June 1981 A.E. Res. 81-5

EXPANDING DAIRY BEEF PRODUCTION IN THE NORTHEAST: THE PRICE EFFECT OF REDUCED CALF SLAUGHTER

William Lesser
Vishva Bindlish

Department of Agricultural Economics
Cornell University Agricultural Experiment Station
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York 14853

It is the policy of Cornell University actively to support equality of educational and employment opportunity. No person shall be denied admission to any educational program or activity or be denied employment on the basis of any legally prohibited discrimination involving, but not limited to, such factors as race, color, creed, religion, national or ethnic origin, sex, age or handicap. The University is committed to the maintenance of affirmative action programs which will assure the continuation of such equality of opportunity.

PREFACE

In late 1980 a contract was signed between Cornell University and the New York Department of Agriculture and Markets for conducting a one year study of the economic feasibility of expanding dairy beef production in the Northeast. The funds for this study were provided by the Agricultural Marketing Service of the USDA. This report is the first of a series of studies covering the several aspects of expanded production including feed rations, enterprise analysis, and marketing.

Andy Novakovic provided detailed comments on an earlier draft of this paper. Errors and omissions remain the responsibility of the authors.

Introduction

During the early days of colonization of the United States, the Northeast was a major supplier of most agricultural products, including red meats. The subsequent settling of the West, while providing significant commercial opportunities for the Northeast, led to a substantial decline in the importance of the Northeast as a supplier of a large number of agricultural products, including meat. This trend has continued to the point where today the region provides only a small percentage of the beef consumed there.

The westward shift in agricultural production has left some potential regional resources underutilized. Among these are grazing land and dairy calves. In New York State, for example, there are an estimated 1.4 million acres of idle grazing land. At the same time New York has the largest calf slaughter in the nation, many of them day-old bob calves (Fox; Packers and Stockyards Administration, 1977). Given these two available resources, interest in dairy beef is not surprising. Yet despite past efforts, a regional dairy beef industry has not yet achieved any significant size (Hallmon). Several factors have, however, changed over the past several years suggesting the need to reevaluate the potential of an expanded dairy beef industry. These factors include changes in USDA grade standards, increases in transportation costs and modified feeding systems.

The recent changes in quality grade standards for beef which have lowered the required intramuscular fat or "marbling" have made it easier for a Holstein steer or heifer to grade choice. Moreover, transportation cost increases due to higher fuel and equipment prices have

made regional fed beef more attractive to existing area packers. Currently these firms rely heavily on Midwestern cattle for the bulk of their estimated half-million head annual kill. Finally, feeding experiments at Cornell University have indicated that Holsteins because of their larger intestinal capacity can consume sufficient corn silage to satisfy the energy requirements of a high growth diet (Fox). This is significant because much of the Northeast is more competitive in corn silage production than it is in corn grain production.

Whatever the potential may be, dairy beef production will not be economically viable if the diversion of surplus dairy calves from veal slaughter to fed beef leads to a substantial price increase for these calves. Surplus calves are those which are not required for dairy replacements and include most bull calves plus some heifers. The price effect from reducing veal slaughter could be significant because, on the average, slaughter calves are largely a by-product of dairying, and a price increase for calves may not markedly increase the long-run supply. For the 1950-72 period Jordan estimated an inelastic supply of 0.76 for veal with respect to a price ratio reflecting the opportunity value of using dairy calves as feeder calves. This estimate, however, reflects the allocation at the margin between use as veal and as feeder calves. The price elasticity of the total supply of surplus dairy calves is expected to be notably smaller.

In this context, this paper reports the results of an econometric study designed to assess the effects on dairy calf prices of reducing veal slaughter. The econometric model, following the format used by Freebairn and Rausser, describes the production, trade and consumption

of veal. Flexibilities are estimated from this model and used to evaluate the effects on calf prices of increases in Holstein feeder calf production of 90, 180 and 270 thousand head per year. These numbers represent respectively 31, 61 and 92 percent of the approximately 293,000 live dairy calves born in the Northeast in 1978 (USDA, ESS, Livestock Section).

