HOG PRICE FLEXIBILITIES AS RELATED TO CYCLE PHASES

D. W. Parvin, Jr.

During the past decade, commercial pork production has varied from 723 to 1,372 million pounds (dressed weight) per month. For the same period, the average farm price of hogs has ranged from $12 to $30. Consequently, net returns to hog producers were highly variable.

Agricultural economists have devoted considerable research effort to estimating the quantity-price relationship for pork [1, 3, 5, 6, 8]. Purcell and Raunikar [7] suggest that the relationship between price and quantity of pork may differ for positive and negative changes in the price of pork at the retail level.

If the response of hog prices to changes in pork supply differs for positive and negative changes in production, this is important for forecasting prices based on farrowings and/or farrowing intentions. Such forecasting may allow producers to reduce their losses in periods of excessive production.

The purpose of this study was to evaluate the reversibility of the relationship between the quantity of pork produced and the price of hogs.

HISTORY

Beginning with extremely low prices in January 1960, prices increased for 7 months to moderately profitable levels and fluctuated around this level for 30 months. Sharp seasonal (midyear highs) patterns occurred in 1963 and 1964 with no trend. A low in the fall of 1964 was followed by an upward trend ($12 rise) in 1965. A 15 month downward trend followed in 1966 and early 1967. Sharp seasonal patterns again occurred in 1967 and 1968. An upward trend ($9 rise) in 1969 followed the seasonal low in 1968. A downward turn occurred in early 1970 and prices fell $13 by the end of the year.

DATA

The price variable used in this analysis was average farm price of hogs and the quantity variable was commercial pork production (dressed weight). The monthly data (1960-1970) encompasses an extreme low in 1960 and in 1970 so that this data set should not be cycle biased.

STATISTICAL PROCEDURE

A difference (same month, year to year) analysis[1] was employed. The regression model was of the form:

(1) $P_{i+1,j} - P_{ij} = a + b\,(Q_{i+1,j} - Q_{ij}) + u.$

The dependent term represents the change in price from the i^{th} to the $(i + 1)^{th}$ year for the same month (j). The independent term represents the change in pork production for the same period. The constant term represents trend in the first-difference equation. It accounts for inflation, changes in population and other factors influencing trend. The u term is a disturbance assumed to be randomly distributed [2]. Since a rather large number (132) of observations were available, positive and negative quantity changes were analyzed separately to test the reversibility of the relationship [7].

Price flexibility[2] was calculated for each pair of observations indicated by equation (1). Table 1 summarizes the results for small, medium, and large, positive and negative changes in production. In five of

D. W. Parvin, Jr. is assistant professor of agricultural economics at the University of Georgia, College of Agricultural Experiment Station, Experiment, Georgia.

[1] The model (same month, year to year) removes seasonal trends.

[2] Percentage change in price divided by percentage change in quantity for same month, year to year.

Table 1. ESTIMATED HOG PRICE FLEXIBILITIES FOR POSITIVE AND NEGATIVE CHANGES IN PRODUCTION, SAME MONTH, i^{th} YEAR TO $(i+1)^{th}$ YEAR.[a]

Beginning level of production	Level of production following year		
	Positive Changes		
	$Q_{i+1,j} \leq 930$	$930 < Q_{i+1,j} < 1030$	$Q_{i+1,j} \geq 1030$
$Q_{ij} \leq 930$	- .48[b]	- .73	- 1.23
$930 < Q_{ij} < 1030$		- .52	- 1.37
$Q_{ij} \geq 1030$			- .51
	Negative Changes		
$Q_{ij} \leq 930$	- 1.71		
$930 < Q_{ij} < 1030$	- 2.51	- .35	
$Q_{ij} \geq 1030$	- 2.29	- 2.75	- 5.11

[a]Q = Commercial hog production (million pounds), i = year, j = month.
[b]Values are averages of price flexibilities calculated for each pair of observations indicated by equation (1). Numbers of observations per cell ranged from 5 to 20.

the six cases the flexibilities for the negative changes are larger (absolute value). Such a distribution would occur by chance only 9 percent of the time if the price flexibilities for positive and negative changes in production were of equal magnitudes.

