A DEMAND ANALYSIS OF BOB CALVES FOR VEAL AND FEEDER CALF USES IN THE NORTHEAST

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INTRODUCTION

The Northeast is the major calf-killing region in the country with the bulk of the calf supply composed of week old dairy bull calves of approximately 100 pounds (USDA, Livestock and Meat Stat.). Until recently this by-product of the dairy industry had little alternative uses. Currently, however, the meat grade standards have been relaxed to the point where it is possible for a properly fed Holstein steer to grade at or near choice with live weight below 1200 pounds. This regulatory change has made dairy bob calves more potentially valuable as feeder calves.

Two studies have been completed for the region evaluating the economic returns of raising bob calves on the dairy farm as a supplemental enterprise to dairying (Knoblauch et al., and Milligan et al.). Both studies showed that dairy feeder calf production was profitable (at the assumed prices) and fit well into the operators' time constraints for small to medium sized dairy operations. Moreover the supplemental feeder calf enterprise was found to provide additional cash flow during a time of declining real milk prices.

The farm budget analysis used by Knoblauch and Milligan was, however, strictly a micro-level analysis which did not consider the aggregative effects on prices if many dairy farmers held their calves for subsequent feeding. Two sector-wide or macro-level effects are possible, one on the effects on bob calf prices and the other on the effects on feeder calf prices. This paper analyzes the impacts of diverting calves from slaughter on the prices of bob calves by using a simultaneous equations model. An analysis of any possible impact on feeder calf prices is left to other researchers.

THE MODEL

A seven-equation system is developed to evaluate the interactions among calf supplies, prices and retail and wholesale demand for veal. Four of the equations are operational while three are identities balancing the system. The system, which follows the format used by Freebairn and Rausser, is described below. In the variable descriptions below, the signs in parentheses are the expected ones for each variable.

Retail Demand for Veal: the demand for veal at the retail level is hypothesized to be a function of the price of veal, the price of choice beef, a substitute, and per-capita disposable income. When modeling the retail demand for veal it is also important to recognize the fluctuating supply of this product. Over the study period annual average per capita consumption varied by 70 percent, from a high of 6.1 pounds to a low of 1.8 pounds. According to industry observers there are two distinct consuming groups for this product. One is an ethnic/religious group (e.g., Italian and Jewish) who are regular consumers and relatively insensitive to price. The other is occasional consumers who appear to be more price sensitive, and purchasing veal for example on those occasions when it is available as supermarket specials. This asymmetric demand function is modeled by using an adaptation of an irreversible supply specification developed by Houck. The equation is:

$$PCV = \alpha_0^1 T + \alpha_1^1 VPI + \alpha_2^1 VPD + \alpha_3^1 PCB + \alpha_4^1 PCY \qquad (1)$$

where

PCV - change in annual per capita veal consumption,

T - time trend,

VPI, VPD - respectively accumulative increases and decreases in retail veal prices (-) (see Houck, pp. 570-72, for a discussion of these variables),

PCB - national average retail price of choice beef, (+) and

PCY - national per capita disposable income (+).

Calf slaughter in the Northeast: the model treats the Northeast as a quasi-independent producing and processing region. This specificaton 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.

The supply of slaughter calves in the Northeast 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 feedgrain prices lead to the slaughter of significant numbers of beef breed calves outside the North-

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east (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. The equation is:

$$CSNE = \alpha_0^2 + \alpha_1^2 MCINV + \alpha_2^2 PFC/PSC + \alpha_3^2 D*MCINV \quad (2)$$

Where
CSNE - calf slaughter in the Northeast,
MCINV - January 1 milk cow inventory in the region (+),
PFC - price of feeder calves,
PSC - price of slaughter calves,
D - shifter for change in the cattle cycle in 1975 (+), and
D*MCINV - shifter times the milk cow inventory (+).