The model treats the Northeast as a quasi-independent producing and processing region. This specification is appropriate because the fragility of the very young calves generally precludes long distance transportation without a significant death risk, resulting in imperfect arbitrage of live animals between areas. The quasi-independence specification is handled empirically by treating the out-of-region supply as exogenous. Exogeneity implies that the supply from these other areas is perfectly price inelastic, an understatement of the true supply response. This assumption however does result in a downward bias of the total supply available following a Northeastern price increase and hence provides an upper bound estimate of price effects in the Northeast.

A number of additional variables are treated as exogenous in the empirical estimates. Regional milk cow inventories are assumed to be independent of the calf price. Calves provide only a small part of gross receipts on most dairy farms even during periods of relatively high prices (Smith). Feeder calf prices are considered to be national prices which will be basically unaffected by changes in Northeastern dairy calf production. The total Northeastern bob calf supply in 1977 was only 2.3 percent of the feeder calves marketed that year (Ag. Stat.

1976), and the sturdier feeder calves can be readily transported over long distances.

Econometric Model

A simultaneous equation model is specified to describe the causal relationships in the Northeast veal sector. Producer behavior relating to the production and sales for slaughter of surplus calves is modeled while the Northeast dairy herd size, calf retentions for replacements and prices of feeder calves are treated as predetermined. A national consumer demand equation describes behavior at the retail level. Finally, a margin equation links the retail and farm prices.

Equations describing the annual supply of slaughter calves and slaughter calf prices in the Northeast are based on models of producer decision making. Slaughter calf supply is a function of the regional dairy herd inventory and the opportunity value of calves for use as feeder calves (Jordan). Slaughter calf prices are described as a function of calf slaughter in the Northeast, calf slaughter in the remainder of the US, and feeder calf prices. The designation of supplies from both inside and outside the region admits the assumed quasi-independence of the Northeastern calf sector. In this equation, the feeder calf price represents the opportunity cost of calf slaughter (Freebairn and Rausser, p. 680).

In both equations the steady-state assumption regarding the exogenous nature of the out-of-region supply was invalidated by the acceleration of the liquidation phase of the cattle cycle beginning in 1975. During that year, commercial calf slaughter rose 84 percent

over 1974 and the share of slaughter in the Northeast declined from 40 percent to 32 percent (USDA, Livestock and Meat Situation, 1975). For reasons discussed below, slope shifters are used to account for this exogenous structural change.

Following Freebairn and Rausser the farm-retail price margin equation allows for both an absolute and a percentage margin (p. 680). The cost of providing service is accounted for by a wage rate variable adjusted to reflect changes in productivity. An additional factor influencing the margin is the level of capacity utilization. In a high fixed cost industry like meat packing, capacity utilization can affect margins. For the industry under study, in which capacity utilization varied from 43 to 100 percent over the 1961-77 study period (assuming the maximum kill over that period represents full capacity operation), the impact of capacity utilization on margins could be substantial. To account for this factor, margins are adjusted to reflect the full capacity margin by weighing the margins by capacity utilization.

The consumer demand equation is based on the traditional theory of utility maximization with veal belonging to a separable community group --meat. Within this system the quantity demanded of veal is a function of its own price, the price of other foods, and disposable income. Few previous estimates of the retail demand for veal are available to guide a more specific form for this equation (e.g., Tryfos and Tryphonopoulos). Descriptive material on veal consumption, however, identifies it as a specialized produce with a distinct regional character. For example, in 1965 almost 6 pounds per capita were consumed in the urban Northeast but only one-half pound in the rural south (USDA, Nat'l. Food Sit., p. 28).

Conversations with industry observers depict this product as particularly sought after by Jewish and Italian-American consumers. These distinctions are important when annual average per capita consumption varied by 70 percent from 6.1 to 1.8 pounds during the study period (USDA, Livestock and Meat Situations). This suggests two broadly distinct consuming groups. One is a small population of regular users who are willing to pay higher prices when supplies are low. The other is the large remaining residual population which purchases veal occasionally at restaurants or at the meat counter when it is favorably priced. The regular users by definition are less price sensitive and demand should be more elastic during supply expansions than during constrictions when occasional users have withdrawn from the market. A means of modeling this asymmetric demand function is to use an adaptation of the irreversible supply function formulation developed by Houck.

