta CS3_{t-2} + .943\varepsilon_{t-1}$	3.01
		(5.06) (2.95) (31.10)	
PORK	REGRESSION:		
	$\Delta \ln RETP_t$ =	$-.001 + .233\Delta \ln CH_{t-2} + .141\Delta \ln CH_{t-3}$	.175
		(-.34) (1.66) (1.01)	
	ARMA:		
	$\Delta \ln RETP_t$ =	$.573\varepsilon_{t-1}$	.027
		(6.95)	
	$\Delta \ln RETP_t$ =	$-.608\Delta \ln RETP_{t-1} - .231\Delta \ln RETP_{t-2}$	.027
		(-6.20) (-2.33)	
	TRANSFER FUNCTION:		
	$\Delta \ln RETP_t$ =	$.229\Delta \ln CH_{t-2} + .132\Delta \ln CH_{t-3} + .581\varepsilon_{t-1} + .146\varepsilon_{t-5}$	.025
		(1.98) (1.26) (6.49) (1.46)	
	$\Delta \ln RETP_t$ =	$.189\Delta \ln CH_{t-2} + .113\Delta \ln CH_{t-3} - .768\Delta \ln RETP_{t-1}$	.024
		(1.76) (1.24) (-9.15)	
		$+ .417\varepsilon_{t-1}$	
		(3.40).	

[1] Models estimated with weekly price data from January 1, 1983, through December 31, 1984. Original series has 104 observations

[2] t - statistics in parenthesis

[3] Δ-implies weekly first difference; t refers to week number; ε is a random error term.

All other variables are as previously defined. Each equation actually represents the expected dependent variable, alternatively one could implicitly add a random error term to each model.

week did not have a significant impact on the retail pork price in the current week. Boyd and Brorsen point out that the autoregressive portion of the time series model may cause an underestimation of the lead-lag relationship. This is only a potential problem for the second pork transfer function reported in table 2 (due to the inclusion of an AR(1) process in the retail pork transfer function model). However, the lag structure implied is the same for both of the pork models; therefore, this likely is not a problem in these results. Nonetheless, it is a potential problem one should be aware of in using such models.

A comparison of transfer functions for beef and pork using the wholesale carcass prices and live animal prices is shown in table 3. Generally, the wholesale and live prices are determined simultaneously. This is consistent with Parham and Duewer's findings that farm-level meat price changes are usually reflected into wholesale meat prices in 1 week or less. This was also tested by computing the cross correlation function of the prewhitened wholesale and live price series; for both beef and pork, the most significant correlation implied simultaneous price movement. This is also reconfirmed by comparing the transfer functions with live prices used as an input variable versus those with wholesale prices used as the input. The beef transfer function changed very little, with the magnitude of the input coefficients increasing some, as would be expected given the relative magnitudes of the respective price series. The pork transfer function estimated with live hog prices as the input variable yielded somewhat less conclusive evidence on the relationship between pork prices at the respective levels. The lag structure implied by the cross-correlation function (CCF) was the same for the live-hog model as for the carcass model. However, in the live-hog transfer function the live-hog price lagged 2 weeks had no significant effect on current week's retail pork prices. The live pork price lagged 3 weeks had the most significant impact on the current week's retail pork price. This may provide some evidence that the farm level pork price leads the wholesale pork price by 1-2 weeks.

The results found here differ in some regards from those found by previous studies using weekly data. The beef model results are consistent with King, Parham and Duewer, and Miller (1980) all of whom found that farm level beef prices lead wholesale level beef price by 1 week or less. Likewise they also found that wholesale beef prices (on average) lead retail beef prices by 3 weeks or less. Our results indicate a 2 week lead-lag relationship between wholesale and retail beef prices which is consistent with these previous results. Boyd and Brorsen found quite different results in that the farm beef price led the wholesale beef price by 4 to 5 weeks and the wholesale beef price led the retail beef price by 3 to 5 weeks.

The results of the pork models are somewhat different from previous results. The simultaneity of wholesale and farm pork prices (or possibly as much as a one week lag of the wholesale price as indicated by the transfer function in table 3) are different from those found by Miller (1979) who found farm pork prices led wholesale pork by 3 weeks and Boyd and Brorsen found a 1 to 2 week lead time. In the wholesale to retail pork price relationships we found wholesale pork prices leading retail prices by 3 weeks which is consistent with what was found by Parham and Duewer and Miller (1980), but again different from the 5 to 6 week lead-lag

TABLE 3: Comparison of Transfer Function Models Using Weekly Live Interior Iowa Prices versus Using Wholesale Carcass Prices 1983-84

