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Lead/Lag Relationships Between Retail, Wholesale and Farm Beef Price Changes

by

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ABSTRACT

This research used first difference equations to examine lead/lag relationships between retail, wholesale, and farm beef price changes. It was determined that changes in the price of beef at the farm level tended to be reflected in price changes at the retail level in 9-11 months. Changes in the price of beef at the retail level tended to be reflected in price changes at the farm level in 8-10 months. Adjustments between the wholesale and retail price was responsible for most of the time lag between farm and retail, regardless of direction.

Lead/Lag Relationships Between Retail, Wholesale and Farm Beef Price Changes

Introduction

Over the last twenty years price spreads for beef have increased dramatically. Figure 1 depicts the carcass to retail and farm to retail beef price spread. Price spreads are computed by taking the price in some higher level in the marketing chain and subtracting a comparable price from a lower level in the chain. For example, the farm to retail beef price spread is equal to the average retail price minus the average farm price on a comparable unit basis (Ikerd).

Price spreads are important at all levels in the marketing chain. Price spreads represent the costs of preparing the product for the next higher step in the marketing chain plus any profits. Price spreads also represent the different levels' share of the consumer dollar. A major beef retailing cost is labor for cutting, packaging, and stocking retail beef cuts as well as providing customer service. Other major costs include energy and the transportation costs needed to get the beef to the consumer. Costs of wholesaling include those costs of fabricating beef into primal cuts and transporting, storing, delivering, and cutting the beef carcasses for use at the retail levels. Major farm costs include transportation, yardage, and marketing fees in addition to the costs of production (Ikerd).

Economic theory explains part of the relationship between price at varied levels in the marketing chain. Supply is primary at the farm level