Estimated Structural Model

Annual observations for the period 1961 through 1977 are used to estimate the parameters of the stochastic equations. The system is estimated by three-stage least squares (3SLS) using the Time Series Processor Version 3.5. The system is overidentified and the estimates have only the large sample properties of consistency and asymptotic efficiency.

Adjustments in the model to accommodate exogenous structural changes and to remove serial correlation necessitated repeated estimation using the same data. Under these conditions, the reported

standard errors of the estimates understate their true magnitudes (Wallace). Only the preferred estimates are reported for the sake of brevity. Their selection was based on a subjective evaluation of the signs and sizes of the estimated parameters and on the explanatory power of the system and the individual equations. Where possible the parameter estimates were compared to previous studies.

The estimate of the consumer demand equation is shown in line one of table 1. This equation omits net veal imports which amounted to almost 2 million pounds in 1977, or less than one percent of consumption that year. Per capita consumption of veal from a 1959 base is regressed on nominal beef price, real national per capita disposable income, a trend variable and two nominal veal price variables representing cumulative price increases and cumulative decreases from the base period. (See Houck, pp. 570-72 for a discussion of the composition of these variables.) Other substitute foods including pork and chicken were found to have small t-ratios and were dropped. The t-distribution is not strictly appropriate in a simultaneous equation system but distortions are usually reasonably small (Kmenta, pp. 584-85).

All the variables have the expected sign with the possible exception of income. Tryfos and Tryphonopoulos found a positive income effect for veal consumption in Canada for the 1954-1970 period although the t-statistic was about the same size as in table 1 (p. 649). Additionally, the 1965 USDA Household Food Consumption survey showed that veal consumption varied directly with income (USDA, Nat'l. Food Sit. p. 28). However, the demand situation may be different in Canada and in any event may have changed substantially over the past decade.

Table 1. Econometric Model of the Northeastern Veal Sector

1.1 National Retail Demand for Veal

$$\Delta PCV = -.162\ T - .0067\ VPI - .191\ VPD + .026\ PCB - .001\ DPY$$
$$(-1.68)^a \quad (-1.61) \quad (-6.44) \quad (2.03) \quad (-1.59)$$
$$S = .295 \quad D.W. = 1.96^b$$

1.2 Calf Slaughter in the Northeast

$$CSNE = 8.94 + .101\ MCINV - 34.24\ PFC/PSC + .046\ D \times MCINV$$
$$(.27) \quad (11.07) \quad (-1.05) \quad (7.74)$$
$$S = 16.20 \quad D.W. = 2.35^b$$

1.3 Farm-Retail Price Spread

$$MCU = 9.11 + .506\ PSC - .558\ \Delta PSC + 3.583\ W + .319\ D*PSC$$
$$(1.14) \quad (7.85) \quad (-4.43) \quad (1.43) \quad (9.06)$$
$$S = 3.36 \quad D.W. = 2.39^c$$

1.4 Slaughter Calf Demand

$$PSC = 56.34 - .066\ CSNE - .022\ CSR + .630\ PFC + .040\ D*CSR$$
$$(4.01) \quad (-1.31) \quad (-1.46) \quad (3.23) \quad (7.24)$$
$$S = 3.98 \quad D.W. = 2.18^b$$

Source and Notes:

Endogeneous Variables: ΔPCV = change in annual per capita consumption of veal in pounds in the US from the base year (1959) level (USDA, Livestock and Meat Situation): CSNE = calf slaughter in the Northeast in m. lbs computed using avg. carcass of 137 lbs. per head (USDA, ESS, Livestock Sec., unpub. data); PSC = avg. annual prime veal calf price in cents per lb. for the Lancaster market (USDA, Consumer and Mkng. Serv., Livestock Div., Livestock Detailed Quotations, annual); MCU = farm-retail veal price margin in cents per lb., computed as the difference between PSC and the natl. avg. retail price, and weighted by capacity utilization to reflect full capacity operation assuming the 1962 calf slaughter to represent total available capacity in the Northeast (PSC, and USDA Livestock and Meat Sit. for the retail price of veal); ΔPSC = year-to-year change in PSC, cents per lb. (USDA Consumer and Mktng. Serv., Livestock Div., Livestock Detailed Quotations); VPI = accumulative increase in the avg. retail price of veal in cents per lb. from the base year (1959) level (USDA, Livestock and Meat Sit.); VPD = accumulative decrease in the average retail price of veal) in cents per lb. from the base year (1959) level (USDA, Livestock and Meat Sit.).