	Dependent Variables	Estimates[1]	Root Mean Squared Error
BEEF:	Live Interior Iowa $\Delta RETB_t$ =	$.812\Delta IIB_{t-1} + .649\Delta II_{t-2} + .824\varepsilon_{t-1}$ (2.07) (1.70) (13.01)	11.92
	Carcass $\Delta RETB_t$ =	$.785\Delta CS3_{t-1} + .442\Delta CS3_{t-1} + .943\varepsilon_{t-1}$ (5.06) (2.95) (31.10)	3.01
PORK:	Live Interior Iowa $\Delta lnRETP_t$ =	$.034\Delta lnIIP_{t-2} + .187\Delta lnIIP_{t-3} + .578\varepsilon_{t-1}$ (.29) (1.61) (6.38) $+ .103\varepsilon_{t-5}$ (1.03)	.026
	Carcass $\Delta lnRETP_t$ =	$.229\Delta lnCH_{t-2} + .132\Delta lnCH_{t-3} + .581\varepsilon_{t-1}$ (1.98) (1.26) (6.49) $+ .146\varepsilon_{t-5}$ (1.46)	.025

[1] t statistics in parenthesis

All variables are defined as previously.

relationship between wholesale and retail pork prices as was found by Boyd and Brorsen.

These results thus are similar to some previous work and different from some others. Part of the differences may be related to the following: 1) Our 1983-1984 data series is more recent; most previous studies were evaluating data in the late 1970's, with the exception of Boyd and Brorsen whose data series goes up through 1981. 2) We have used Interior Iowa live prices, yellow sheet wholesale price data, and Commodity News Service retail price data; most of the previous studies used USDA price data. Small differences in reporting and locational differences of the data may have a slight impact on the lead lag structure found. Bailey and Brorsen for example, found that live cattle prices in Texas lead those in the Omaha area and (as pointed out by an anonymous journal reviewer) this may well explain partially the shorter lag relationships we have found for farm to wholesale beef prices (though this could only explain about a 1 week difference and not the 3 or more weeks we found). 3) We have used a different technique in estimating these relationships; others used various techniques ranging from econometric procedures to Granger causality types of analysis. The transfer function approach used here reduces the two data series of interest to white noise processes and thus, the estimated model approximates the relationship between the two series after removing most other influences extraneous to the analysis (such as serial correlation of the series with itself).

Implications

This study found that retail beef and pork prices typically lag behind the wholesale and live prices by 1, 2, and as much as 3 weeks. In light of this, claims by retailers that the farm-to-retail margins, as reported by the U.S. Department of Agriculture (USDA), are not representative of the true market, may be reinforced here. The USDA margin series is calculated by comparing the current month's retail and live (wholesale) prices. However, if live and wholesale prices lead retail prices by as much as 3 weeks, the monthly margin is clearly not representative of the actual prices paid and received by retailers in the short run. The margin, as calculated, compares prices of different forms of product (as it is intended to do) but also over different time periods, which distorts its interpretation.

In short-term evaluations of increasing (decreasing) margins (as they are presently calculated), one must also be aware of what the direction of price movement has been before one can make any meaningful judgments. For example, if live and wholesale meat prices decline substantially in the last 2 to 3 weeks of a month, the live-to-retail margin will undoubtedly increase. Accusations by consumer and producer groups of retailers failing to react to declining prices, however, cannot be substantiated based on this short-term widened margin because the impact of the declining prices has not had time to reach the retail shelf yet. In a rising market, the farm-to-retail margin (as currently calculated) would be expected to decline in the short run, assuming that all other factors affecting the margin, such as labor costs, transportation, and interest rates, remain fairly stable.

FOOTNOTES

[1] The wholesale beef price lagged 4 months was also reported by Heien as being positively related to current monthly average retail price. However, it was not significantly different from zero at the .05 significance level.

[2] Heien used the "Granger causality test"; a time series approach involving a regression of the filtered values of the original series of retail and wholesale prices, respectively, one on future prices of the other and testing the significance of the coefficients to determine causality and direction of causality.

[3] The purpose of prewhitening is to reduce the autocorrelation that can exist in the input series. Prewhitening allows one to calculate the correlation between the input and output series, having allowed for the autocorrelation of the input series with itself. As a result, this process will also tend to reduce any spurious correlation exhibited between the input and output series (Jenkins).

[4] Beef carcass prices are from the National Provisioner summary of the yellow sheet prices. Because no hog carcass prices are actually negotiated or reported, the carcass price was estimated by using the weighted sum of the National Provisioner prices of the various wholesale pork cuts. The weights used were those estimated by the Livestock Division of the U.S. Department of Agriculture as published in the Livestock Meat and Wool Market News weekly statistics. The hog carcass price estimates used in this analysis were based on wholesale cuts composing 89 percent of the total carcass weight. The 11 percent of the carcass weight not specifically averaged into the carcass price included primarily low value items such as neck bones, feet, tails, and waste. Thus, the 89 percent of the carcass weight averaged in the carcass price likely accounts for even a higher percentage of the variability in the carcass price because the low value items such as feet and tails would not have much effect on the price of the entire carcass.

[5] The composite retail prices are simple averages of weekly prices of specific 10 retail cuts (pork) and 15 retail cuts (beef) from 9 major U.S. cities as collected and reported by the Commodity News Service (CNS).

[6] There are some formal statistical tests available for testing the stationarity of the variance; however, Granger and Newbold argue that informal inspection of the plots of the data or a mean variance plot of the data split into subperiods are as useful as any other procedure.

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