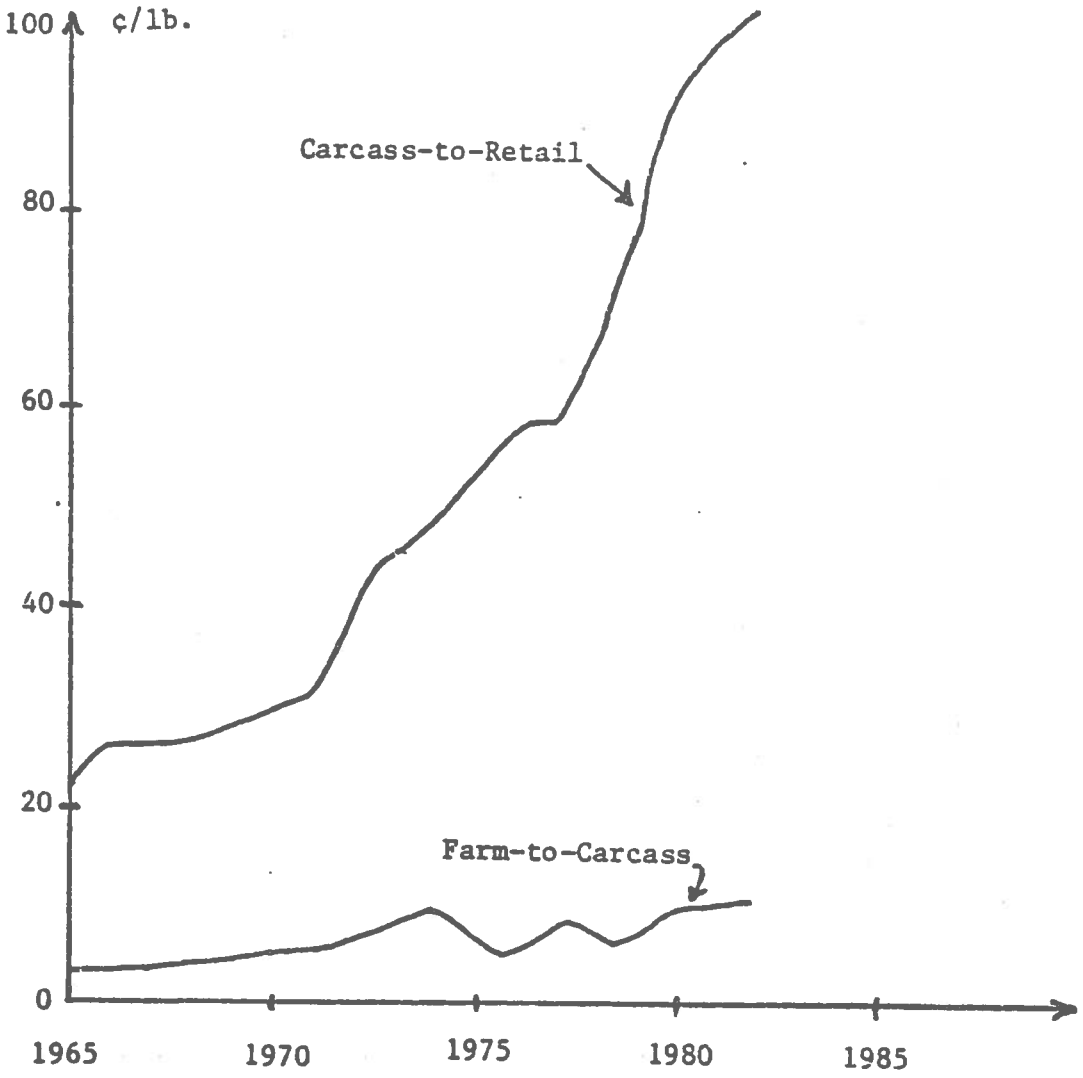

Figure 1 Farm-to-Carcass and Carcass-to-Retail Beef Price Spreads, Average U.S., 1965-1982.

with supply at higher levels in the chain derived. Demand is primary at the retail level with demand at lower levels in the marketing chain derived. Hence, price signals should move in a bidirectional manner with changes in either supply or demand being reflected up and own the marketing chain (Friedman).

However, theory does not give insight into the amount of time required to send price signals up and down the marketing chain. Information regarding leads and lags is necessary to build either explanatory or predictive models of the beef marketing system. The objective of this paper is to describe the lead/lag relationships between retail, wholesale, and farm beef price changes.

Methodology

Causality is a complex and often controversial issue (Granger; Jacobi et al.; Sims; Zelner). However in this instance, theory has been sufficiently developed to establish bidirectional causality. A series of equations were developed using first differences of prices to determine significant leads and lags between price changes at different levels in the marketing chain.

Specifically, first differences of retail, wholesale, and farm beef prices were regressed against lags (ranging from 1 to 12 months) of these first differences. A statistically significant explanatory variable of lag n indicated that the explanatory price change had a statistically significant influence on the dependent price change n months later.

Data consisted of average monthly U.S. prices for choice, yield grade 3 beef from January 1973 to August 1983 for retail price, gross carcass value,

and gross farm value. Throughout the paper the following abbreviations are used: R = first difference of retail price; W = first difference of wholesale price; F = first difference of farm price; and Rn, Wn, or Fn equals a n period lag of R, W, or F.

Results

Retail to Farm

Table 1 presents models explaining the dependence of changes in the farm price of beef on changes in the retail price of beef. The only explanatory variables which are significant are those associated with 8, 9, and 10 month lags of retail price changes. Each of these variables are significant at the .0001 level. Hence changes in the retail price of beef tend to be reflected in changes at the farm level 8-10 months later. The different signs associated with the different lags are probably indicatitive of a more complex structure than was tested by the models.

Retail prices have a tendency to change relatively slowly (especially in the downward direction). It was hypothesized that most of the time lag in sending price signals from retail to the farm level would occur between the retail and wholesale level as opposed to between the wholesale and farm level. In other words, prices changes occuring at the retail level would be reflected in wholesale prices more slowly, than price changes occuring at the wholesale level would be reflected in farm prices. To test this hypothesis, models were developed to measure the responsiveness between price changes at the wholesale and farm levels. The remainder of the 8-10 month lag between retail and farm could be attributed to the lag between retail and wholesale prices.

Table 1: Models Explaining the Dependence of Farm Beef Price Changes on Retail Beef Price Changes.

