ESTIMATING GROSS MARGINS IN MEAT PACKING FOR BEEF, PORK, AND LAMB

Eric L. Sweatt, Derrell N. Peel, and Clement E. Ward*

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* Graduate Research Assistant, Associate Professor and Extension Economist, and Professor and Extension Economist, respectively, Department of Agricultural Economics, Oklahoma State University. The authors gratefully acknowledge the encouragement and support for this research from the Research Institute on Livestock Pricing, Agricultural and Applied Economics, Virginia Tech.

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Summary and Conclusions

Much has been written about how structural changes in the livestock-meat subsector have affected pricing behavior in the meat packing industry. A major question pertains to whether the trend toward fewer, larger meat packers gives meat packers enough market power to influence prices paid for livestock. Economic performance measures are needed to assist in determining whether monopsony or oligopsony pricing is occurring. Profitability is one measure of economic performance, but profit data are not widely available from private firms and the meat packing industry as a whole. A second-best alternative is to use available public data to calculate estimated gross margins in meat packing.

The objectives of this research were: (1) to develop methodology to estimate historical gross margins in meat packing for beef, pork, and lamb based on available public market information; (2) to explain the level and variability of gross margins over time, including between-year, within-year, and sex-grade-weight or market location differences; and (3) to assess the adequacy of publicly available market data for estimating and monitoring meat packing industry margins.

Beef

Several weekly gross margins series were calculated using available data for the period 1990 to 1994 (i.e., gross margin series for different quality groups of cattle purchased, a weighted margin for steers, a weighted margin for heifers, a weighted margin for Choice grade cattle, a weighted margin for Select grade cattle, and an overall weighted beef packer gross margin for fed cattle). Weighted average gross margins ranged from an annual average low of $57.20/head in 1993 to $87.94/head in 1990 (March to December only). Heifer gross margins exceeded steer margins. Steer-heifer differences in gross margins averaged from $1.32/head in 1991 to $7.81/head in 1993. Large differences were found between Choice and Select cattle. Annual average differences in gross margins ranged from $46.82/head in 1990 (March to December only) to $30.05/head in 1993. Major determinants of gross margins were boxed beef cutout values, live prices paid for fed cattle, live weights of cattle purchased, and dressing percentage.

Gross margins for beef exhibited a seasonal pattern. Monthly average gross margins over the five-year period were highest from May to September and lowest from October to April. Peak months were June and August, while the lowest months were March and April. Several of the gross margin components also exhibit seasonal patterns, including price differences between Choice and Select grades of boxed beef cutout values and between light and heavy boxed beef cutout values. The seasonal pattern in gross margins is the net effect of several seasonal components but does not follow the seasonal pattern of any given component.

This research was hampered by the inability to compare the historical calculated gross margin series with actual industry gross margins. Given estimated slaughtering-fabricating costs, gross margins estimated in this study suggest beef packers have not been generally profitable over the five-year period. However, periodic reports by publicly-held meat packing companies indicate they have experienced record profits in recent years. That discrepancy raises questions about the ability to model and estimate gross margins. Yet, the authors believe these estimates are as accurate as possible **with the public data that are reported regularly**.

To get more precise estimates of gross margins in beef packing, additional data are needed. Additional data can likely be collected, but only at a cost to individual firms and to the collecting agency of the Federal government. Thus, the question is raised whether or not the additional cost is warranted. Perhaps the historical gross margins series capture the variability and pattern of gross margins, even though the level is not measured accurately. A major limitation of the margin series reported here is the lack of value for closely-trimmed products, a category that has grown sharply in recent years. It is not known whether closely-trimmed product has different price seasonality and product composition than reported

commodity trim values. The series reported here may or may not capture within year variability of packer margins, and it certainly is limited in its ability to capture anticipated futures changes in beef product mix.

Pork

Less data were available for pork compared with beef. Estimated gross margins were calculated for quality grade groups (i.e. #1, #2, #3, and #4) using live weights and live hog prices from two market reporting areas (i.e., a six-market average and Iowa-Southern Minnesota direct trade market) for the period 1988 to 1994. Annual average gross margins for pork ranged from $9.70/head in 1988 to $15.89/head in 1994 in the Iowa-Southern Minnesota area. Annual average gross margins varied across quality grades #1 to #4 from $9.78/head in 1994 to $12.93/head in 1990. Estimated gross margins for #4 hogs were negative on average in some years. Differences between gross margins for the six-market average and Iowa-Southern Minnesota direct market were typically small, but the differences switched over time. Gross margins were highest for the Iowa-Southern Minnesota area from 1988 to 1990. Thereafter, gross margins for the six-market average were above those for Iowa-Southern Minnesota.

Gross margins estimates for pork followed a seasonal pattern, which represents the net effect from seasonal patterns for several gross margins components. Gross margins were highest in September through December, peaking in November, and lowest from January to August, reaching a low in May.

As with beef, the authors have concerns about the effectiveness of the gross margins estimating process. Data were more limited for pork than for beef. Since the quality composition of hogs purchased for slaughter is unknown, it was not possible to calculate an overall average gross margin for pork packing. Similarly, since the quality composition may vary seasonally, the calculated gross margins may not accurately reflect the true seasonal pattern in gross margins for pork. Given what is known about slaughtering-processing costs in pork packing and given periodic financial information from publicly-held meat packers, the level of estimated gross margins is likely understated, but by how much is not known. More data could improve the gross margins estimates, though added data will only be collected at higher private and public costs.

Lamb

Less data were also available for estimating gross margins in lamb than for beef. Gross margins were calculated with carcass prices for lambs dressing between 55 and 65 lbs. and lambs dressing between 65 and 75 lbs. from 1990 to 1994. In 1992, data became available to calculate gross margins using boxed lamb cutout values. Annual average gross margins using boxed lamb cutout values ranged from $11.80/head to $6.02/head above those estimated using carcass prices for the 1992 to 1994 period.

Seasonality in gross margins based on boxed lamb cutout values is less clear than gross margins for beef and pork, in part because of the shorter data period. Gross margins were above the three-year average from February to March, July and August, and again in December. Gross margins were clearly highest in April and lowest in May-June and again in October-November. Again, the seasonal pattern in lamb gross margins may not reflect the true seasonal pattern due to data limitations, especially for the composition of lambs procured for slaughter.

Even less information is available to assess the accuracy of lamb gross margins than for beef and pork. In addition, the authors have the same concerns about accuracy due to data limitations. Again, if enough importance is placed on monitoring gross margins in lamb packing, more data are needed, though it must be collected at higher private and public costs.

Estimating Gross Margins in Meat Packing
for Beef, Pork, and Lamb

Background

Structural changes have been occurring in the meat packing industry for the past two decades (Ward 1988). In general, the meat packing industry has trended towards fewer, larger plants and firms. Although less extensive, cattle feeding, hog finishing, and lamb feeding have trended in the same direction, towards fewer and larger operations.

Behavioral changes have accompanied structural changes in meat packing. A variety of vertically integrated arrangements have become increasingly common between livestock producing and meat packing entities. In some cases, packing and feeding operations are under a common ownership umbrella. An example is Cargill's ownership of Excel, one of the largest meat packing firms, and Caprock Industries, one of the largest cattle feeding firms. Vertically integrated arrangements exhibit a range of relationships from minimal coordination and exchange of information to highly structured, centrally-managed production-processing arrangements. One type which has increased in importance is exclusive marketing/purchasing arrangements between packers and independent feedlots. An example, and one of the first such arrangements, is a formula marketing agreement between Cactus Feeders, one of the largest cattle feeding firms, and IBP, the largest meat packing firm. These agreements are one type of vertical coordination arrangements that are taking place outside the spot or cash market. Marketing/purchasing agreements along with two other marketing/procurement methods (i.e. forward contracts and packer feeding) are commonly referred to as types of "captive supply" procurement methods. Increased use of captive supply arrangements have led to concerns about thinner spot markets and fewer publicly reported prices, both of which likely impact the price discovery process.

Structural changes have led to concerns of oligopsony pricing of slaughter livestock, while increased use of captive supply arrangements have increased concerns about thin markets for cash-marketed livestock and too few publicly reported prices (Purcell and Rowsell; Purcell 1990, 1992). Thus, the crux of concerns is the impacts structural and behavioral changes have had on the price discovery process for livestock. Given meat packing industry changes and related concerns, there is a need to evaluate the economic performance of the meat packing industry. Measures of economic performance include profits or profitability of firms and the industry as a whole. This research attempts to measure performance in the meat packing industry using publicly reported data.

Two organizations previously published annual performance statistics for the meat packing industry. For several years, the American Meat Institute (AMI) published annual financial performance of their member firms, and *Forbes* magazine published data from an annual survey of the 500 largest corporations. But, as a result of structural changes, these sources discontinued reporting financial performance data or were forced to combine meat packing firms with a broader group of firms, such as the food manufacturing industry. Both organizations only published annual performance figures and the data had several limitations. For example, average annual measures of performance revealed nothing of the weekly variability or within-year seasonality of performance. When questions are raised about meat packing firm behavior, short-run behavior is often the subject. However, no short-run financial performance information is publicly available. While having annual performance information was better than having nothing at all, several private firms have attempted to fill the void in shorter-run performance by developing gross margins series for the meat packing industry. These firms periodically report gross margins in trade publications, but no information is available to assess the reliability of the procedures and data from which reported gross margins are estimated.

Objectives

The central question addressed in this study is whether or not publicly reported data can be used to accurately estimate gross margins in the meat packing industry. Once gross margins are estimated, then the adequacy of public data can be assessed and recommendations made to improve the data if estimated gross margins fail to accurately represent actual meat packer gross margins.

Therefore, the general objective of this research was to use public data to measure performance in the meat packing industry. If public data are adequate, anyone wishing to track meat packing performance could do so with the publicly available data. Three specific objectives include:

(1) To develop methodology to estimate historical gross margins series in meat packing for beef, pork, and lamb based on available public market data;

(2) To explain the level and variability of gross margins over time, including between-year differences, within-year differences (including seasonality), and sex-grade-weight or market location differences; and

(3) To assess the adequacy of publicly available market data for estimating and monitoring meat packing industry margins.

General Framework

In the industrial organization paradigm, performance of an industry is the yardstick by which conduct is measured, and profitability is one way to measure performance (Carlson and Perloff). The profit (Π) equation for a given firm, in its simplest form, is total revenue (TR) minus total costs (TC).

$$\Pi = TR - TC$$

In order to use this equation to compute profit, information must be available for the components of total revenue and total costs. Equation (2) shows the components of the profit equation for a meat packing firm.

$$\Pi = (R_M + R_{BY}) - (C_I + C_P)$$

In equation (2), profit (Π) is the difference between total revenue and total costs, where total revenue consists of revenue from meat sold (R_M) and revenue from by-products sold (R_{BY}). Total costs are cost of the live animal input (C_I) and the cost of slaughtering-processing (C_P). One problem encountered in this research was that not all of the components of equation (2) are available to calculate profit in meat packing. Available public data do not include adequate short run information on the cost of slaughtering and processing. Therefore, the next best alternative was to estimate gross margins as

$$GM = TR - C_I ,$$

where gross margin (GM) for a given firm is total revenue (TR) minus cost of the livestock input (C_I). For meat packing firms, the gross margin equation is

$$GM = (R_M + R_{BY}) - C_I ,$$

where gross margin (GM) is revenue from selling meat (R_M) plus revenue from selling by-products (R_{BY}) minus the cost of the live animal input (C_I).

Data and Procedures for Beef

With what seems to be a simple gross margin equation, there are still many factors which contribute to each component of the gross margins equation. In the case of beef packing, revenue from the sale of meat contains variables for the price of boxed beef and the quantity of boxed products. Revenue from the sale of by-products contain variables for the price of by-products and quantity of by-products. Costs of inputs are costs of purchasing live animals, which includes the price of fed cattle and quantity of fed cattle. Each of these variables include additional factors, such as carcass weights, qualities of meat, sex of animals, and seasonality of prices. Table 1 shows for each component of the gross margin equation variables used to compute gross margins, factors embodied within each variable, and further variability within the factors.

Table 1. Gross Margins Components and Sources of Variability.

Margin Component	Variables	Factors	Variability within factors
R_M	PBB	weight quality grade	light (550-700) heavy (700 +) choice select
	QBB	weight of carcass -sex quality of carcass	differences in dressing % for steers and heifers choice select
R_{BY}	PBY	based on $/cwt.	
	QBY	live weight	more weight = more value
C_I	PFC	quality weight sex location	expected grade choice expected grade select light heavy price for steers price for heifers this study concentrates on one geographic region
	QFC	sex	weight of steers weight of heifers proportion of steers vs. heifers

Procedure 1

Procedure 1 involves using the gross margin equation for meat packing (4), rewritten as

$$GM_{BEEF} = [(PBB * QBB) + (PBY * QBY)] - (PFC * QFC)$$

where

GM_{BEEF} = Weekly gross margin for beef ($/head);

PBB = Boxed beef cutout value (Choice 550-700 lbs., Choice 700-850 lbs., Select 500-700 lbs., Select 700 lbs. or more) ($/cwt.);

QBB = Carcass dressed weight [Federally inspected (FI) dressed weight of steers and heifers] (lbs.);

PBY = By-products value (Based on live animal weight) ($/head);

QBY = Fed cattle weight (Texas-Oklahoma market area) (lbs.);

QFC = Fed cattle weight (Texas-Oklahoma market area) (lbs.); and

PFC = Fed cattle price (Western Kansas reported price) ($/cwt.).

Data used to calculate gross margins for this research are reported in *Livestock, Meat, Wool Market News: Weekly Summary and Statistics* (AMS-USDA), compiled by the Agricultural Marketing Service, U.S. Department of Agriculture. Data were for March 1990 to December 1994 for each of the variables used in the gross margin equation. Data included four weekly average boxed beef cutout values (FOB Central U.S., Omaha Basis), depending on the dressed weight of the carcass for the following groups: (1) Choice 550-700 lbs.; (2) Choice 700-850 lbs.; (3) Select 550-700 lbs.; and (4) Select 700 lbs. or more. To calculate the meat portion of the revenue equation, dressed weight of the animal is needed along with the boxed beef cutout value. Data used included weekly average Federally inspected dressed weights for steers and heifers. The next part of the revenue portion of the equation includes revenue from by-products. The quantity of by-products is based on the live weight of fed cattle for the Texas-Oklahoma region. The reported by-products value per cwt. (for hide and offal) is based on current Central U.S. by-products prices. The final portion of the equation is the cost portion. Costs include the price of fed cattle (i.e., the Western Kansas reported price) and quantity of fed cattle, which is the same as the quantity of by-products (i.e., the Texas-Oklahoma live weight of cattle).