Exogenous Variables: PCB = national average retail price of choice beef, cents per lb. (USDA, Livestock and Meat Sit.); DPY = national avg. per capita disposable income, dollars per year (U.S. Dept. of Commerce, Stat. Abs. of the US); MCINV, Northeastern Milk cow inventory on January 1, thousand head (USDA, EES, Livestock Sec., unpublished data); PFC = price of feeder calves in Kansas City, cents per lb. (USDA, Livestock and Meat Stat.); W = national average wage rate in $/hr. in the meat-packing industry, deflated by an index of labor productivity in the U.S. agr. sector, computed as the ratio of the index of agricultural output to the index of labor input (U.S. Dept. Labor Employment and Earnings and Monthly Report on the Labor; and USDA, Agr. Stat.); CSR = calf slaughter in m lbs. in the rest of the United States excluding the Northeast, carcass weight at an average of 137 lbs. per animal (USDA, Agr. Stat.); D = dummy variable, assigned the value of 0 for 1960-74, and 1 for 1975-77; T = time (1960 = 1); S = standard error of the regression; D.W. = Dubrin-Watson statistic.

[a] t-statistic.

[b] Cannot reject zero first order serial correlation at the 5 percent level.

[c] Durbin-Watson statistic in the inconclusive range at the 5 percent level.

(See Phillips, Lovfald and Friend pp. 16-17 for a discussion of inter-country differences in the demand characteristics of veal.)

The demand elasticities agree with our expectations. The elasticity for price increases, -0.02, is substantially more inelastic than the -0.14 estimated for price decreases. Purcell and Raunikar found a similar situation using cross-sectional data when evaluating differential effects of price increases and decreases in demand for beef and veal, although their results did not show as great a difference as ours (p. 219).

The supply of slaughter calves in the Northeast (equation 1.2) is explained by the inventory of dairy cows in the region and the ratio of feeder calf and slaughter calf prices, a measure of the opportunity cost of slaughter for bull calves (Jordan p. 719). The inclusion of the dairy cow inventory assumes dairy breed calves are the principal source of veal (see USDA, Livestock and Meat Situation, 5/69, 5/70). This assumption appears to be valid up to 1975 when higher feed-grain prices lead to the slaughter of significant numbers of beef breed calves outside the Northeast (USDA, Livestock and Meat Situation, 10/75). A slope shifter for the milk cow inventory in 1975-77 was included to account for this exogenous change. With an asymmetric demand curve the use of a slope shifter is more appropriate for representing exogenous changes than is an intercept shifter. In the model, intercept shifters had small t-ratios and were not retained.

The signs of all variables are as expected. The coefficient on the cow herd variable is substantially smaller than that estimated by Freebairn and Rausser (p. 683) but close to the 0.106 reported by Arzac and Wilkinson for the period 1965-75 (p. 300). Thus our results

probably reflect recent changes in calf retentions for building dairy herd sizes in the Northeast and the increased elasticity of slaughter calf supply observed by Jordan in recent years (p. 720).

The price margin between the farm and retail prices of veal is examined in equation 1.3 (Table 1). To account for the effect of capacity utilization on the margin in the high overhead meat-packing industry, the margin is adjusted to reflect the full capacity value by weighing the level of capacity utilization. As with Freebairn and Rausser, the margin (adjusted in our case) is positively related to the farm price and to the wage rate and is negatively related to changes in the farm price. These results may be explained by recognizing that higher farm prices imply smaller volumes for packers and hence higher unit costs and margins. However, as prices rise, packers may not be able to pass along the full processing cost increases to consumers and margins would then be negatively related to changes in prices. The t-statistic for the wage parameter estimate is smaller than for other studies, possibly because many of the calf processing plants in the Northeast, unlike much of the total packing industry throughout the nation, are nonunionized. The wage rate in this equation is adjusted to reflect productivity changes. The slope shifter is retained to explain the exogenous change in calf slaughter at the end of our study period.