Model	Dep Var	I	R	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R^2
1	F	.382 (.7783)	.016 (.665)													.001505
2	F	.328 (.8105)		.025 (.4806)												.004029
3	F	.036 (.8245)			.008 (.8315)											.000376
4	F	.347 (.8028)				-.017 (.6277)										.001924
5	F	.306 (.8273)					.004 (.9118)									.000102
6	F	.297 (.8335)						-.004 (.9063)								.000116
7	*F	.278 (.8453)							-.008 (.8279)							.000399
8	F	.167 (.9070)								-.012 (.7395)						.000941
9	F	.149 (.9093)									.164 (.0001)					.171722
10	F	.773 (.3290)										-.331 (.0001)				.700760
11	F	.255 (.8466)											.168 (.0001)			.179948
12	F	.455 (.7568)												$9.177e^{-5}$ (.998)		.000001
13	F	.260 (.8594)													.021 (.5536)	.093114

*F = first difference of farm beef price. R = First difference of retail beef price. I = intercept. Rn = n month lag of R. Numbers in parenthesis are observed significance levels.

Models 14 and 15 describe the dependence of farm price changes on wholesale price changes. Numbers in parenthesis are observed significance levels. Although other lags were tested, the only significant lag was a one month lag. Hence changes in wholesale prices tend to be reflected in farm prices quickly (either in the same month or with a one month lag). Most of the lag between changes in retail prices and farm prices can be attributed to the lag between changes in retail prices and wholesale prices.

Model 14 $F = .8150 + .5610W \quad R^2 = .50$

$(.9476) \quad (.0001)$

Model 15 $F = .4500 - .2280W1 \quad R^2 = .08$

$(.7313) \quad (.0011)$

Farm to Retail

Models 16 through 28 are presented in Table 2. The models demonstrate that changes in the farm price if beef tends to be reflected in retail prices from 9 to 11 months later. Lags of beef farm prices from 1 month to 13 months were tested but only the lags associated with 9, 10, and 11 months were statistically significant. All of the variables associated with these months were significant at the .01 level or better. As with the retail to farm models, however, the different signs for F9, F10, and F11 in models 25, 26, and 27 are probably indicitive of a more complex model than tested.

Again, it was hypothesized that the majority of this 10 to 11 month lag occurs between the wholesale and retail levels. Models 29 and 30 were designed to test this hypothesis. Other lags of farm price were tested but only F and F1 were significant. The numbers in parenthesis are observed

Table 2: Models Explaining the Dependence of Retail Beef Price Change on Farm Beef Price Changes*

Model	Dep Var	I	F	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	R^2
16	R	.922 (.77)	.097 (.665)													.001505
17	R	.787 (.8175)		.056 (.8025)												.000506
18	R	.734 (.831)			.083 (.713)											.001103
19	R	.812 (.8149)				-.068 (.7631)										.000747
20	R	.844 (.8092)					-.112 (.6236)									.001997
21	R	.797 (.8213)						-.011 (.9617)								.000019
22	R	.824 (.8168)							-.078 (.7333)							.000979
23	R	.797 (.8239)								.159 (.5849)						.002536
24	R	.819 (.8207)									.242 (.5709)					.002753
25	R	.341 (.9229)										1.225 (.0036)				.070550
26	R	1.589 (.6342)											-1.943 (.0001)			.177430
27	R	.265 (.9407)												1.322 (.0018)		.081894
28	R	.691 (.8537)													.147 (.7375)	.000998

*R = first difference of retail beef price. F = first difference of farm beef price. I = intercept. Fn = n month lag of R. Number in parenthesis are observed significance levels.

significance levels. As with the retail to farm models, the reaction to price signals between the farm and wholesale levels occurs relatively quickly. The majority of the 9 to 11 month lag required for price changes occuring at the farm to be reflected at the retail level, occurs between the wholesale and retail level.

Model 29 $W = .0257 + .8920F \quad R^2 = .50$

$(.9831) \quad (.0001)$

Model 30 $W = .4750 - .3170F1 \quad R^2 = .60$

$(.7363) \quad (.0045)$

Conclusions

Figure 2 graphically illustrates the time required for price changes at a single level to be incorporated into the price at a different level in the beef marketing chain. Price changes, with the resulting signals, have a tendency to move slightly faster down the marketing chain than when moving up the chain. Changes in prices at the retail level have a significant effect on changes in farm prices in 8 to 10 months. Whereas, changes in price at the farm level have a significant effect on change sin retail prices in 9 to 11 months. Changes in price at the wholesale level are reflected in farm price changes within a month and vice versa.