Several issues emerged using Procedure 1 to calculate packer margins. Only one live weight was published for steers and heifers combined. Thus, there was only one live weight to calculate the by-products value, which averaged less than $10/cwt. for the data period. The same live weight was used to calculate the cost portion of the equation, which averaged more than $60/cwt. Therefore, this procedure underestimated the heifer gross margins and over-estimated steer gross margins. Second, the same live weight was used for dressed weights included in the 550-700 lb. group and the 700-850 lb. group, though cattle from each group would not weigh the same. Cattle in the 700-850 lb. group would be heavier, which would increase the cost of the cattle more than it would increase the by-products component of revenue. All steers are in the 700-850 lb. dressed weight group and some heifers are in this group. Therefore, steer gross margins are over-estimated for the heavier boxed beef groups and heifer gross margins are over-estimated for this same group. Third, there was no breakdown of how many cattle would grade Choice and how many cattle would grade Select.

Using this set of public data, only a rough estimate of gross margins for each category could be calculated. For example, gross margins could be calculated by year for steers and heifers individually for each of the four boxed beef groups. However, no information is available on the number of cattle grading Choice or Select, or how many cattle are light or heavy.

Procedure 2

Procedure 2 applied different data to the same gross margin equation (4) as in Procedure 1. The more complete data for Procedure 2 are available in the same AMS-USDA report and the data were reported beginning in March 1990. Additional data include cattle sold on a live weight basis and dressed weight basis, separately for steers and heifers from the Texas-Oklahoma, Kansas, Colorado, Nebraska, and Iowa-Southern Minnesota region. Both live and dressed weight sales

include total number of head sold, number of cattle in sale lots which are expected to grade 80-100 percent Choice, 65-80 percent Choice, 35-65 percent Choice, 20-35 percent Choice, and 0-20 percent Choice. Within each purchase category, a weighted average weight and weighted average price of cattle are reported. However, for some weeks, no cattle were reported in all categories. The extreme categories, 80-100 percent Choice and 20-35 percent Choice or lower categories, were sporadically reported. When calculating gross margins, the 0-20 percent group was omitted due to limited observations. Weighted average weights and prices were other data used to calculate gross margins.

Equation (6) illustrates factors which affect gross margins for beef packing.

$$GM_t = \sum_{j=1}^{J} \sum_{k=1}^{K} \sum_{l=1}^{L} \sum_{m=1}^{M} [(N_{jk} / N (PBB_{jk} * QBB_{jk}) + N_{lm} / N (PBY * QBY_{lm}) - N_{lm} (PFC_{lm} * QFC_{lm})]$$

Gross margins for a given week (GM_t) are the sum across some given portion of (j) carcasses grading either Choice or Select, (k) light or heavy carcass weights, (l) different buying groups of live animals, and (m) steers or heifers. Gross margins are dependent on the previously discussed variables, and the several factors within them. Revenue from meat sales is determined by (N_{jk}), the number of Choice or Select, light or heavy cattle, divided by (N), total number of cattle slaughtered for the week. These groups of cattle are then used to determine beef sales revenue by using the correct boxed beef cutout value (PBB). To determine the corresponding boxed beef cutout value, factors which must be addressed include the proportion of Choice carcasses versus Select carcasses and different values for light versus heavy carcasses. As shown in equation (7), the boxed beef cutout value (PBB) chosen is based on whether the dressed weight of the carcass (QBB) is either light or heavy (i.e., either above or below 700 lbs.).

$$PBB = [PBB_{light} \text{ if } QBB_k \_ 700] \quad [PBB_{heavy} \text{ if } QBB_k \text{ f } 700]$$

To calculate whether the dressed weight of the carcass is either light or heavy, equation (7) multiplies the steer or heifer dressing percentage by the corresponding steer or heifer live weight to get the dressed weight for both steers and heifers.

$$QBB_k = QFC_{lm} * DRPCT_{lm}$$

Revenue from by-products sales is determined by (N_{lm}), the portion of cattle in the buying group for both steers and heifers, divided by (N), the total number of cattle slaughtered. Factors affecting revenue collected from the sale of by-products include the buying group from which cattle are purchased and sex of the animal. The latter becomes important because live weights differ by sex of cattle and the value of by-products depends on the live weight of each animal.

Factors within the cost portion include grading discounts on live cattle, because prices paid for lower quality cattle are typically lower than prices paid for higher quality cattle. Live weights of cattle also affect prices paid, as does sex of the

animal since prices paid for steers and heifers frequently differ. This study used data to calculate beef packing gross margins from one geographic region, but location can also be a factor affecting gross margins since prices paid for cattle may differ for a deficit region versus a surplus region.

One advantage Procedure 2 has over Procedure 1 is that each purchase category has a live weight published with price and quantity, so steer and heifer margins are more accurately estimated. Another advantage is being able to estimate how many cattle graded Choice and Select. Finally, data allow calculating several different series of gross margins (i.e., for each grade category, each sex category, weighted grade categories, weighted sex categories, and an overall weighted average for all grades and sexes).

Although data for Procedure 2 are more detailed, several issues had to be addressed and some assumptions made. The first question was what dressing percentage to use for each buying group. After conferring with animal scientists, a constant dressing percentage was assumed for each category of cattle, though some concern persisted for the categories including cattle grading 20-35 percent Choice. Dressing percentage was calculated using the Federally inspected dressed weight divided by the weighted average live weight for all categories. The dressing percentage was then applied to each individual live weight category to get the dressed weight for each buying group.

A second question was how to estimate the number of cattle grading Choice and Select. Assuming the distribution of cattle in each category was normally distributed, the midpoint was used for each category. For example, the 35 to 65 percent buying group implies that 50 percent of cattle graded Choice and 50 percent graded Select. Even with these assumptions, Procedure 2 allowed estimating a more realistic gross margin series.

Data and Procedures for Pork

Less data were available to calculate a gross margins series for pork than for beef. For example, no data were reported on number of hogs in each quality grade category, prices paid for each grade category, and dressed weights or separate live weights for each grade category. The only estimated gross margins series which could be calculated for pork was comparable to Procedure 1 for beef but for each quality grade (i.e. #1, #2, #3, and #4).

Thus, the following is the gross margins equation for pork:

$$GM_{PORK} = [(P_{PC} * Q_{PC}) + VAL_{BY})] - (P_{SH} * Q_{SH})$$

where

GM_{PORK} = Weekly gross margins for pork ($/head);

P_{PC} = Pork carcass cutout values (#1, #2, #3, and #4) ($/cwt.);

Q_{PC} = Dressed weight of hogs [Federally Inspected (FI) dressed weight of barrows and gilts] (lbs.);

VAL_{BY} = By-products value ($/head);

P_{SH} = Live price of slaughter hogs ($/cwt.); and

Q_{SH} = Live weight of slaughter hogs (lbs.).

Public data needed to calculate gross margins for pork are found in the same AMS-USDA report as discussed above. The revenue portion of the equation has two components, meat and by-products. Pork revenue was estimated from

pork carcass cutout values (P_{PC}) (based on a 175 lb. carcass) for each of the four grade categories and FI dressed weights (Q_{PC}) of barrows and gilts. Byproducts revenue was estimated from a composite value of by-products (VAL_{BY}). AMS-USDA does not publish a separate by-products value per hundredweight for pork, comparable to the hide and offal value reported for beef. Therefore, by-products value for hogs on a per head basis was computed from individual components of pork by-products, which are reported by AMS-USDA.

The final part of the gross margin equation for pork is the cost portion. Two types of data are needed, live animal prices (P_{SH}) and live animal weights (Q_{SH}). Two different live animal prices were used for comparison purposes. First was a six-market average[1], and the second was the Iowa-Southern Minnesota direct market. The same two markets were used for live weight data. Using these data in equation (9), an estimated gross margins series was calculated for pork. This series represents a rough estimate of gross margins for pork from each quality grade category though no data were available on the proportion of hogs purchased within each quality category. This is the best estimate given the limited hog-pork data currently available.

Data and Procedures for Lamb

Data for estimating gross margins in lamb was also quite limited. Data are not available for categories of slaughter lambs purchased. Therefore, as with pork, only an estimated gross margins series could be calculated for lamb. The estimated gross margin equation for lamb was

$$GM_{LAMB} = [(P_{BL} * Q_{BL}) + PELT] - (P_{SL} * Q_{SL})$$

where

GM_{LAMB} = Weekly gross margin series for lamb ($/head);

P_{BL} = Boxed lamb cutout values ($/cwt.);

Q_{BL} = Dressed weight of lambs (lbs.);

PELT = Price of pelts ($/pelt);

P_{SL} = Live price of slaughter lambs ($/cwt.); and

Q_{SL} = Live weight of slaughter lambs (lbs.).

Public data used to calculate gross margins for lamb came from the *Lamb and Wool Market News* report published by the American Sheep Industry Association (ASIA). Some data in that report are collected by ASIA and some are collected by AMS-USDA. Estimating gross margins for lamb also requires revenue and cost information. Data needed to calculate the revenue portion of the equation include boxed lamb cutout values or lamb carcass prices, dressed weight of lambs, and pelt prices. Gross margins for lamb were calculated from 1990 to 1994 using carcass prices, but data were only available from May 1992 to 1994 to calculate gross margins using boxed lamb cutout values (P_{BL}). East Coast wholesale carcass prices were reported for five dressed weight categories: 55 lbs. or less, 55-65 lbs., 65-75 lbs., 75-85 lbs.,

[1] The Kansas City terminal market was dropped in October 1991, thereby reducing the seven-market average to a six-market average. In April 1994, National Stockyards in St. Louis was dropped, creating a five-market average.

and an average of 40-75 lbs. Since average dressed weights did not fall below 55 lbs. or above 75 lbs. during the period data were available, only the 55-65 lb. and 65-75 lb. carcass prices were used for the estimated gross margins series. In May 1992, boxed lamb cutout values began being reported for lamb carcasses of 65 lbs. or less, and for more than 65 lbs. The quantity of boxed lamb (Q_{BL}) is the average dressed weight of lambs. Pelt prices (PELT) used were #1 grade pelts.

Data needed to calculate the cost portion of the gross revenue equation included the live price and live weight of slaughter lambs. The live price of slaughter lambs (P_{SL}) is a national average price. The quantity of slaughter lambs (Q_{SL}) is the average live weight of lambs slaughtered. As with pork, no data are available on the distribution of slaughter lamb weights. Using available data with equation (10), two estimated gross margins series were calculated, one using boxed lamb cutout values and one using carcass lamb prices. Again, these represent a rough estimate of lamb gross margins given the data currently available.

Results

Beef

Estimated gross margins over the five-year period 1990 to 1994 are reported here, along with factors which affect the variability of gross margins within and between years. As indicated, several weekly gross margins estimates were calculated: for each buying group (i.e., 80-100 percent Choice, 65-80 percent Choice, 35-65 percent Choice, and 20-35 percent Choice); for cattle grading Choice and Select; for steers and heifers; and a weighted series for all fed cattle combined. Summary statistics for these series are shown in Tables 2 to 4.

Beef packers' overall average gross margins for 1990 to 1994 were $72.99 per head (Table 2).[2] Gross margins declined early in the period but increased in 1994 (Figure 1). There were large differences between the minimum and maximum during each year. Large differences were found between Choice and Select grade cattle and narrower differences between steers and heifers.

Weighted average gross margins ranged from an annual average low of $57.20/head in 1993 to $87.94/head in 1990. Estimated gross margins in 1990 and 1991 were higher, $87.94 and $85.00/head, respectively. That was $14.95/head (20.48 percent) and $12.01/head (16.45 percent) above the five-year average, respectively. In 1992, there was a dramatic decrease in the level of gross margins. Gross margins decreased 23.56 percent from the previous year, and fell by 10.99 percent below the five-year average. Factors which contributed to the decrease in gross margins from 1991 to 1992 included: (1) decreased boxed beef cutout values of $1.44/lb. (-1.23 percent); (2) increased live steer prices of $0.99/cwt. (1.32 percent); (3) increased live weights of 4.22 lbs. (0.36 percent); (4) increased dressed weights of 2.83 lbs. (0.37 percent); and (5) increased revenue from by-products sales of $0.13/cwt. (1.75 percent). The combined effect of increased live weights and increased live prices increased live animal costs of $14.82/head (1.69 percent). The net effect from decreased boxed beef cutout values and increased dressed weights reduced beef sales revenue $7.62/head or (-0.86 percent). The only positive impact on gross margins was the combined effect from increased by-products values and increased live weights.

The net change in estimated gross margins of minus $20.59/head (-24.22 percent) from 1991 to 1992 resulted from decreased beef sales revenue of $7.62/head, increased by-products revenue of $1.84/head, and increased costs from purchasing live animal inputs of $14.81/head. The decrease in average gross margins components of 24.22 percent nearly equals the total decrease in average gross margins of 23.56 percent from 1991 to 1992. From 1992 to 1993, gross margins decreased further. Gross margins fell by 11.96 percent below the previous year, and 21.63 percent below the five-year average. Factors which contributed to the change in gross margins from 1992 to 1993 included: (1) boxed beef cutout values

[2] Readers should note that calculated gross margins for beef for 1990 are for March to December only. Given the estimated seasonal pattern, average gross margins reported for 1990 may be higher than the full-year average.

increased $1.96/cwt. (1.69 percent); (2) live steer price increased $1.41/cwt. (1.87 percent); (3) live weights decreased 6.85 lbs or (0.58 percent), which combined with the increase in live prices increased live animal costs $11.36 (1.28 percent); (4) dressed weights decreased by 12.73 lbs. (-1.68 percent); and (5) by-products values increased $0.21/cwt. (2.78 percent). Combined with a decrease in live weight, the effect of by-products on gross margins increased revenues $1.95/head (2.19 percent) from 1992 to 1993. Gross margins also in 1993 compared with 1992 declined. The net decline in gross margins of $9.51/head (-14.64 percent) resulted from decreased meat sales revenue, increased by-products revenue, and increased live animal costs. Changes in gross margins from the components used to compute gross margins of 14.64 percent, nearly equals the total change in gross margins of 11.04 percent, so these factors explain nearly all of the change in gross margins from 1992 to 1993.