The Northeastern slaughter calf price, equation 1.4, is positively related to the feeder calf price, the opportunity value, and negatively related to the supply of slaughter calves. As the Northeastern veal industry is considered to be quasi-independent of the remainder of the nation, the supply of slaughter calves is partitioned into the

supply from the Northeast and from the remainder of the nation. Both variables have the expected sign and modest sized t-statistics.

The slope shifter also has the correct sign although this may not be immediately apparent. When the shifter is in effect in 1975-77, the aggregate slaughter calf demand function still has the expected negative slope (-0.048) although in absolute value it is numerically smaller than the absolute value of the slope during the remainder of the period (-0.088). Calculated as price flexibilities at the sample means for the 1969-74 and 1975-77 periods, flexibility in the Northeast for the later period is 18 percent smaller than that of the earlier period, -0.28 and -0.34. This is the result which would be expected from a demand equation showing greater demand elasticity during price declines such as characterized 1975, 1976 and 1977 than during the price increases of the earlier period.

Table 2 lists the identities which complete the structural model. Equation 2.1 is a market-clearing equation which specifies that all veal produced is consumed. Equations 2.2 (a) and (b) links farm and retail prices while equation 2.3 delineates the separation of calf slaughter to two sections of the country. Equations 2.1 and 2.2 (b) relate to the Houck transformations.

Forecasting Accuracy of the Model

The forecasting properties of the model are evaluated by comparing the estimated values of the dependent variables with the actual values for the years 1976, 1977 and 1978. The first two years represent years which lie within the period the model was estimated while 1978 lies outside the sample set but not outside the range of the data.

Table 2. Identity Relations of Structural Model

(2.1) Supply and Demand

$$(\Delta PCV_t + PCV_o) \times 1/P_t \equiv CSNE_t + CSR_t$$

(2.2) Price Margin

$$M_t \equiv RPV_t - PSC_t$$

$$RPV_t \equiv RPV_o + VPI_t + VPD_t$$

(2.3) Calf Supply Balance

$$CST_t \equiv CSNE_t + CSR_t$$

Sources and Notes: Variables as defined in the notes to Table 1, with the addition of PCV_o = per capita veal consumption in lbs. in the base year (1959) (USDA, Livestock and Meat Sit.); P = total US population, millions (U.S. Depart. of Commerce, Stat. Abstract of the US); M = farm-retail price margin, cents per lb. (USDA, Consumer and Mktng. Serv., Livestock Div., Livestock Detailed Quotations (annual), and USDA, Livestock and Meat Sit.); RPV = nat'l avg. retail price of veal, cents per lb. (USDA, Livestock and Meat Sit.); CST = total US calf slaughter, million lbs. carcass wt. (USDA, ESS, Livestock Section, unpub. data).

The mean forecasts of the exogenous variables as shown in Table 3 are quite close to the observed values. For 1978 the forecasts were computed using Newton's iterative technique. This technique linearizes the model around the values from the previous iteration and solves it by matrix inversion. The search, which is based on the sum of squared deviations of the equations obtained by substituting the current values of these variables from the values of the last iteration, is terminated when all the deviations approach zero.

To measure the accuracy of the forecasts, the mean-square error (MSE) was computed and decomposed into its bias, regression and disturbance components. The bias component indicates the extent of the tendency to estimate a value too high or too low for the forecast variable. In the case of the forecasts made here, the proportion of the forecast error due to bias is 1.5 percent for calf slaughter in the Northeast, and less than one-half percent for the other two variables, indicating that on average the changes predicted by the model do not differ significantly from the average actual changes.

In 1978 the predicted values of two endogenous variables, including the critical slaughter calf price, fell well within the 95 percent confidence interval for the forecast. For a third equation, the regional supply of slaughter calves, the predicted value fell just outside this interval. The slightly poorer forecasting ability of this equation is probably due to changes in calf retentions for dairy replacements which are treated as exogenous in this model. No forecast was attempted for the retail demand equation because of a change in one of the price series (see footnote of Table 3). These results provide good reason to believe that the model provides a reasonable representation of the decision factors influencing the Northeastern veal sector.