Farm-Retail Price Spread: 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 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 equation is:

$$MCU = \alpha_0^3 + \alpha_1^3 PSC + \alpha_2^3 \Delta PSC + \alpha_3^3 W + \alpha_4^3 D*PSC \quad (3)$$

Where
MCU - farm-retail margin weighted by capacity utilization,
PSC - price of slaughter calves (+),
ΔPSC - annual change in slaughter calf prices (-)
W - national average wage in the meat-packing industry for productivity changes, (+), adjusted,
D - shifter for change in the cattle cycle in 1975 (+), and
D*PSC - shifter times the price of slaughter calves (+).

Slaughter Calf Demand: slaughter calf prices are described as a function of calf supplies, here disaggregated into supplies from inside and outside the region in accordance with the quasi independence assumption. The feeder calf price variable in this equation represents the opportunity cost of calf slaughter (Freebairn and Rausser, p. 680). The equation is:

$$PSC = \alpha_0^4 + \alpha_1^4 CSNE + \alpha_2^4 CSR + \alpha_3^4 PFC + \alpha_4^4 D*CSR \quad (4)$$

where all variables have been previously identified. The supply variables have expected negative signs while the opportunity cost variable should have a positive sign.

Identities: three identities complete the system (Table 1). Equation (5) is a market-clearing equation which specifies that all veal produced is consumed. The form of this equation reflects the variable transformations used for the Houck-suggested asymmetric specification. Equation (6a) defines the farm-retail margin while (6b) again refers to the Houck transformation. Finally, equation (7) delineates the separation of calf slaughter into two sections of the country.

EMPIRICAL RESULTS

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. The t-distribution is not

Table 1. Identity Relations of Structural Model

Supply and Demand

$$(\Delta PCV_t + PCV_o) \times 1/P_t = CSNE_t + CSR_t \quad (5)$$

Price Margin

$$M_t \equiv RPV_t - PSC_t \quad (6a)$$

$$RPV_t \equiv RPV_o + VPI_t + VPD_t \quad (6b)$$

Calf Supply Balance

$$CST_t \equiv CSNE_t + CSR_t \quad (7)$$

strictly appropriate in a simultaneous equation system, but distortions are usually reasonably small (Kmenta, pp. 584-85).

All the variables (Table 2) 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. (See Phillips, Lovfald and Friend pp. 16-17 for a discussion of intercountry 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 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 wage rate variable in equation (3) has a smaller ratio of the parameter estimate to its standard error of estimate than that found in other studies. This is possibly because many of the calf processing plants in the Northeast, unlike much of the meat packing industry throughout the country, are nonunionized. Thus the national variable may not reflect local wage changes very closely.

The slope shifter in equation (4) 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 in 1975, 1976 and 1977 than during the price increases of the earlier period.

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 2, the flexibility of bob calf prices with respect to calf slaughter is estimated to be -0.32 at the mean over the 1961- 77 period.

With this estimated price flexibility a 10 percent (24.6 million pound) reduction in regional calf slaughter from the 1978 level would lead to a 3.2 percent increase in slaughter calf prices, or 2.8 cents per pound in 1978. Underlying this projection 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 3 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). The practicability of feeder calf production in the Northeast is such that a 180,000 head increase would appear to be a practical upper limit for the foreseeable future (see, e.g., Nowak et al.). During this period the price effect of expanded dairy feeder calf production on bob calf prices, while not insignificant, does not appear to be a key factor in the economic viability of this enterprise.

The projection is 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 2: Econometric Model of the Northeastern Veal Sector

1.1 National Retail Demand for Veal

$$\Delta PCV = -.162\ T - .0067\ VPI - .191\ VPD + .026\ PCB - .001\ PCY$$

$$(-1.68)^a \quad (-1.61) \quad (-6.44) \quad (2.03) \quad (-1.59)$$

$$S = .295 \quad D.W. = 1.96^b$$

1.2 Calf Slaughter in the Northeast

$$CSNE = 8.94 + .101\ MCINV - 34.24\ PFC/PSC + .046\ D * MCINV$$

$$(.27) \quad (11.07) \quad (-1.05) \quad (7.74)$$

$$S = 16.20 \quad D.W. = 2.35^b$$

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.); PCY = 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]Ratio of the parameter estimate to its standard error of estimate.

[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.

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