Table 2. Gross Margins Components and Sources of Variability

	Beef Weighted Avg.	Choice	Select	Steers	Heifers
			$/Head		
1990					
Avg	87.94	105.65	58.83	88.99	86.36
Max	107.92	132.53	80.08	111.29	102.36
Min	65.07	71.73	36.45	65.30	64.47
1991					
Avg	85.00	99.33	65.10	84.46	85.78
Max	133.27	144.83	117.57	133.94	132.10
Min	58.12	72.68	36.39	51.88	63.81
1992					
Avg	64.97	79.49	47.52	63.91	66.78
Max	90.22	114.78	76.42	90.62	89.49
Min	44.02	49.17	21.11	40.76	43.45
1993					
Avg	57.20	71.51	41.46	54.27	62.08
Max	80.10	99.98	70.04	78.50	91.32
Min	31.65	43.50	11.29	25.99	36.69
1994					
Avg	72.73	89.23	53.90	71.91	73.95
Max	111.57	132.68	94.57	115.84	108.89
Min	41.82	56.39	16.46	38.93	45.24
1990-94					
Avg	72.99	88.38	52.39	72.06	74.53
Max	133.27	144.83	117.57	133.91	132.10
Min	31.65	43.50	11.29	25.99	36.69

In 1994, gross margins increased sharply. Gross margins increased by 27.15 percent above the previous year, but were slightly below the five-year average, by 0.36 percent. Factors which contributed to the change in gross margins from 1993 to 1994 included: (1) decreased boxed beef cutout values of $11.07/cwt. (-9.39 percent); (2) decreased live steer prices

of $7.39/cwt. (9.61 percent); (3) heavier live weights of 36.16 lbs. (3.08 percent), which combined with decreased live prices, decreased live animal costs $61.49/head (6.82 percent); (4) heavier dressed weights of 28.72 lbs. (3.84 percent), though with decreased boxed beef cutout values, meat sales revenue declined by $52.05/head (-5.91 percent); and (5) increased by-products revenue from increased by-products values of $0.59/cwt. (7.60 percent). Combined with increased live weights, the effect of by-products on gross margins was higher gross margins of $9.93/head (10.92 percent) from 1993 to 1994. The net change in gross margins of $19.37/head (33.86 percent) from 1993 to 1994 resulted from a combined decrease in meat sales revenue of $52.05/head, increased by-products revenue of $9.93/head, and decreased costs for live animal inputs of $61.49/head. Changes in gross margins from the components used to compute gross margins of 33.86 percent is larger than the total change in gross margins of 27.15 percent, and over-estimated the percentage change in gross margins somewhat.

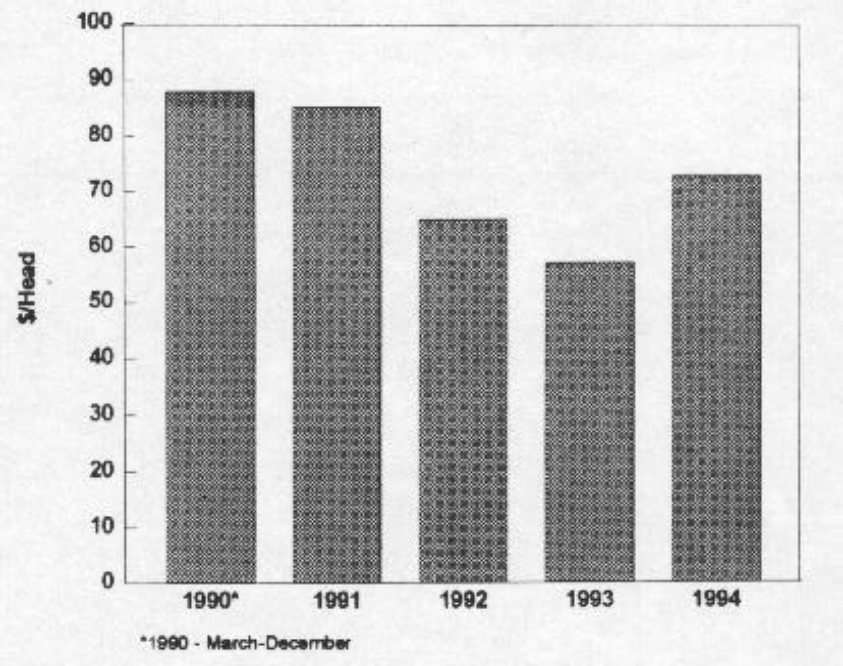

Figure 1. Annual Average Gross Margins for Beef

Steers versus Heifers

Some interesting comparisons between steer and heifer average gross margins can be made over the 1990 to 1994 period (Table 2). Steer-heifer differences in gross margins averaged from $1.32/head in 1991 to $7.81/head in 1993. In 1990, average gross margins for steers were $2.63/head more than for heifers. But in 1991, average gross margins for heifers were higher than steers by $1.32/head. This spread between heifer gross margins and steer gross margins became larger in 1992 and 1993, $2.87 and $7.81/head, respectively, but declined again in 1994 to $2.04/head. There appears to be some year-to-year correlation between the dressing percentage of steers versus heifers, percentage of steers versus heifers in the slaughter mix, and differences in average gross margins of steers versus heifers between years.

The percentage of steers slaughtered in 1990 was the smallest for the time period of this research, 60.03 percent. Thus 39.97 percent of the cattle slaughtered were heifers. This was the only year that average gross margins for steers were higher than for heifers. In 1991, slightly more steers were slaughtered than in the previous year, 60.56 percent of total cattle slaughtered, and heifer margins were more than steer margins, by $0.14/head. In 1992, more steers were slaughtered than in 1991 totaling 62.32 percent of total cattle slaughter, and the difference between heifer gross margins and steer gross margins widened to $2.87/head. In 1993, the largest percentage of steers slaughtered was recorded, 63.09 percent, and the difference between the heifer gross margins and steer gross margins was the largest at $7.81/head. Finally in 1994, the

percentage of steers slaughtered fell to near the 1992 level of 62.06 percent, and the spread between heifers gross margins and steer gross margins decreased to $2.04/head, also near the 1992 difference in gross margins.

The five-year average dressing percentage for steers was 64.20, or 0.58 percentage points less than the five-year average dressing percentage for heifers of 64.78. In 1990, the average dressing percentage for heifers exceeded the average for steers by 0.46 percentage points, when gross margins for steers were higher than for heifers. In 1991, the difference in dressing percentages widened to 0.54 and heifer gross margins were higher than steer gross margins. In 1993, the difference between dressing percentages was at its highest level at 0.86 percentage points, when the difference between steer and heifer gross margins was at its highest level of $7.81/head.

Within-Year Variation

Gross margins for beef exhibited a seasonal pattern. Monthly average gross margins over the five-year period were highest from May to September and lowest from October to April (Figure 2). Peak months were June and August, while the lowest months on average were March and April. June had the highest monthly gross margin, $85.19/head, which was $12.20/head (16.71 percent) above the five-year annual average of $72.99/head. The next highest month was August, which averaged $84.66/head, and was $11.67/head (15.99 percent) above the five-year average. May, July, and September were the only other months which were above the five-year annual average at $73.80, $78.78, and $78.22/head, respectively (1.11, 7.93, and 7.17 percent, respectively) above the five-year average. The remaining months (October through April) averaged between $62.54 and $72.57/head, and ranged from minus $10.45/head (-14.32 percent) to minus $0.42/head (-0.58 percent) below the five-year average.

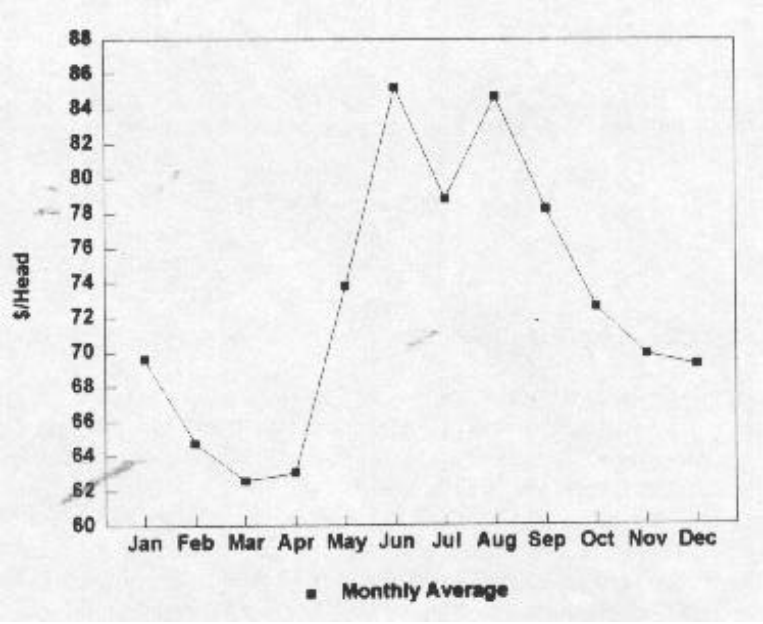

Figure 2. Monthly Average Gross Beef Packing Margins, March 1990 - December 1994

From January to April, five-year average monthly gross margins decreased by $6.55/head (-9.41 percent). During these months, meat sales revenue increased $6.18/head (0.71 percent). Within this component, five variables influenced revenue from meat sales; Choice and Select boxed beef cutout values (Figures 3 and 4), dressed weight (Figure 5), the proportion of steers and heifers in the slaughter mix (Figure 6), the proportion of Choice and Select cattle (Figure 7), and the boxed beef cutout value difference between light and heavy carcasses (Figures 8 and 9). All average dressed weights for steers were greater than 700 lbs., so heavy boxed beef cutout values were used for steers. Heifer average dressed weights were less than 700 lbs., so light boxed beef cutout values were used for heifers.

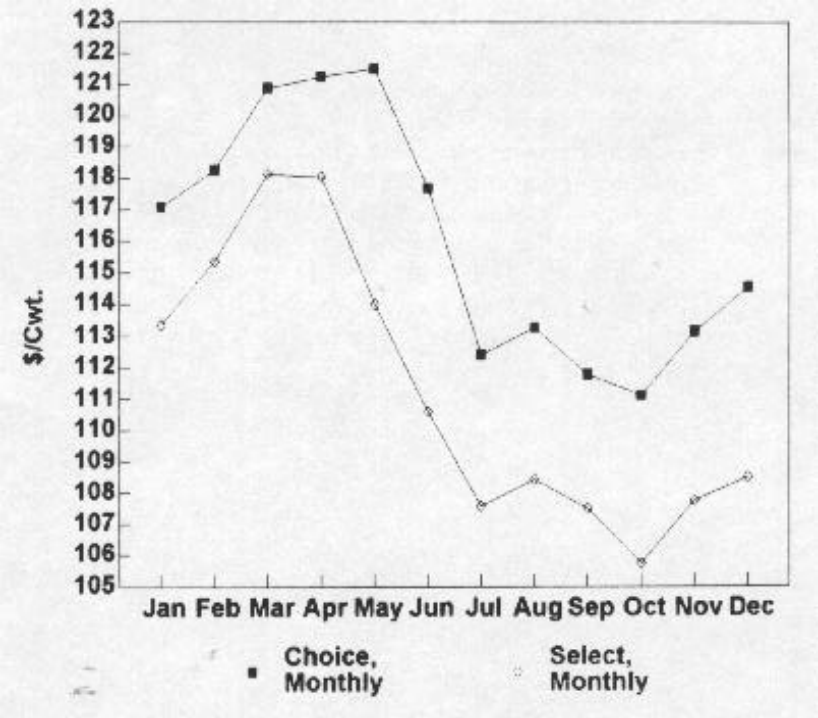

Figure 3. Monthly Average Choice and Select Boxed Beef Cutout Values, March 1990 - December 1994

Several of the components which contribute to gross margins exhibit seasonal patterns, including price differences between Choice and Select grades of boxed beef cutout values and between light and heavy boxed beef cutout values. Large differences were found between gross margins for Choice and Select cattle. Annual average differences in gross margins ranged from $46.82/head in 1990 to $30.05/head in 1993. The five-year average monthly Choice boxed beef cutout value increased $4.17/cwt. (3.56 percent) from January to April, while the Select boxed beef cutout value increased $4.69/cwt. (4.14 percent). The proportion of Choice cattle slaughtered increased slightly, which offset lower dressed weights of 20.25 lbs. (-2.68 percent). The light-heavy price difference decreased by $1.00/cwt. and the proportion of heifers decreased slightly, for a combined decrease in revenue of $2.71/head from the light-heavy spread. These factors combined for a net positive increase in meat sales revenue of $6.18/head.