Price Flexibilities

A price flexibility may be used to estimate the effect that changes in one variable may have on price, other variables held constant. For this study the interest is in estimating the effect of reducing regional calf slaughter on the Northeast calf price; exogenous shifts in

the structural equations other than reductions in slaughter will not be considered. From equation 1.4 in table 1 this flexibility is estimated to be -0.32 at the mean over the 1961-77 period.

With this estimated price flexibility a 10 percent or 24.6 million pound reduction in regional calf slaughter from the 1978 level would lead to a 7.9 cents per pound or 9 percent increase in slaughter calf prices. The price effects of several levels of reductions in calf slaughter are reported in Table 4. Underlying these projections is the assumption of a perfectly inelastic price response from outside the region. The effect of this assumption is probably an overestimation of the price response to reduced slaughter in the Northeast.

Conclusions

The model analyzed here leads to the finding that a 10 percent (24.6 million pounds) reduction in regional calf slaughter will lead to a 9 percent increase in the Northeastern slaughter calf price. The 10-percent reduction represents approximately 180,000 head of dairy beef using a 137 pounds a head average for calves. For the region this represents a large number, approximately two and a half times the potential number of beef breed calves available in New York in 1979 (New York Crop Reporting Service). Thus it would seem to represent the maximum level of production which would be reached over the foreseeable future. During this period the price effect of expanded dairy beef production on calf prices, while not insignificant, does not appear to be a key factor in the economic viability of this sector.

These projects are based on the particular specifications of the model used there. Changes in the decision framework of the sector or in the variables considered as exogenous could affect the results significantly.

Table 3. Actual and Forecast Values of Endogenous Variables

Endogenous Variable	1976		1977		1978		
	Actual	Forecast	Actual	Forecast	Actual	Forecast	RMSE [a]
Change in per capita veal consumption from the 1959 level (lbs.)	-1.4	-1.2	-1.8	-1.8	-2.7	--[b]	--
Calf slaughter in the northeast (m. lbs.)	315.9	298.4	291.0	295.8	245.8	283.0	17.59
Margin adjusted for capacity utilization (¢ per lb.)	82.5	77.2	81.9	83.3	79.4	82.3	3.61
Slaughter calf price (¢ per lb.)	73.1	71.0	72.2	73.0	88.5	84.7	3.90

Notes:

[a]Root-mean-squared error.

[b]No forecast for this variable for 1978 was obtained, as in that year the reporting system for the price of choice beef, an explanatory variable in equation 1, was changed, making the reported price in that year difficult to compare with the earlier series (Duewer).

Table 4. Effects of Hypothetical Decreases in Calf Slaughter on Price in the Northeast

Hypothetical Decreases in Slaughter				Induced Effect on Price			
Actual 1978 Value (m. lbs.)	Assumed Change		Hypothetical Value (m. lbs.)	Actual 1978 Price (cents per lb.)	Resulting Price	Increase	Resulting increase in price
	M. Lbs.	% Decrease					
245.8	12.3	5	233.5	88.5	92.4	3.9	4.4
245.8	24.6	10	221.2	88.5	96.4	7.9	8.9
245.8	36.9	15	208.9	88.5	100.3	11.8	13.3
245.8	49.2	20	196.6	88.5	104.2	15.7	17.7
245.8	61.4	25	184.4	88.5	108.1	19.6	22.1

Note: The effects on price of changes in slaughter are calculated using the average price flexibility of -.32 estimated from equation 1.4 for the sample period.

REFERENCES

Arzac, E. R. and M. Wilkinson. "A Quarterly Econometric Model of United States Livestock and Fed Grain Markets and Some of Its Policy Implications." Amer. J. Agr. Econ. 61 (1979): 297-308.

Duewer, Lawerence A. "Changes in Price Spread Measurements for Beef and Pork." Livestock and Meat Situation No. 222, August 1976.

Fox, D. Department of Animal Science, Cornell University, personal communication, 1980.

Freebairn, J. W. and G. T. Rausser. "Effects of Changes in the Levels of U.S. Beef Imports." Amer. J. Agr. Econ. 57(1975): 676-88.

Hallmon, L. C. "Raising Dairy Calves for Beef Purposes." Jr. Animal Sci. 32(1971): 442-45.