Based on this distribution two equations were estimated. The observations indicating a positive change in production were used to estimate equation (2). The remaining observations (negative changes in production) were used to estimate equation (3).

$$(2) \qquad \hat{\Delta P} = 1.34 - \underset{(.004)^3}{.036}(+\Delta Q); N = 73, R^2 = .55$$

$$(3) \qquad \hat{\Delta P} = 1.10 - \underset{(.007)^3}{.041}(-\Delta Q); N = 47, R^2 = .41$$

Because the estimated regression coefficients in equation (2) and (3) were not the same, the corresponding price flexibilities are not equal. Table 2 demonstrates the differences in flexibilities and its effects on price. When production increases and then decreases by the same amount (returning production to its original level), price returns to a level in excess of the original price. For example, with a beginning quantity of 984 million pounds, and a price of \$18.59 per hundredweight, a 100-unit increase in quantity results in a price of \$14.99 (from equation 2). However, from this point when quantity is reduced by 100 units back to the original level of 984 the resulting price is \$19.09 (from equation 3).

LIMITATIONS AND IMPLICATIONS

Variation in first differences of pork production (same months year to year) explain approximately 50 percent of the variations in the price of hogs. Although the estimated regression coefficients in equations (2) and (3) were significant, statistical tests indicated that the coefficients did not differ significantly.[4] However, the results reported in Table 1 indicate that the relationship between pork production and price of hogs may differ depending on the direction of the change in production. The study suggests that a negative change in production brings forth a larger (absolute value) change in price

[3]Standard error.

[4]Two F-tests were required to test the estimated regression coefficients for homogeneity. The first hypothesis was: one regression can be used for both positive and negative changes in production. The second hypothesis was: the regression coefficient for equation (2) equals the regression coefficient for equation (3). The second test can not be made unless the first hypothesis is rejected. In this analysis, the first hypothesis was not rejected. See [4] for construction of test statistics.

Table 2. EFFECTS OF EQUAL POSITIVE AND NEGATIVE CHANGES IN PRODUCTION ON PRICE OF HOGS.

Δ Production[a]	Production[a]	Price[b]	Flexibility[c]
	984[d]	18.59[d]	
+25			- 1.97
	1,009	17.69[e] (2.07)[f]	
- 25			- 2.27
	984	18.72[g] (3.08)	
	984	18.59	
+50			- 2.05
	1,034	16.79 (2.08)	
- 50			- 2.32
	984	18.84 (3.09)	
	984	18.59	
+100			- 2.21
	1,084	14.99 (2.10)	
- 100			- 2.48
	984	19.09 (3.16)	
	984	18.59	
+200			- 2.60
	1,184	11.39 (2.21)	
- 200			- 2.86
	984	19.59 (3.40)	

[a]Million of pounds.
[b]Average Farm Price per cwt.
[c]Arc Flexibility = $(\Delta P/\bar{p}) / (\Delta Q/\bar{Q})$.
[d]Base production and price. Mean values of data used to estimate equations (2) and (3).
[e]Change in price estimated from equation (2)
[f]Standard error of the predicted price.
[g]Change in price estimated from equation (3).

than a like positive change in production. In terms of price flexibility, the study indicates that flexibilities (absolute value) vary directly with the size of the change in production and that the flexibilities associated with negative changes in production are greater (absolute value) than those associated with similar changes in the positive direction.

Additional research is needed on the question of reversibility of the relationship between changes in pork production and prices. Also, information regarding the statistical problems associated with separating data according to the sign of a selected variable is lacking.

REFERENCES

[1] Breimyer, Harold F., *Demand and Prices for Meat: Factors Influencing Their Historical Development,* USDA Tech. Bull, 1253, 1961.

[2] Foote, R. J., *Analytical Tools for Studying Demand and Price Structures.* USDA Agr. Handbook 146, 1958.

[3] Harlow, Arthur A., *Factors Affecting the Price and Supply of Hogs,* USDA Tech. Bull. 1274, 1962.

[4] Hill, Lowell and Takashi Takayama, *Statistical Test for Comparing Means, Variances, and Regressions Coefficients,* University of Illinois Agr. Res. Bull. 4279. 1971.

[5] Leuthold, Raymond M., *Economic Analysis and Predictions of Short-Run Hog Price and Quantity Fluctuations,* Illinois Agr. Exp. Sta., AERR 104, 1970.

[6] Purcell, Joseph C., *Trends and Relations in the Livestock-Meat Sector Affecting Prices and Revenue to Primary Producers,* Georgia Agr. Exp. Sta. Res. Bull. 35, 1968.

[7] Purcell, J. C. and Robert Raunikar, "Price Elasticities From Panel Data: Meat, Poultry, and Fish," *American Journal of Agricultural Economics* 53: 216-221, May 1971.

[8] West, Donald A., *Swine Producers Price Expectations and the Hog Cycle,* North Carolina State University Econ. Res. Report 10, 1969.