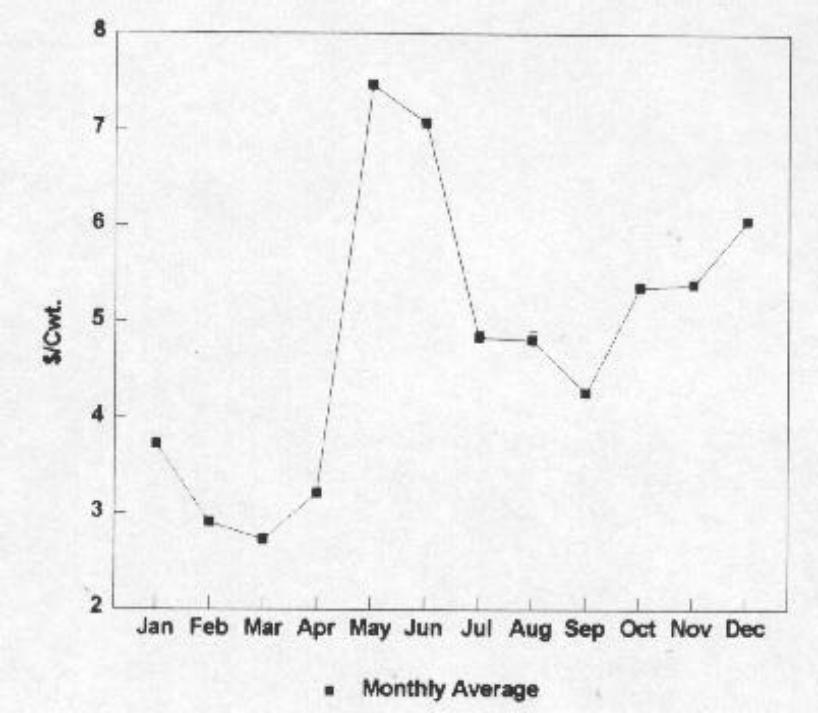

Figure 4. Monthly Average Choice-Select Spread, March 1990 - December 1994

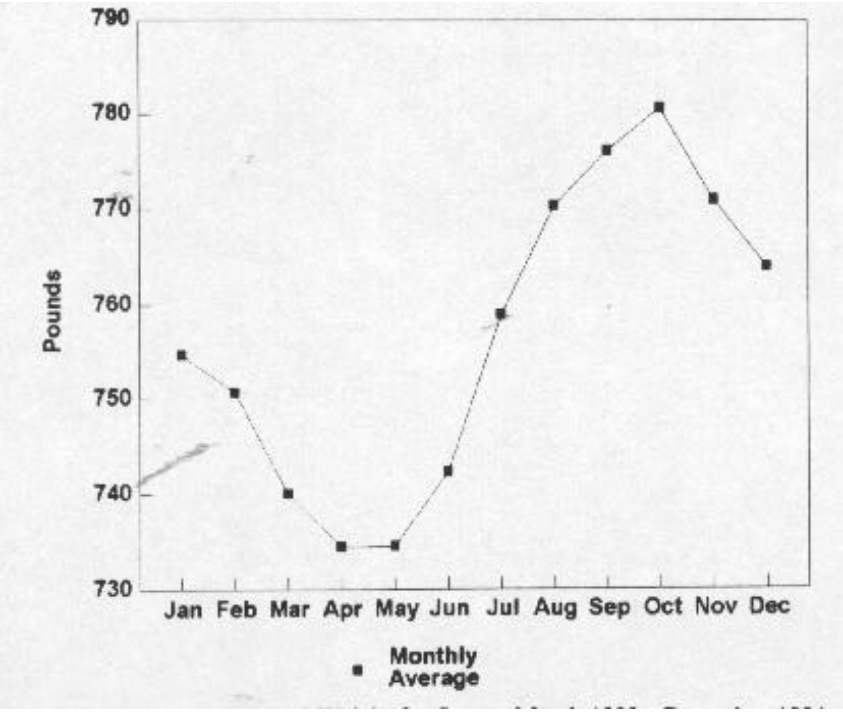

Figure 5. Monthly Average Dressed Weight for Steers, March 1990 - December 1994

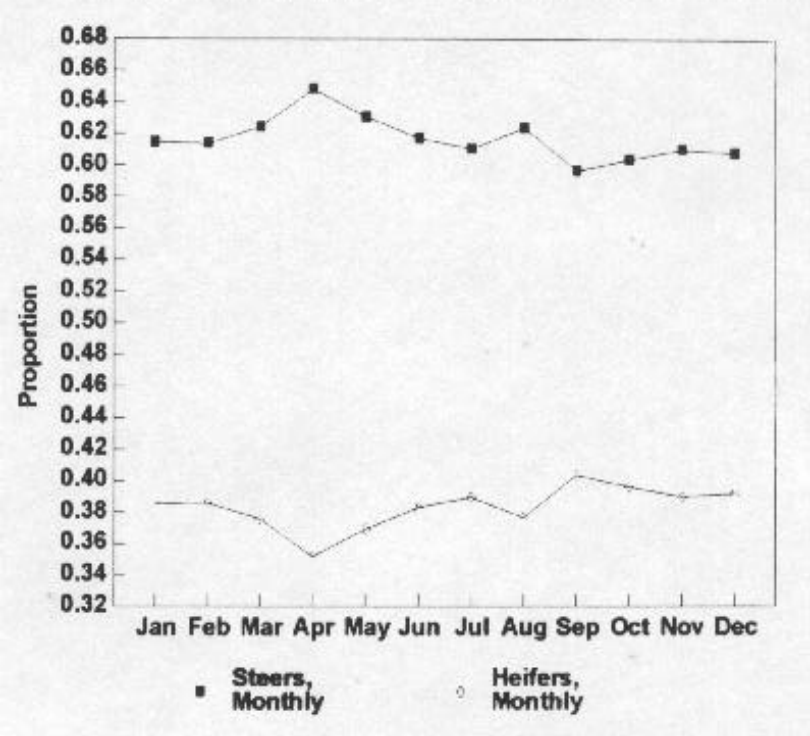

Figure 6. Monthly Average Proportion of Steers and Heifers Slaughtered, March 1990 - December 1994

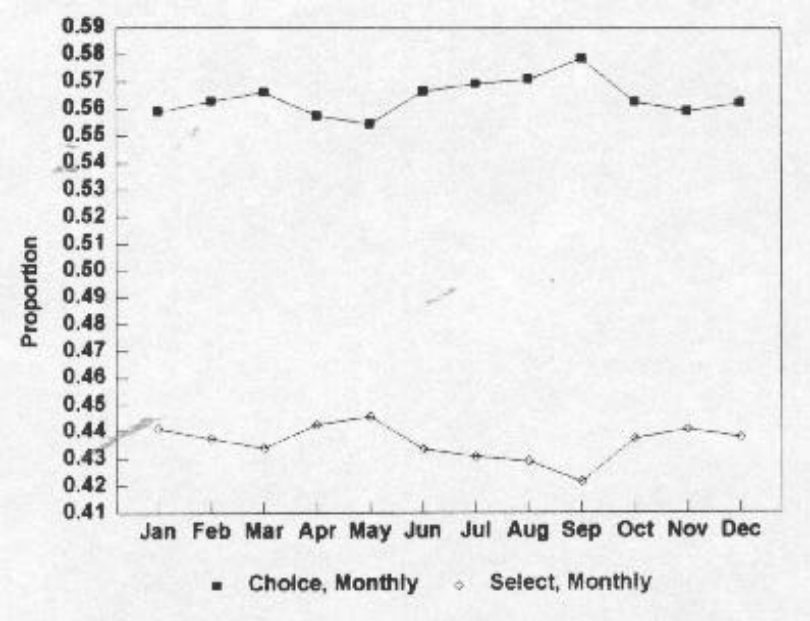

Figure 7. Monthly Average Proportion of Choice and Select Slaughtered, March 1990 - December 1994

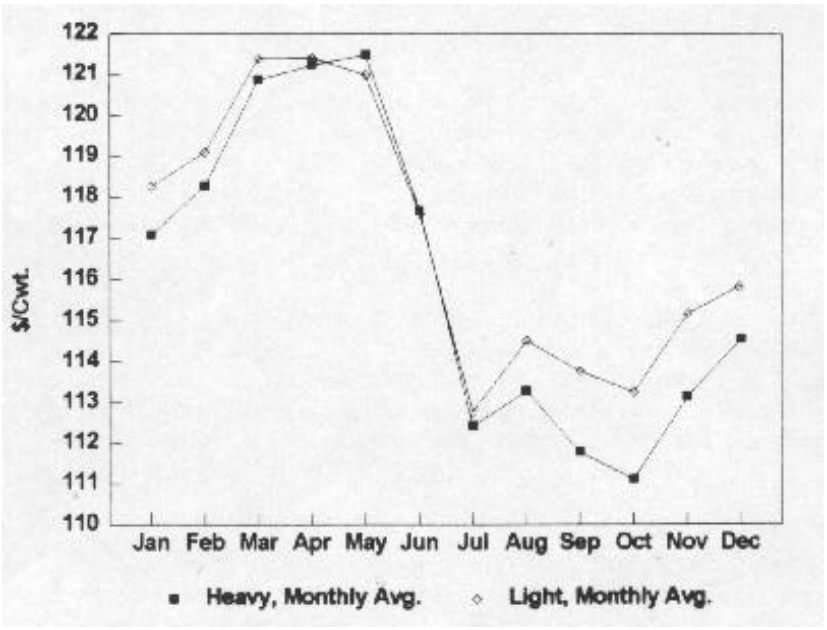

Figure 8. Monthly Average Light and Heavy Boxed Beef Cutout Values, March 1990 - December 1994

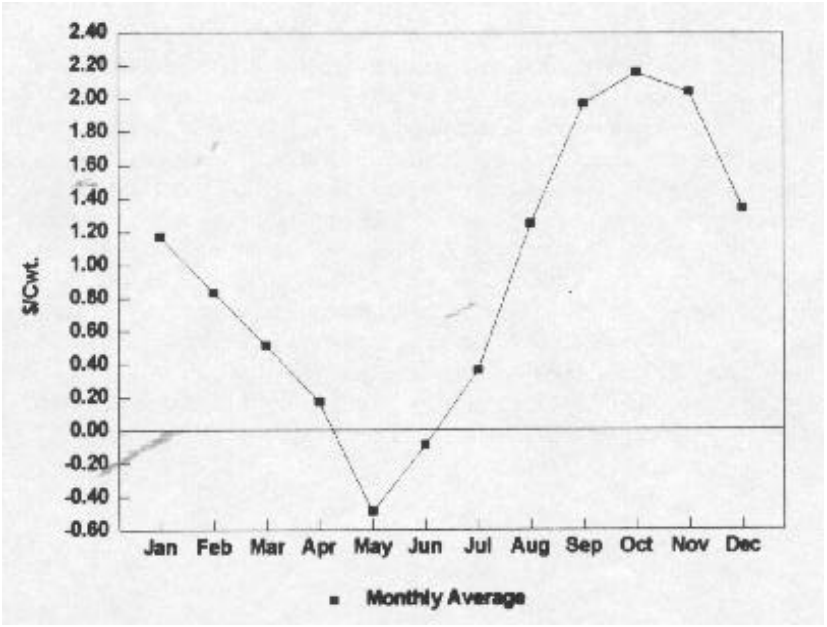

Figure 9. Monthly Average Light-Heavy Boxed Beef Cutout Value Spread, March 1990 - December 1994

The next component is the revenue received from by-products sales. The two variables used to calculate this component are by-products value (Figure 10) and live weight (Figure 11). The average by-products value decreased $0.22/cwt. (-2.75 percent) from January to April, combined with the live weight decrease of 32.77 lbs. (-2.77 percent), resulted in reduced by-products revenue of $5.15/head (-5.46 percent).

The two variables used to calculate live animal costs included the live price and live weight (Figure 11). The live price increased by $3.16/cwt. (4.16 percent), and the live weight decreased by 32.77 lbs. (-2.77 percent) from January to April. Although the live weight decreased, the increase in live price caused the total cost of purchasing the live animal input to increase by $11.40/head (1.27 percent). Combined, the three revenue and cost components produced a net change of minus $10.37/head compared with the five-year average. Note the strong inverse relationship between average live weight and fed cattle prices in Figure 11.

From April to August, gross margins increased $21.63/head (34.32 percent). Within the meat revenue component, Choice boxed beef cutout values decreased $7.98/cwt. (-6.58 percent) and Select boxed beef cutout values decreased $9.58/cwt. (-8.12 percent), but the proportion of Choice cattle increased slightly and dressed weights increased 35.98 lbs. (4.90 percent). The light-heavy price difference increased by $1.08/cwt. and the proportion of heifers slaughtered increased slightly, resulting in increased revenue from sales of light carcasses. Although dressed weights increased, boxed beef cutout values decreased, leading to a net decrease in revenue of $20.64/head (-2.34 percent).

By-product values decreased $0.13/cwt. (1.67 percent) from April to August, but live weights increased 43.97 lbs. (3.83 percent). This increase in live weight more than offset the decline in by-product values to result in increased by-products revenues of $1.87/head (2.10 percent). For live animal costs, live prices decreased $6.78/cwt. (-8.57 percent), while live weight increased 43.97 lbs. (3.83 percent), for a decrease in the cost of live cattle of $46.07/head (-5.07 percent) between April and August. The net change in revenue from April to August from using monthly averages was an increase in gross margins of $27.30/head. Comparing this to the five-year weekly average of $21.63/head, shows that gross margins during the months from April to August are more variable on a weekly average than using monthly averages.

From August to December, gross margins decreased by $15.44/head (-18.24 percent). Choice boxed beef cutout values increased $1.28/cwt. (1.13 percent), and Select boxed beef cutout values increased $0.04/cwt. (0.04 percent), while dressed weights decreased 6.48 lbs. (-0.84 percent). The light-heavy price spread increased by $0.09/cwt. and the proportion of heifers increased slightly, causing an increase in revenue from light carcasses of $0.37/head. Meat sales revenue decreased gross margins $1.39/head (-0.16 percent), because the proportion of Choice carcasses sold decreased slightly. Increases in boxed beef cutout values did not offset the decrease in dressed weights, light-heavy price spread increase, and proportion of light carcasses slaughtered. Revenue from by-product sales increased $9.26/head (10.16 percent), due to by-product values increasing $0.75/cwt. (9.82 percent), combined with increased live weights of 3.81 lbs. (0.32 percent). For the cost of purchasing the live animal input, live price increased by $1.90/cwt. (2.63 percent) and, in addition to the increase in live weights of 3.81 lbs. (0.32 percent), the cost of purchasing live cattle increased by $25.49/head (2.95 percent). Combining the three components, the net effect was decreased gross margins of $14.84/head for monthly averages, compared with the weekly averages over the five-year period of a decrease of $15.44/head, which shows that during the months of August to December, gross margins are more variable on a weekly basis than using monthly averages.