Houck, J. "An Approach to Specifying and Estimating Nonreversible Functions." Amer. J. Agr. Econ. 59(1977): 570-72

Jordan, W. J. "The Short-Run Supply of Veal." Am. J. Agr. Econ. 57(1975): 719-20.

Kamenta, J. Elements of Econometrics. New York: Macmillan Co., 1971.

Phillips, D. M., Jr., L. O. Loufald and R. E. Friend, "Consumption of Meat in Western Europe," USDA, ERS-Foreign 367, Sept. 1974, pp. 15-17.

Smith, S. F. "Dairy Farm Management Business Summary, New York." Dept. Agr. Econ., A.E. Res. 80-16. Cornell University, Sept. 1980.

Tryfos, P. and N. Tryphonopoulos. "Consumer Demand for Meat in Canada." Amer. J. Agr. Econ. 55(1973): 647-52.

USDA, Agricultural Statistics, various dates.

USDA, Consumer and Marketing Service, Livestock Division, "Livestock Detailed Quotations (annual): Lancaster, Pa., Market." Unpublished data.

USDA, ESS, Livestock Section, unpublished data.

USDA, "National Food Situation." NFS-161, Sept. 1977.

USDA, Packers and Stockyards Adm., Resume, 1977.

U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States, various dates.

U.S. Department of Labor, Bureau of Labor Statistics, "Employment and Earnings and Monthly Report on the Labor Force," various dates.

Wallace, T. D. "Pretest Estimation in Regression: A Survey." Amer. J. Agr. Econ. 59(1977): 431-43.

DATA

	CSNE (1000 head)	CSUS (1000 head)	PSC (¢/lb.)	PFC (¢/lb.)	RPV (¢/lb.)	MCINV (1000 head)	PCB (¢/lbs.)
1960	2298.1	6312.9	36.58	27.88	78.8	3150	80.2
1961	2318.4	5762.6	38.01	27.77	78.5	3187	78.4
1962	2462.8	5391.2	39.05	27.69	82.5	3176	81.7
1963	2345.6	4852.4	37.52	27.02	82.7	3129	78.5
1964	2008.9	5623.1	36.33	22.57	84.4	3030	76.5
1965	2307.5	5480.5	37.70	23.70	83.3	2945	80.1
1966	2143.3	4719.7	44.12	28.38	90.0	2806	82.4
1967	2015.7	4095.3	43.78	28.00	94.2	2684	82.6
1968	1991.7	3625.3	46.45	29.10	101.0	2558	86.6
1969	1663.3	3347.7	53.82	32.89	110.8	2469	96.2
1970	1683.1	2519.9	50.52	36.73	124.3	2390	98.6
1971	1611.6	2213.4	54.62	36.84	135.8	2123	104.3
1972	1391.5	1809.5	62.28	46.54	153.9	2090	113.8
1973	1065	1339	75.42	59.73	181.7	2061	135.5
1974	1278.9	1896.1	74.64	39.23	194.1	2025	138.8
1975	1724.2	3681.8	66.77	29.48	181.1	2054	146.0
1976	2025.7	3501.3	73.09	38.82	173.3	2088	138.9
1977	1955.5	3736.5	72.15	41.41	175.3	2077	138.3

	W ($/hr.)	M (¢/lb.)	PCV (¢/lbs.)	($)	(Prop.)
1960	4.06	42.22	6.1	2184	.993
1961	3.84	40.49	5.6	2213	.941
1962	3.74	43.45	5.5	2278	1.000
1963	3.56	45.18	4.9	2325	.952
1964	3.73	46.07	5.2	2441	.816
1965	3.36	45.60	5.2	2574	.937
1966	3.37	45.88	4.6	2674	.870
1967	3.24	50.42	3.8	2745	.818
1968	3.29	54.55	3.6	2815	.809
1969	3.33	56.98	3.3	2851	.675
1970	3.52	73.78	2.9	2903	.683
1971	3.26	81.18	2.7	2972	.654
1972	3.35	91.62	2.2	3067	.565
1973	3.36	106.28	1.8	3219	.432
1974	3.79	119.46	2.3	3146	.519
1975	3.74	114.33	4.2	3156	.700
1976	3.79	100.21	4.0	3228	.823
1977	3.79	103.15	3.9	3311	.794

Note: For definitions and sources see Table 1.