The findings should prove useful for those developing either price prediction equations or structural equations for the beef marketing system. Because of the relative simplicity of the models presented, caution should be exercised in applying the results directly for prediction. Other

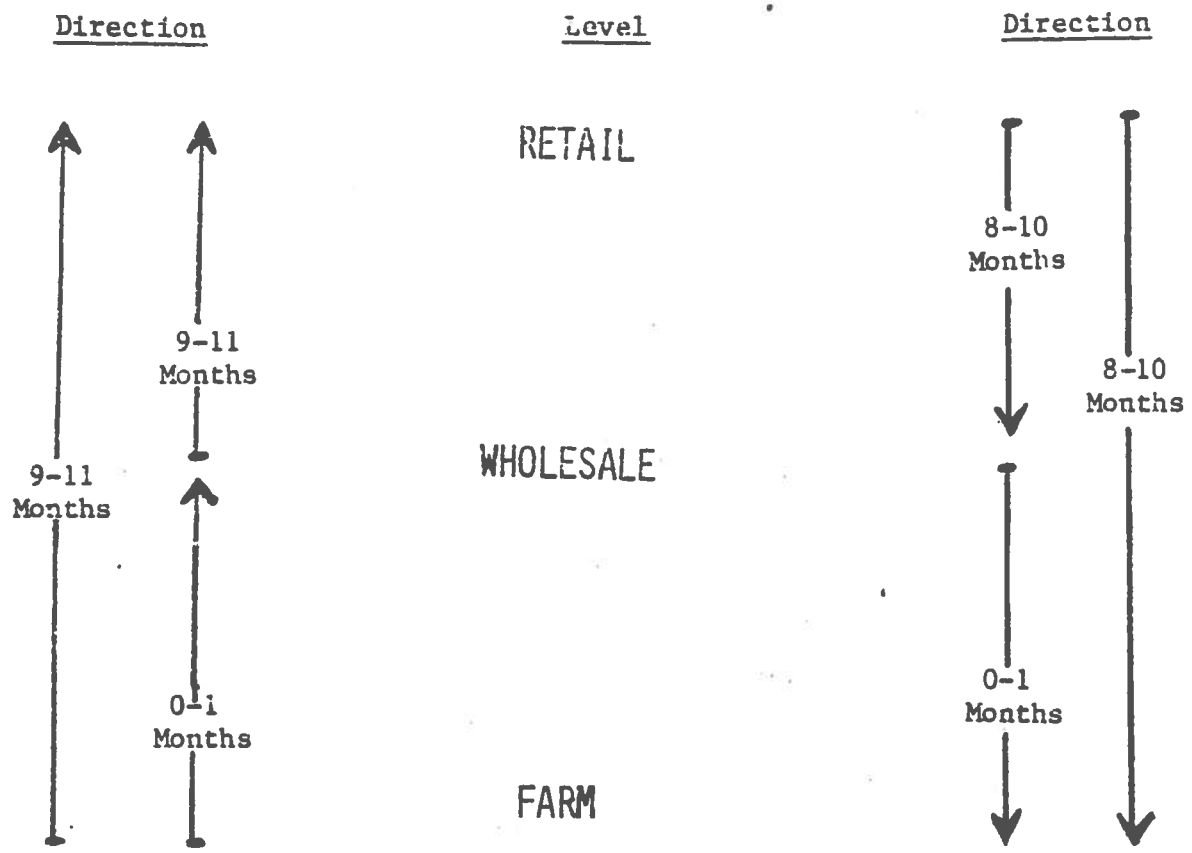

Figure 2: Time Required for Price Changes to be reflected at other Levels within the Beef Marketing System.

equations or systems of equations should be developed to further examine the phenomenon. Other research should concentrate on examining system impacts when the demonstrated ability to incorporate price information differs depending on the direction in which the information is traveling.

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