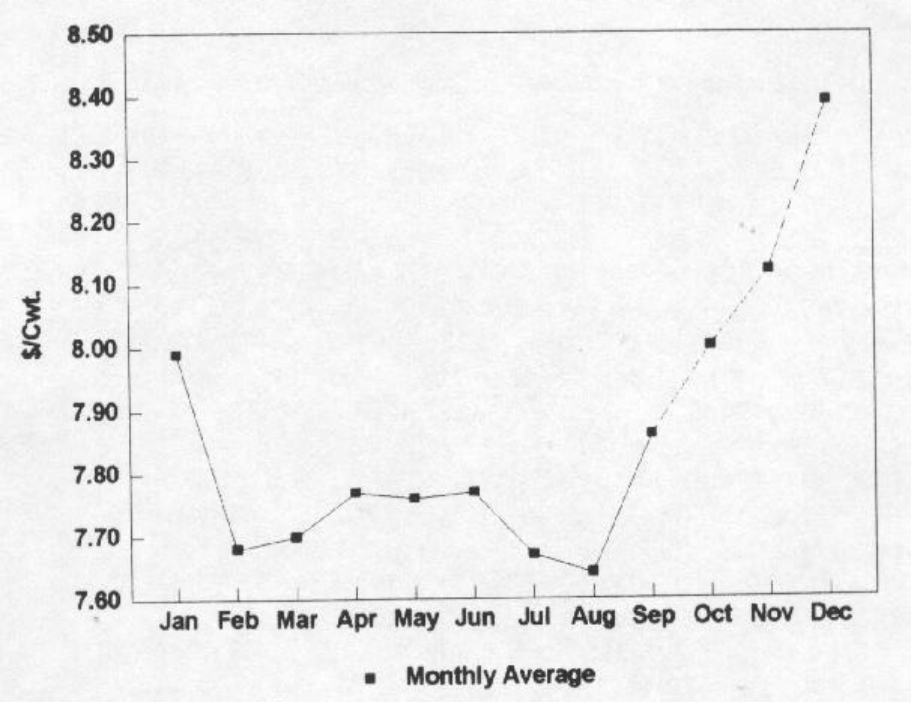

Figure 10. Monthly Average By-Product Value for Beef, March 1990 - December 1994

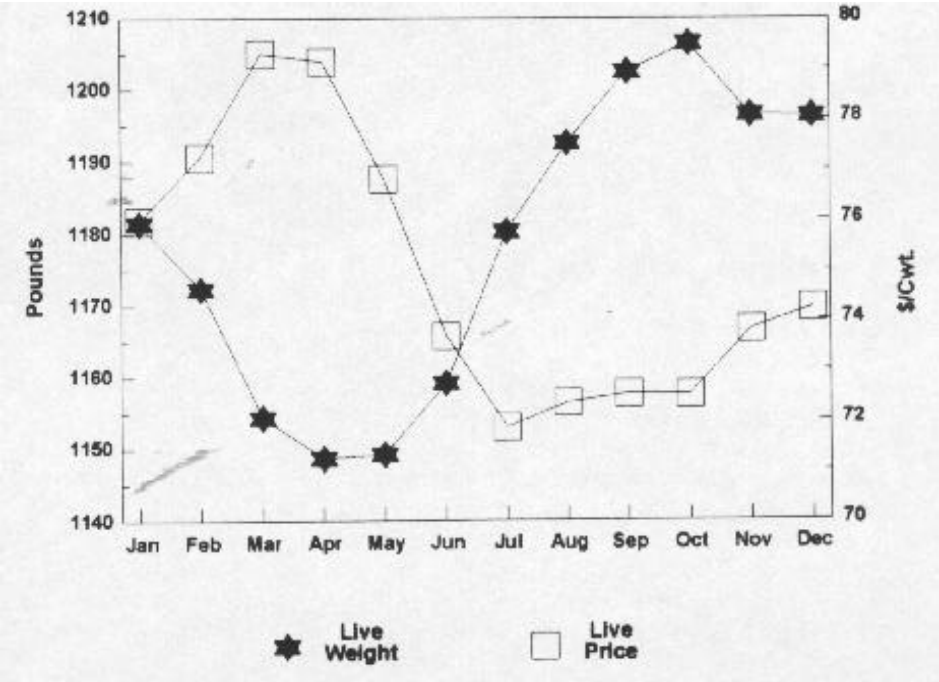

Figure 11. Monthly Average Live Weight vs. Live Price for Fed Cattle, March 1990 - December 1994

Estimating Weekly Gross Margins

$$41.82 = [47349 * [((368 / 47349*.9) * (101.83 * 771.98)) + ((368 / 47349*.1) * (95.67 * 771.98)) + ((10155 / 47349*.725) * (101.83 * 803.88)) + ((10155 / 47349*.275) * (95.67 * 803.88)) + ((35111 / 47349 * .50) * (101.83 * 782.83)) + ((35111 / 47349 * .50) * (95.67 * 782.83)) + ((1715 / 47349 * .275) * (101.83 * 780.91)) + (1715 / 47349 * .725) * (95.67 * 780.91))] + [(368 / 47349) * (1210 * 9.18) + (10155 / 47349) * (1260 * 9.18) + (35111 / 47349) * (1227 * 9.18) + (1715 / 47349) * (1224 * 9.18)] - [(368 / 47349 * 1210 * 68.50) + (10155 / 47349 * 1260 * 68.32) + (35111 / 47349 * 1227 * 69.46) + (1715 / 47349 * 1224 * 68.59] / 100] + [39886 * [((225 / 39886*.9) * (101.83 * 783.67)) + ((225 / 39886*.1) * (95.67 * 783.67)) + ((8355 / 39886*.725) * (101.83 * 742.19)) + (8355 / 39886*.275) * (95.67 * 742.19)) + ((30479 / 39886*.5) * (101.83 * 717.56)) + ((30479 / 39886*.5) * (95.67 * 717.56)) + ((827 / 39886*.275) * (101.83 * 715.61)) + ((827 / 39886*.725) * (95.67 * 715.61))] + [(225 / 39886) * (1209 * 9.18) + (8355 / 39886) * (1145 * 9.18) * (30479 / 39886) * (1107 * 9.18) + (827 / 39886) * (1104 * 9.18)] - [(225 / 39886 * 1209 * 68.73) + (8355 / 39886 * 1145 * 68.45) + (30479 / 39886 * 1107 * 69.58) + (827 / 39886 * 1104 * 68.70)] / 100] / 47349 + 39886$$

Using equation (6), one example of calculating an estimated weekly gross margin is as follows:

This involves a rather tedious process of plugging public data into the gross margins equation. An alternative method is to estimate a regression equation for gross margins in beef packing from the gross margins series calculated by Procedure 2 for the five-year period, 1990 to 1994. The regression equation was specified as follows:

$$GM_t = \alpha + \delta_1 PBB + \delta_2 SPRD_{LG} + \delta_3 SPRD_{CH} + \delta_4 PBY + \delta_5 PFC + \delta_6 DRPCT + \delta_7 PER_{ST} + \delta_8 QFC + \lambda_1 T + \lambda_2 T2 + \phi D1$$

where

GM_t = Gross margin for week t ($/head);

PBB = Boxed beef cutout value (Choice 700-850 lbs.) ($/cwt.);

$SPRD_{LG}$ = Difference between boxed beef cutout value for Choice 700-850 lbs. minus boxed beef cutout value for Select 700 lbs. or more ($/cwt.);

$SPRD_{CH}$ = Difference between boxed beef cutout value for Choice 550-700 lbs. minus boxed beef cutout value for Choice 700-850 lbs. ($/cwt.);

PBY = By-products value ($/cwt.);

PFC = Price of fed cattle ($/cwt.);

DRPCT = Dressing percentage for steers;

PER_{ST} = Percentage of steers slaughtered;

QFC = Live weight of steers (lbs.);

t = Weekly time trend variable;

t^2 = Square of weekly time trend variable; and

D1 Dummy variable for June 12, 1993.

Since more steers are slaughtered than heifers and average dressed weights of steers are above 700 lbs., the Choice 700-850 boxed beef cutout value was used as the base boxed beef price. The difference between Choice 700-850 carcasses and Select 700-850 carcasses was used to account for Select cattle in the slaughter mix and to avoid the multicollinearity problems had both boxed beef cutout values been used in the model. The difference between Choice 550-700 and Choice 700-850 was used to account for heifers in the slaughter mix, since heifer dressed weights usually fall in the 550-700 lb. weight range. Again, this also avoids multicollinearity problems. By-products values were composite prices for by-products per cwt. of live animal weight. Live cattle prices were prices paid for steers, which were usually close to prices paid for heifers. To avoid multicollinearity, steer dressing percentage was used rather than both the dressed weights for steers and heifers. The percentage of steers in the mix was used to account for changes in the number of steers versus heifers from week to week. The live weight of steers was used to account for the seasonality of live weights during the year. A dummy variable for June 12, 1993 was included because the observation for that week caused a non-normal distribution of the error term. Quadratic time trend variables were included to explain exogenous factors affecting gross margins over time.

The model was estimated by Ordinary Least Squares (OLS) regression and first order autocorrelation was corrected by the Cochran-Orcutt procedure. The regression coefficients shown in Table 3 can be used with public data to estimate beef packer gross margins for any week, rather than computing all weighted averages needed to calculate the gross margin by Procedure 2.[3]

The estimated gross margin for the week ending November 5, 1994 using the regression coefficients was $43.47/head. That compares with $41.82/head using Procedure 2. By the nature of linear regression, estimated gross margins over-estimate and under-estimate gross margins depending on the week, compared with the longer but more accurate method. Therefore, importance of accuracy determines to some extent which method is preferred.

Gross margin estimates from Procedures 1 and 2 and the regression estimates can be compared. The easiest way to calculate gross margins is to use Procedure 1. However, with Procedure 1, there are serious data limitations. To get a

[3] The weekly trend variable (t) has a value of 252 for the first week of January 1995.

more accurate estimate of gross margins, Procedure 2 should be used. The top line in Figure 12 compares gross margin estimates for Procedures 1 and 2. Estimates from Procedure 1 are about $15-75/head higher than for Procedure 2, which uses a more complete set of data. Estimates from Procedure 1 are also more variable compared to Procedure 2.

Procedure 2 is the preferred method, but as is shown in equation (11), the calculations are tedious. Therefore, regression coefficients can be used with public data to estimate gross margins in beef. The bottom line in Figure 12 compares estimated gross margins from the regression equation and estimates from Procedure 2. Estimates from the regression equation are typically less than $5/head above or below the actual Procedure 2 estimate (as noted by the zero line in Figure 12) and can be estimated from the regression equation more easily than using Procedure 2.

Table 3. Regression Equation Estimates for Overall Beef Packing Margins

Variable	Coefficient	Standard Error	t-ratio	Probability
constant	-783.06	43.25	-18.11	0
PBB	7.3047	0.1564	46.7	0
$SPRD_{LG}$	-3.4474	0.148	-23.29	0
$SPRD_{CH}$	0.93334	0.352	2.652	0.009
PBY	9.9882	0.7159	13.95	0.018
PFC	-11.064	0.1844	-59.99	0
DRPCT	1026.1	39.56	25.94	0
PER_{ST}	0.30845	1.252	0.2464	0.806
QFC	0.10443	0.01849	5.649	0
T	-0.11699	0.02173	-5.384	0
T2	0.00034	0.00009	3.801	0
D1	-13.675	2.395	-5.71	0
Full Model				
F-value	1055.72			
R-Square	0.9798			

Pork

As noted earlier, publicly reported data for pork are not as detailed as for beef. With available pork data, it was not possible to estimate overall pork packer gross margins weighted by the number of hogs in each quality grade (i.e. #1, #2, #3, and #4). However, available data enabled comparing gross margins across market areas using prices paid and live weights of animals purchased. Since the same Federally inspected (FI) dressed weight, by-products value, and live price paid are used for each quality grade group, the only differences in gross margins between grades #1, #2, #3, and #4 are due to pork carcass cutout values. Gross margins between the quality grade groups differed only by the spread between carcass prices for each quality grade.

Six-Market Average versus Iowa-Southern Minnesota

The average gross margin for pork packing over the period 1988 to 1994, using six-market data and #1 carcasses, was $11.33/head (Table 4). Annual average gross margins ranged from $9.70/head in 1988 to $15.89/head in 1994 in the Iowa-Southern Minnesota area. Annual average gross margins varied across quality grades #1 to #4 from $9.78/head in 1994 to $12.93/head in 1990. Even estimated gross margins for #4 hogs were negative on average in some years. Differences between gross margins for the six-market average and Iowa-Southern Minnesota direct market were typically

small, but the difference switched over time. Gross margins were highest for the Iowa-Southern Minnesota area from 1988 to 1990. Thereafter, gross margins for the six-market average were above those for Iowa-Southern Minnesota.

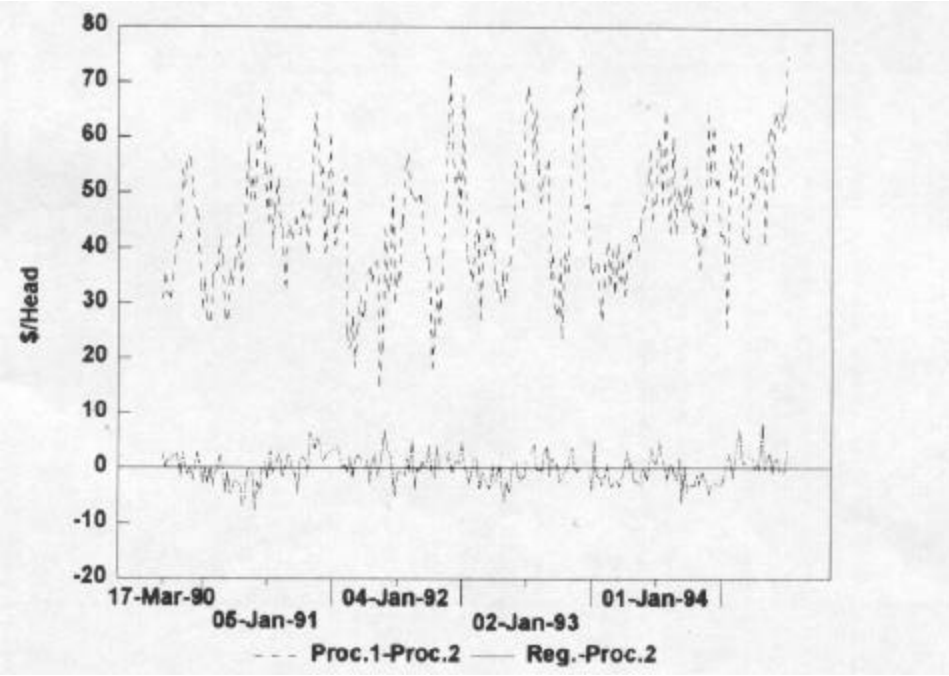

Figure 12. Differences in Beef Margins Between Estimation Procedures, March 1990 - December 1994

From 1988 to 1991, gross margins increased steadily from $9.47 to $10.93/head, a 15.42 percent increase. However, gross margins for that period were still below the seven-year average by $0.40/head (-3.53 percent). During the four-year period, pork carcass cutout values increased $8.05/cwt. (13.11 percent), dressed weights increased 3.44 lbs. (1.99 percent), and by-products values decreased $0.46/head (-4.04 percent). Live price increased $5.59/cwt. (12.86 percent), and live weight increased 1.1 lbs. (0.44 percent). From 1992 to 1993, gross margins ranged from $12.11 to $15.82/head, an increase of 30.64 percent above the 1992 level and 39.63 percent above the seven-year average. Average monthly pork carcass cutout values decreased $1.32/cwt. (-2.19 percent), dressed weights increased 3.9 lbs. (2.21 percent), and by-products values decreased $1.41/head (-13.1 percent). The cost portion of gross margins declined due to a drop in live hog prices of $2.66/cwt. (-6.29 percent), though live weights increased 3.95 lbs. (1.59 percent).

Gross margins for the Iowa-Southern Minnesota region exhibited a different pattern than for the six-market average across years. The seven-year average gross margin, using Iowa-Southern Minnesota data and #1 carcass values, was $11.39/head. The annual average was relatively stable, increasing only slightly until 1993. However, a sharp increase occurred in 1994 (Figure 13). Year-to-year gross margins in the Iowa-Southern Minnesota region varied considerably (Table 4). Since the same pork carcass cutout values, FI dressed weights, and by-products values are used with Iowa-Southern Minnesota hogs as the six-market average series, differences between the two gross margin series are dependent on live hog prices and live weights. From 1988 to 1989, six-market average live prices increased $0.57/cwt. (1.31 percent) and Iowa-Southern Minnesota live prices increased $0.51/cwt. (1.15 percent). Six-market average live weights increased 0.62 lbs. (0.25 percent), while Iowa-Southern Minnesota live weights decreased 1.28 lbs. (-0.53 percent). With these changes in live prices and weights, gross margins increased for both regions.

Table 4. Average, Maximum, Minimum Gross Packing Margins for Pork, 1988 to 1994

	6-Mkt. Average				Iowa/So. Minnesota			
	#1	#2	#3	#4	#1	#2	#3	#4

1988								
Avg	9.47	6.18	2.90	-0.39	9.70	6.41	3.12	-0.16
Max	16.58	13.28	9.97	6.65	17.10	13.93	10.76	7.60
Min	-1.92	-5.25	-8.59	-11.93	2.54	-0.94	-4.43	-7.91
1989								
Avg	9.57	5.96	2.34	-1.27	10.87	7.27	3.65	0.03
Max	18.84	14.57	10.29	6.03	16.59	12.97	9.32	5.70
Min	4.53	0.45	-3.61	-7.69	6.21	2.91	-0.98	-5.06
1990								
Avg	10.00	5.69	1.38	-2.93	10.66	6.35	2.03	-2.27
Max	23.72	19.51	15.30	11.10	22.41	1.21	14.00	9.79
Min	1.42	-3.29	-8.03	-12.75	3.41	-1.14	-5.72	-10.36
1991								
Avg	10.93	7.00	3.12	-0.85	10.32	6.30	2.5015.	-1.46
Max	23.63	19.98	16.33	12.69	22.75	19.05	33	11.63
Min	4.23	0.04	-4.16	-8.35	3.68	-0.51	-4.72	-8.91
1992								
Avg	12.11	8.47	4.85	1.195.1	11.45	7.81	4.19	0.54
Max	16.27	12.55	8.83	1	15.55	11.88	8.32	4.74
Min	6.84	2.88	-1.07	-5.02	7.24	3.14	-0.96	-5.06
1993								
Avg	11.33	7.64	3.94	0.25	10.81	7.13	3.43	-0.26
Max	17.39	13.90	10.40	6.91	16.76	13.27	9.77	6.28
Min	6.40	2.67	-1.05	-4.77	6.45	2.74	-0.95	-4.64
1994								
Avg	15.82	12.57	9.29	6.05	15.89	12.64	9.36	6.11
Max	39.43	36.25	33.06	29.90	39.49	36.30	33.12	29.95
Min	5.84	2.58	-0.68	-3.94	6.13	2.87	-0.39	-3.64
1988-94								
Avg	11.33	7.66	3.98	0.31	11.39	7.72	4.0533.	0.37
Max	39.43	36.25	33.06	29.90	39.49	36.30	12	29.95
Min	-1.92	-5.25	-8.59	-12.75	2.54	-1.14	-5.72	-10.36

Gross margins for the Iowa-Southern Minnesota region exhibited a different pattern than for the six-market average across years. The seven-year average gross margin, using Iowa-Southern Minnesota data and #1 carcass values, was $11.39/head. The annual average was relatively stable, increasing only slightly until 1993. However, a sharp increase occurred in 1994 (Figure 13). Year-to-year gross margins in the Iowa-Southern Minnesota region varied considerably (Table 4). Since the same pork carcass cutout values, FI dressed weights, and by-products values are used with Iowa-Southern Minnesota hogs as the six-market average series, differences between the two gross margin series are dependent on live hog prices and live weights. From 1988 to 1989, six-market average live prices increased $0.57/cwt. (1.31 percent) and Iowa-Southern Minnesota live prices increased $0.51/cwt. (1.15 percent). Six-market average live weights increased 0.62 lbs. (0.25 percent), while Iowa-Southern Minnesota live weights decreased 1.28 lbs. (-0.53 percent). With these changes in live prices and weights, gross margins increased for both regions.

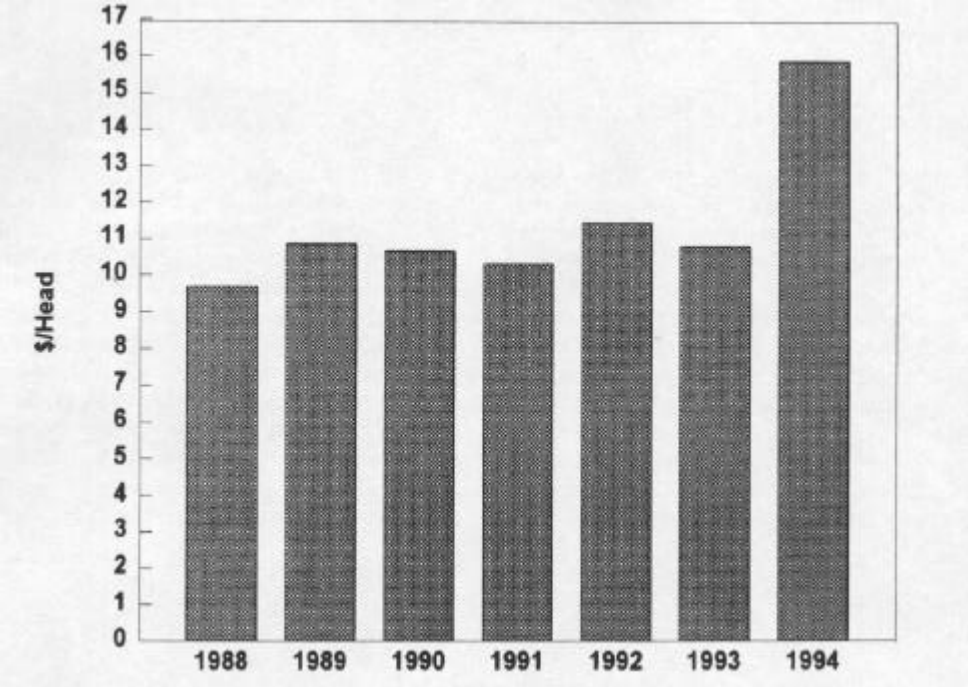

Figure 13. Annual Average Gross Margins for Pork, Using Iowa-So. Minnesota #1, 1988 - 1994

From 1989 to 1990, six-market average live prices increased $10.55/cwt. (23.96 percent) and Iowa-Southern Minnesota live prices increased $10.69/cwt. (23.77 percent). Six-market average live weights increased 0.16 lbs. and Iowa-Southern Minnesota live weights increased 2.21 lbs. Gross margins for the six-market average increased, but gross margins for Iowa-Southern Minnesota decreased.

The six-market average live prices decreased $5.57/cwt. (-10.20) percent from 1990 to 1991 and Iowa-Southern Minnesota live prices decreased $5.57/cwt. (10.00 percent). Six-market average live weights increased 0.32 lbs. (0.13) percent while Iowa-Southern Minnesota live weights increased 2.19 lbs. (0.90 percent). Gross margins for the six-market average increased, while Iowa-Southern Minnesota gross margins decreased.

Between 1991 and 1992, six-market average live prices decreased by $6.75/cwt. (-13.77 percent) and Iowa-Southern Minnesota live prices decreased $6.84/cwt. (-13.65 percent). Six-market average live weights decreased 0.65 lbs. (-0.26 percent) and Iowa-Southern Minnesota live weights decreased 0.65 lbs. (-0.27 percent). With decreases in both live prices and weights, gross margins for both regions increased.

From 1992 to 1993, six-market average live prices increased $3.21/cwt. (7.59 percent) and Iowa-Southern Minnesota live prices increased $3.11 (7.19 percent). Six-market average live weights increased 2.13 lbs. (0.86 percent) and Iowa-Southern Minnesota live weights increased 2.55 lbs. (1.04 percent). With increases in live prices and live weights, both six-market average and Iowa-Southern Minnesota gross margins decreased from 1992 to 1993.

Six-market average live prices decreased $5.87/cwt. (12.91 percent), while Iowa-Southern Minnesota live prices decreased $6.12/cwt. (13.2 percent) from 1993 to 1994. Six-market average live weights increased 1.82 lbs. (0.73 percent) and Iowa-Southern Minnesota live weights increased 1.32 lbs. (0.53 percent). Decreased live prices and increased live weights led to increased gross margins to their highest levels for both regions, to $15.82/head for the six-market average and $15.89/head for the Iowa-Southern Minnesota region.

Within-Year Variation

Gross margin estimates for pork also followed a seasonal pattern, representing the net of seasonal patterns for gross margin components. Gross margins were highest in September through December, peaking in November, and were lowest from January to August, reaching a low in May (Figure 14). Gross margins for the six markets and Iowa-Southern Minnesota region follow the same seasonal pattern. Gross margins for both markets are above the seven-year average during September through December, and peak in November. From January to August, gross margins are below the seven-year average, and are lowest during May. When gross margins are increasing seasonally, live hog prices are decreasing. In November, when gross margins reach their seasonal peak, live hog prices are at the lowest level for the year (Figure 15). Pork carcass cutout values follow the same seasonal pattern as live hog prices, and also reach their lowest level during November (Figure 16). Since gross margins are at their highest level in November, live hog prices are declining more than the pork carcass cutout value. Because only one dressed weight is used, live and dressed weights follow the same seasonal pattern for both market areas (Figures 17 and 18). By-products values are below the seven-year average December through May, and are at a seasonal low in April. From June to November, by-products values are above the seven-year average, peaking in October (Figure 19).

Lamb

As with pork, overall lamb packer margins cannot be calculated due to data limitations on number of lambs in each quality grade, yield grade, and weight category. Only estimated gross margins can be calculated. Lamb packer gross margins averaged $17.69 and $10.47/head for the 55-65 and 65-75 lb. categories, respectively, in 1990 (Table 5). Annual average gross margins using boxed lamb cutout values ranged from $11.80/head to $6.02/head above those estimated using carcass prices for the 1992 to 1994 period.[4] Estimated gross margins using boxed lamb cutout values increased from 1992 to 1994 (Figure 20).

[4] Readers should note that calculated gross margins for lamb for 1992 using boxed lamb cutout values are for May to December only. Given the estimated seasonal pattern, average gross margins reported for 1992 may be lower than the full-year average.

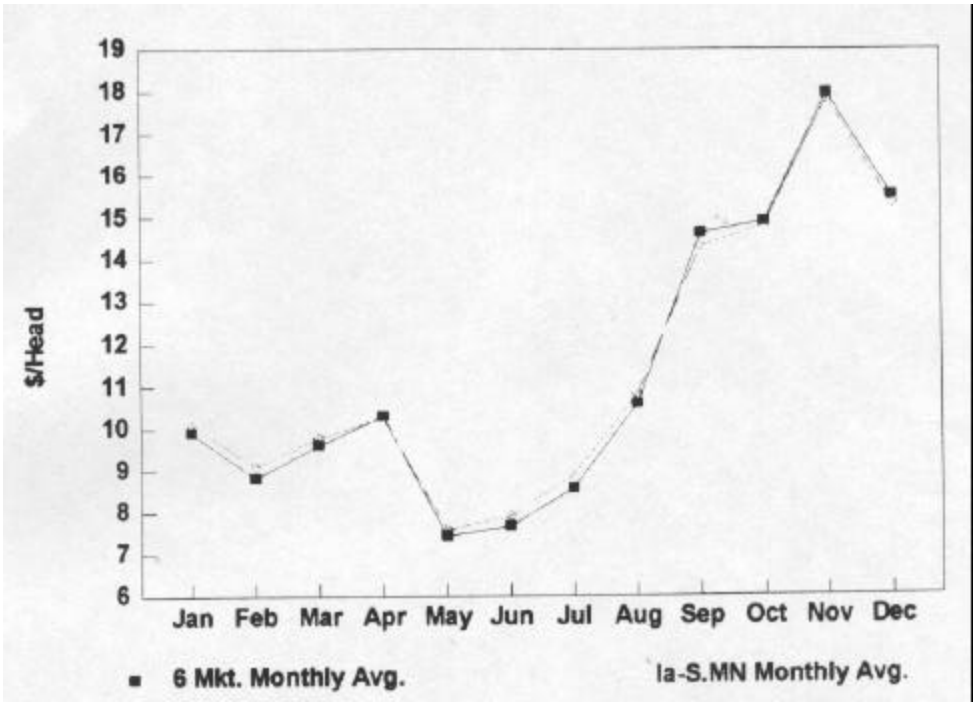

Figure 14. Monthly Average Gross Margins for Pork, 1988 - 1994

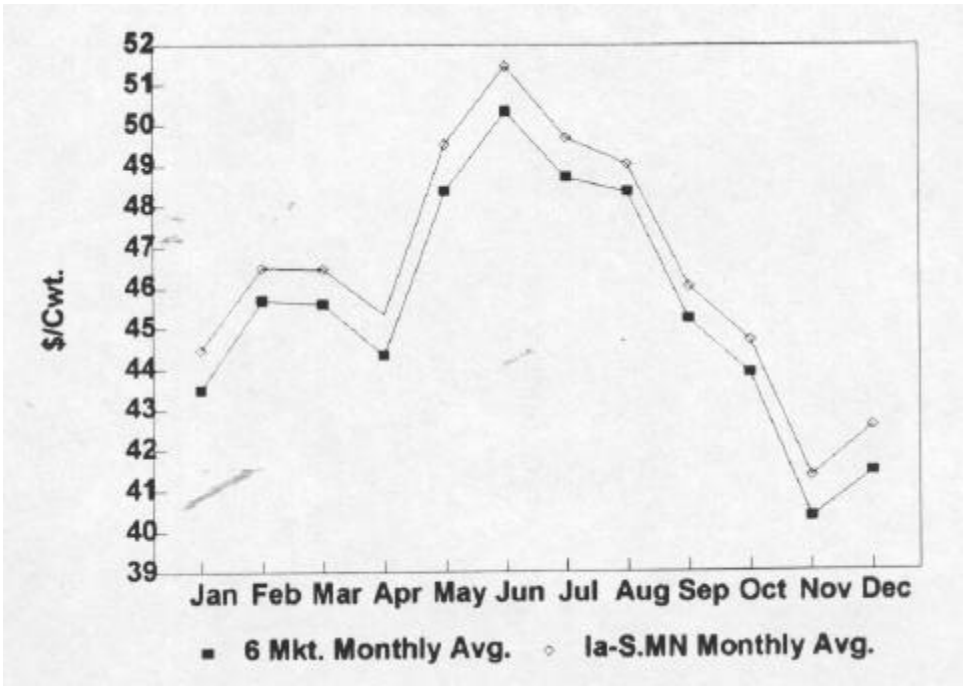

Figure 15. Monthly Average Live Price for Hogs, 1988 - 1994

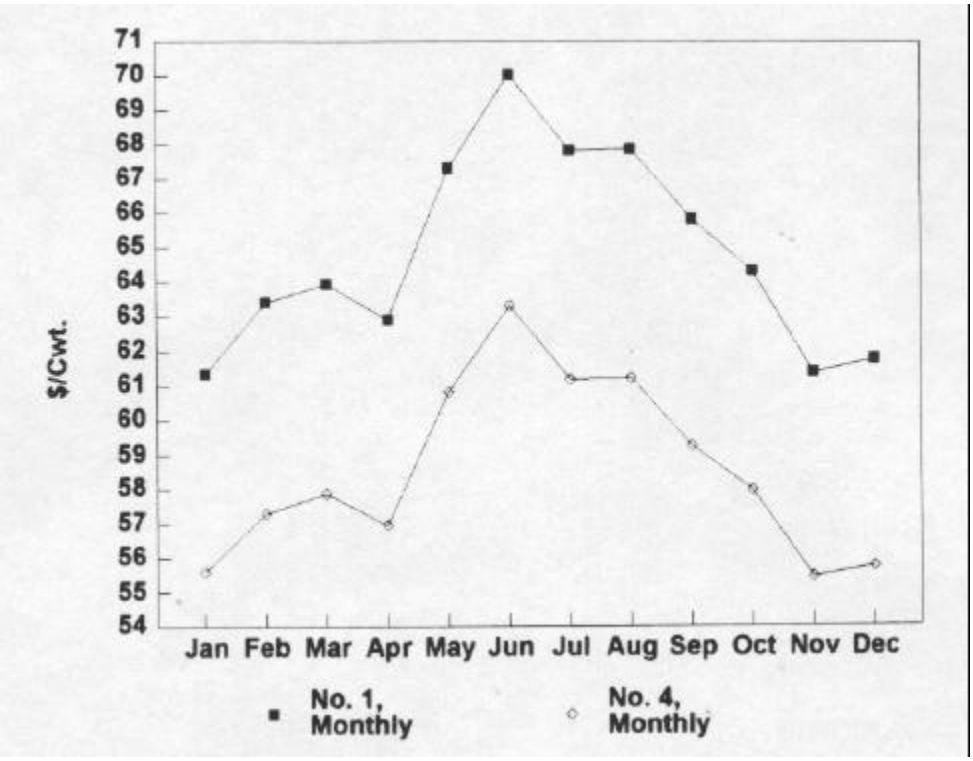

Figure 16. Monthly Average Carcass Cutout Values for Pork No. 1 vs. No. 4, 1988 - 1994

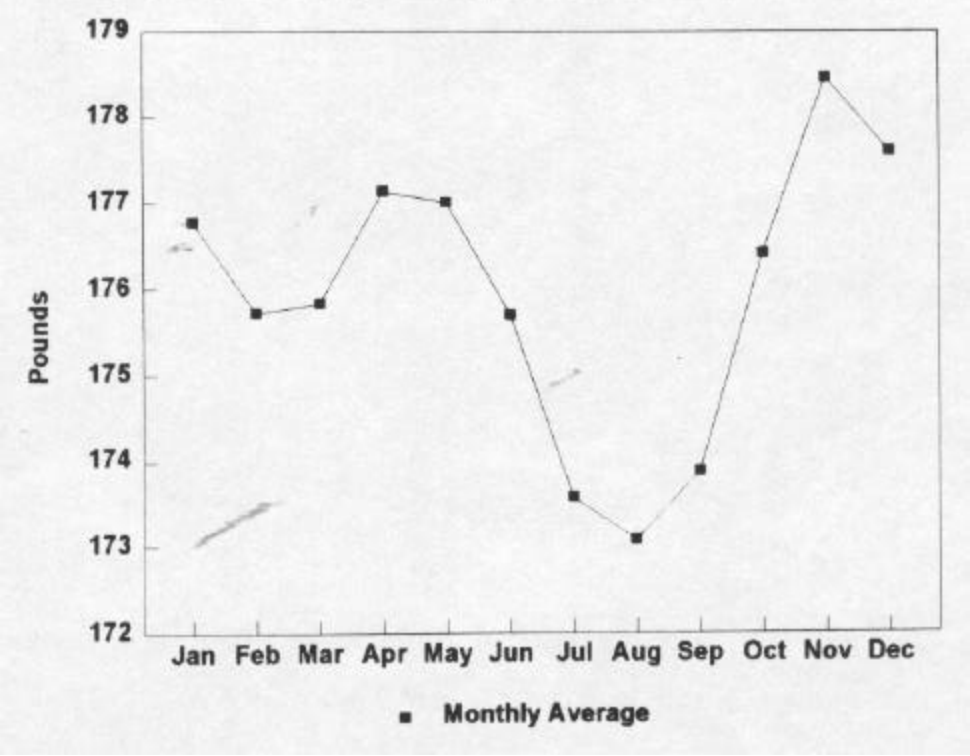

Figure 17. Monthly Average Dressed Weight for Pork Carcasses, 1988 - 1994

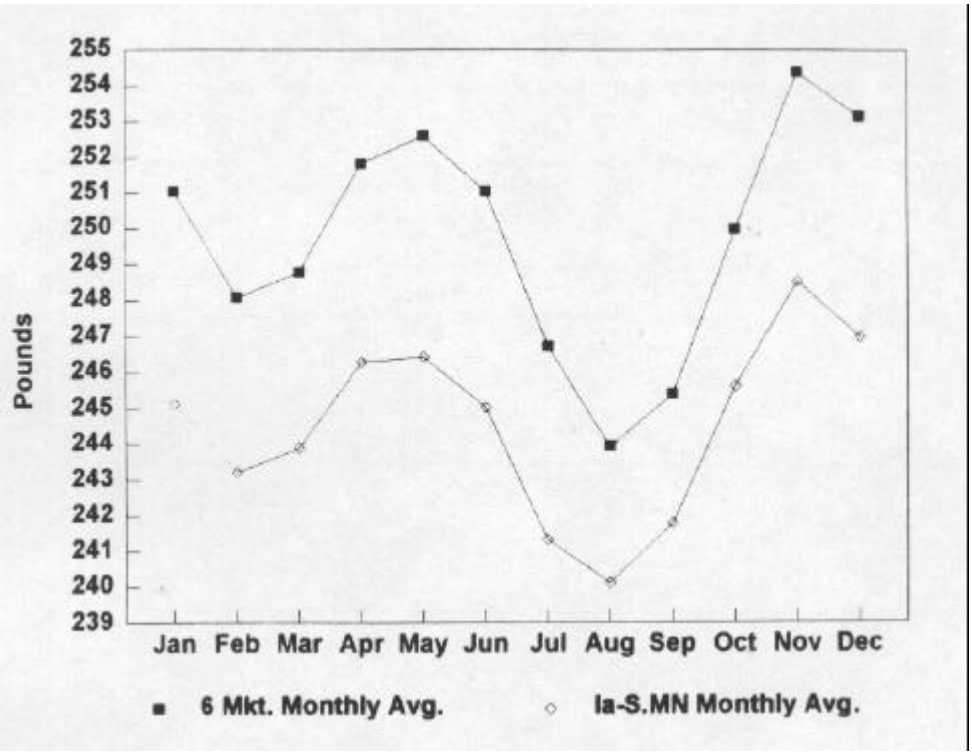

Figure 18. Monthly Average Live Weight for Hogs, 1988 - 1994

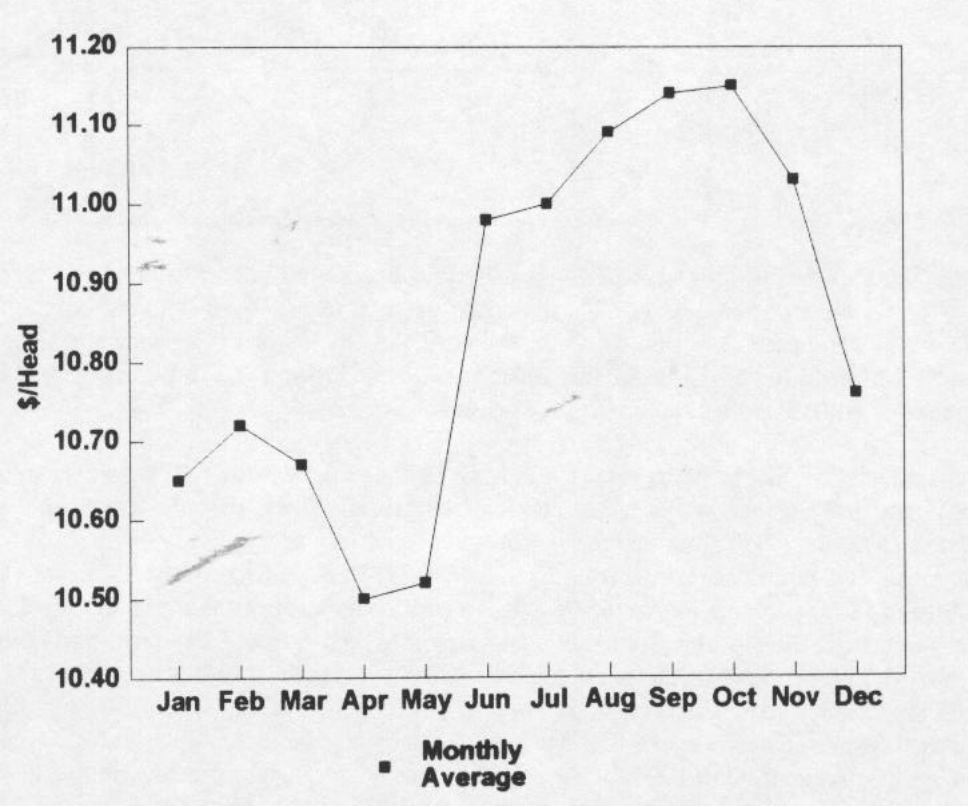

Figure 19. Monthly Average By-Product Value for Pork, 1988 - 1994

Table 5. Average, Maximum, Minimum Gross Packing Margins for Lamb, 1990 to 1994

	Carcass 55-65#	Carcass 65-75#	Cutout Value
1990			
Avg	17.69	10.47	
Max	12.69	17.12	
Min	-3.94	-10.14	
1991			
Avg	12.82	12.34	
Max	18.16	17.71	
Min	7.98	4.68	
1992			
Avg	12.47	12.35	18.49
Max	24.83	24.83	31.85
Min	6.24	5.04	12.14
1993			
Avg	14.75	13.35	24.12
Max	24.73	21.33	33.27
Min	8.73	8.73	17.05
1994			
Avg	16.66	15.09	28.46
Max	23.22	19.66	40.61
Min	12.60	8.66	20.26
1990-94			
Avg	13.88	12.72	24.33
Max	24.83	24.84	40.61
Min	-3.94	-10.14	12.14

In 1991, gross margins declined for the 55-65 lb. category to $12.82/head and increased to $12.34/head for the 65-75 lb. category. This was a decrease of $4.87/head (-27.53 percent) from 1990 for the 55-65 lb. category and an increase of $1.87/cwt. (17.86 percent) for the 65-75 lb. category. In 1992, gross margins were $12.47/head for 55-65 lb. lambs and $12.35/head for 65-75 lb. lambs, a decrease of $0.35/head (-2.73 percent) for the 55-65 lb. category and an increase of $0.01/head for the 65-75 lb. category.

Boxed lamb cutout values began being reported in May 1992 so this was the first year data were available to calculate gross margins using cutout values rather than carcass prices. Gross margins using the cutout values averaged $18.49/head in 1992. In 1993, gross margins were $14.75/head for the 55-65 lb. category and $13.35/head for the 65-75 lb. category. This represented an increase of $2.28/head (18.28) percent for the 55-65 lb. category and an increase of $1.00/head (8.10 percent) for the 65-75 lb. category. Cutout gross margins increased in 1993 by $5.63/cwt. (30.45 percent) above the 1992 level. In 1994, gross margins were $16.66/head for the 55-65 lb. category and $15.09/head for the 65-75 lb. category. This was an increase of $1.91/head (12.95 percent) above the 1993 level for lambs in the 55-65 lb. category and an increase of $1.74/head (13.03 percent) above the 1993 level for the 65-75 lb. category. Cutout gross margins increased $4.34/head (17.99 percent) above the 1993 level. Overall average carcass prices gross margins from 1990 to 1994 for the 55-65 lb. category ranged from $13.88 to $12.72/head for the 65-75 lb. category. Overall average cutout gross margins from 1992 to 1994 were $24.33/head.

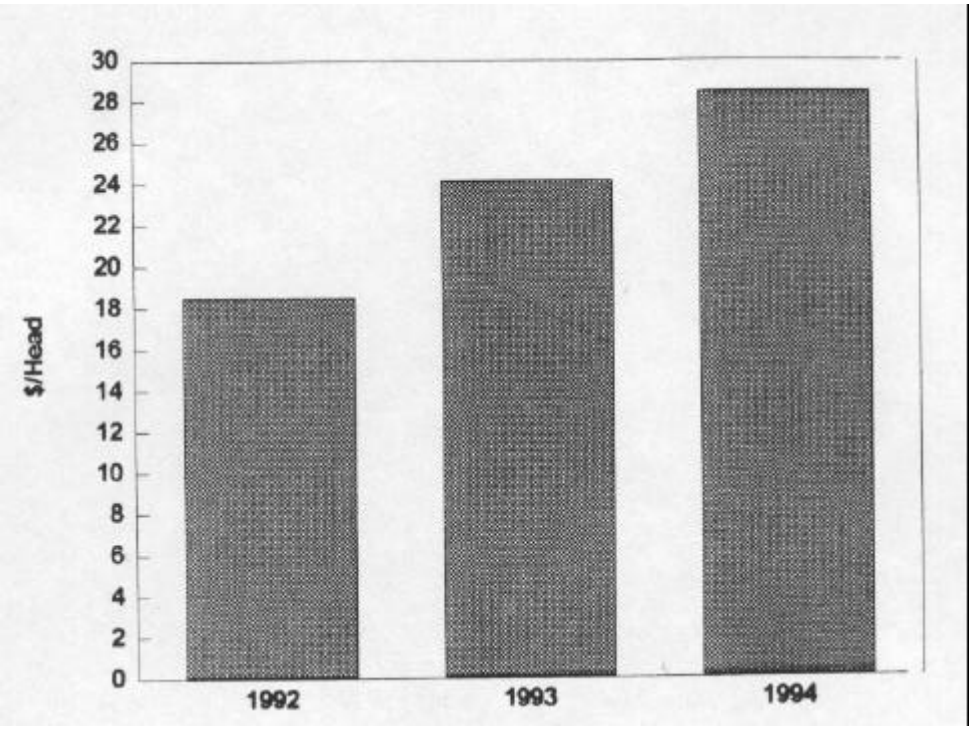

Figure 20. Annual Average Gross Margins for Lamb Using Cutout Values, 1992 - 1994

Within-Year Variation

Seasonality in gross margins based on boxed lamb cutout values is less clear than gross margins for beef and pork, in part because of the shorter data period. Gross margins were above the three-year average from February to March, July and August, and again in December. Gross margins were clearly highest in April and lowest in May-June and again in October-November.

Gross margins using carcass prices for the 55-65 lb. category and 65-75 lb. category (Figure 21) do not follow the same seasonal pattern. The same dressed weights, by-products value, live prices, and live weights are used to calculate gross margins, so factors affecting the variation in gross margins come from prices used to calculate revenue from lamb sales. Month-to-month variation in gross margins is relatively large for 55-65 lb. lambs. Gross margins are at their lowest point during the year in January, $12.12/head, while carcass values for the 55-65 lb. category are also at the lowest point during the year, at $123.09/cwt. Both gross margins and carcass values increase through March. Gross margins increased by $2.19/head (18.07 percent) and carcass values increased $14.52/cwt. (11.8 percent). From March to April gross margins decreased $0.51/head (-3.56 percent), while carcass values declined $1.52/cwt. (1.10 percent). From April through December, gross margins and carcass values fluctuate, increasing in one month and decreasing the next.

Similar to the lighter category, 65-75 lb. gross margins are at their lowest level in January at $9.41/head, along with carcass values (Figure 22), at their lowest level of $118.95/cwt. Gross margins increase through March to $11.72/cwt. (24.55 percent) above the January level. Likewise, carcass values increase to $133.68/cwt. (12.83 percent) above the January level. From March to April, both gross margins and carcass values decrease by $2.10/head (-17.92 percent) and $4.02/cwt. (-3.01 percent), respectively. From April to September, gross margins increased $6.34/head (65.9 percent) above the April level, while carcass values increased $8.85/cwt. (6.83 percent). In the remaining months from September to December, gross margins decreased by $3.56/head (-22.31 percent), while carcass values decreased $6.55/cwt. (-4.73 percent).

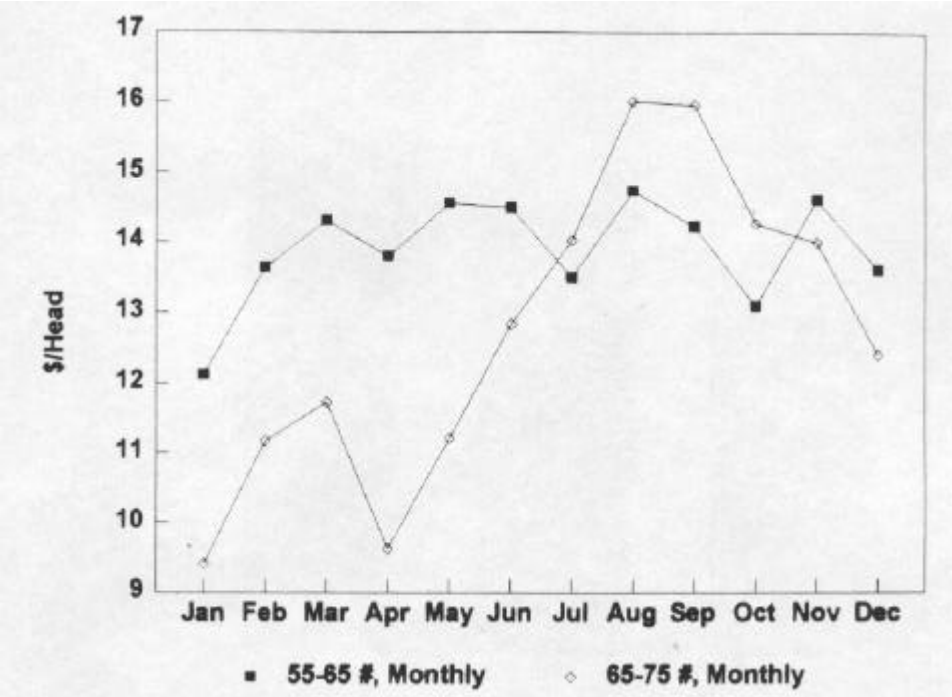

Figure 21. Monthly Average Gross Margins for Lamb Using Carcass Prices, 1990 - 1994

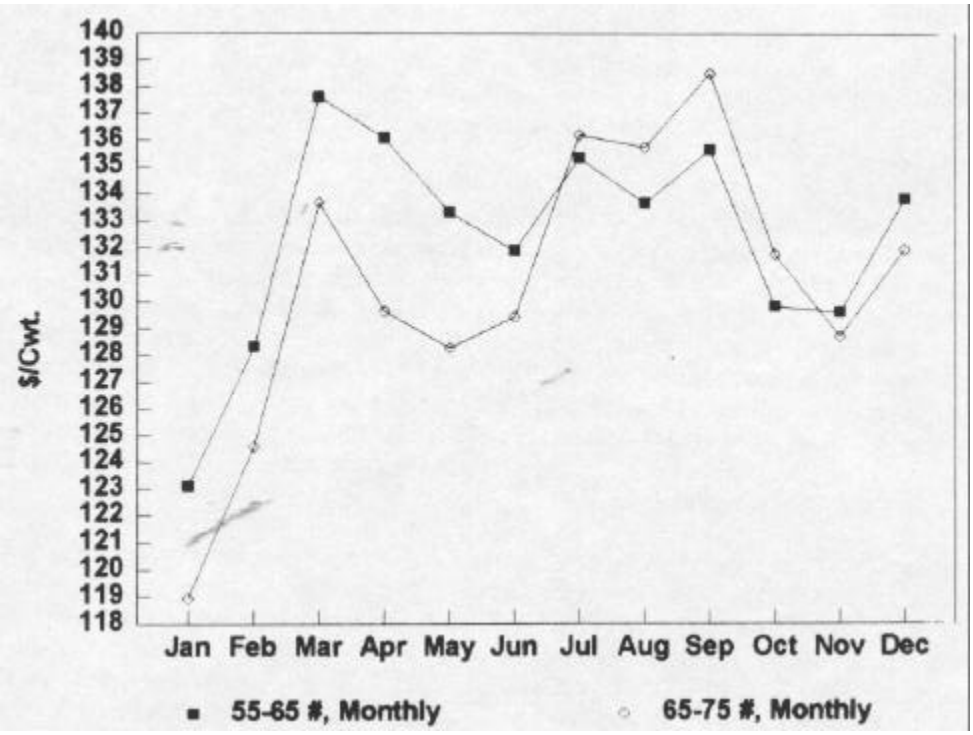

Figure 22. Monthly Average Carcass Prices for Lamb, 1990 - 1994

The final margin series is gross margins using cutout values (Figure 23). Again, gross margins using cutout values use the same dressed weights, by-products values, live weights, and live prices. Thus, the only difference is the price used to calculate the revenue from lamb sales. Gross margins using boxed lamb cutout values have a different seasonal pattern than do either of the gross margins using carcass values as the price of meat. Where gross margins using cutout values are at their lowest level in January, gross margins using cutout values are at their lowest level in June. From January to April, gross margins increase steadily to $6.39/head (21.1 percent) above the level in January, while cutout values increased with gross margins through March by $11.97/cwt. (7.65 percent), but declined from March to April by $7.84 (-4.65 percent) (Figure 24). From April to June, gross margins decreased $9.09/head (-30.02 percent) along with cutout values, a decline of $10.70/cwt. (-6.66 percent). From June to August, gross margins increased by $4.66/head (21.99 percent), along with increased cutout values of $15.55/cwt. (10.37 percent). Then gross margins decreased from August to October by $4.41/head (17.06 percent), with cutout values decreasing $11.47/cwt. (6.93 percent). Finally, from October to December, gross margins increased $5.74/head (26.77 percent) along with cutout values, by $14.82/cwt. (9.62 percent).

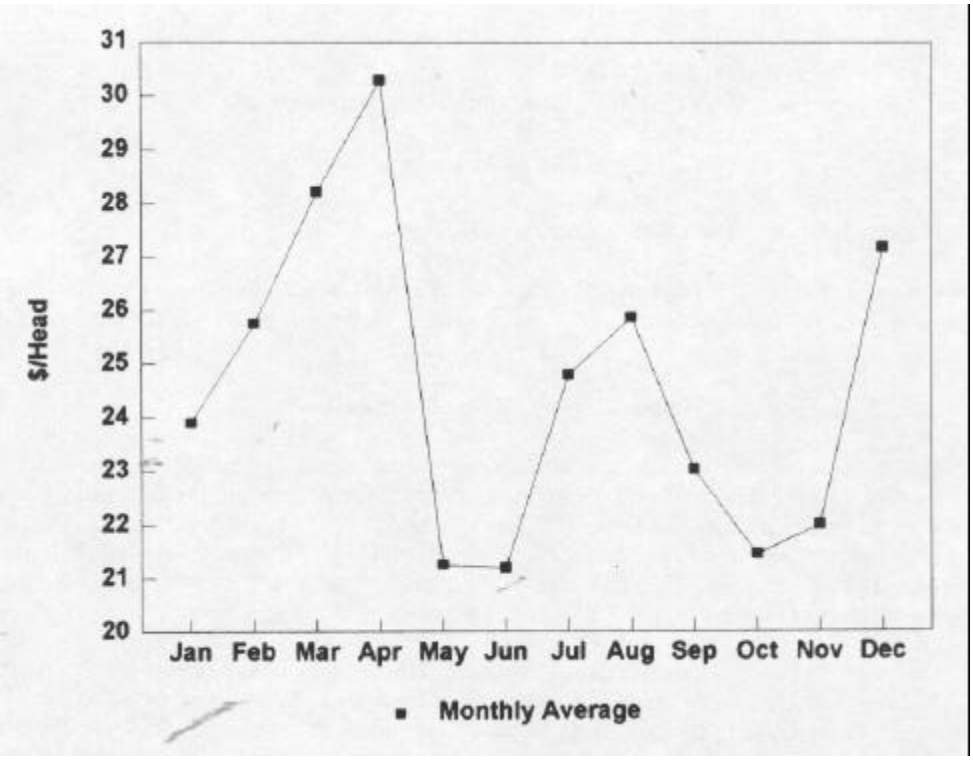

Figure 23. Monthly Average Gross Margins for Lambs Using Cutout Values, 1992 - 1994

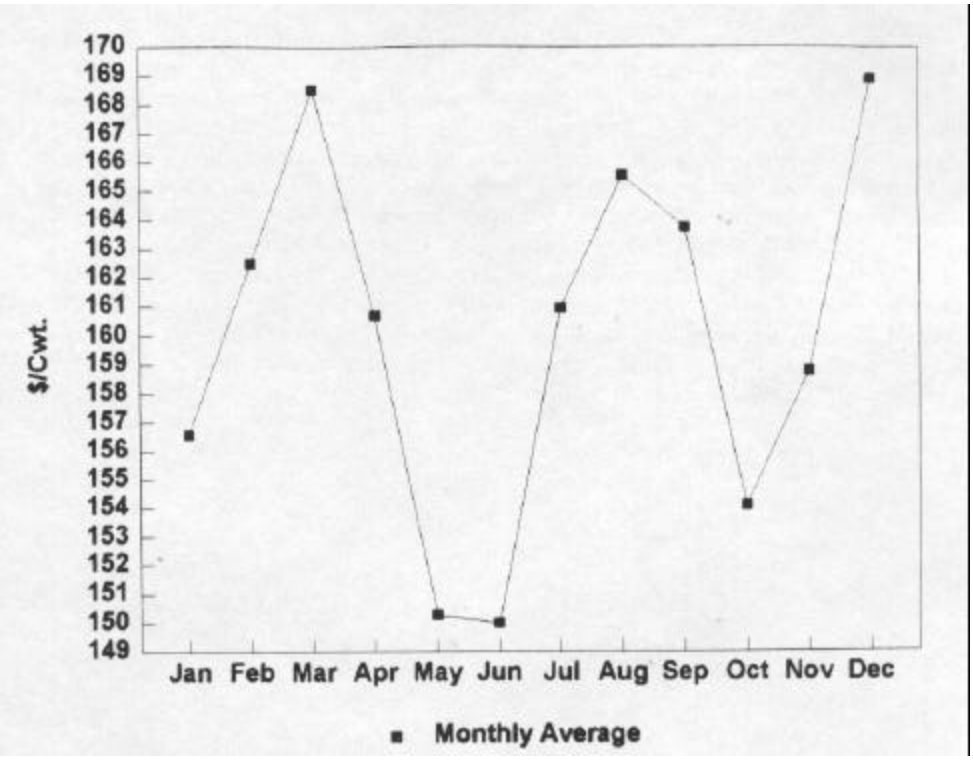

Figure 24. Monthly Average Boxed Cutout Values for Lamb, 1992 - 1994

Seasonal patterns in lamb gross margins are the net seasonal pattern for the gross margins components. Seasonal patterns were also found for lamb dressed weights and live weights, pelt prices, and live lamb prices.

Implications and Policy Considerations

Much has been written about how structural changes in the livestock-meat subsector has affected pricing behavior in the meat packing industry (Ward; Purcell and Rowsell; Purcell 1990, 1992). However, relatively little is known about economic performance of meat packing firms and the meat packing industry as a whole. While profitability is a common measure of economic performance, insufficient profit data are available for private firms and the entire meat packing industry. Therefore, a second-best alternative is to use available public data to calculate estimated gross margins in meat packing and track them over time.

The discussion to this point in the report has focused on how the first two objectives of this research were met (i.e., estimating historical gross margins in meat packing for beef, pork, and lamb based on available public market information; and explaining the level and variability of gross margins over time). The third objective was to assess the adequacy of publicly available market data for estimating and monitoring meat packing industry margins.

More data were available to estimate gross margins for beef than either for pork or lamb. However, even for beef there were serious data limitations. One problem in assessing the adequacy of the research results and the data used to calculate estimate gross margins is the level of estimated gross margins which was calculated. No reliable data series are available with which to compare our estimated gross margins.

Faminow and Ward estimated slaughtering-fabricating costs for beef packing to be approximately $76.50/head. Given those costs, then the five-year annual average gross margins of $72.99/head estimated in this study suggest that beef

packers have not been profitable over the five-year period, and in fact lost a considerable amount of money some years. These results raise serious questions about the gross margins estimated in this research.

Trade publications periodically report quarterly earnings of publicly-held meat packing firms, such as for IBP, the largest meat industry firm. IBP reported record earnings for fiscal 1993. These record earnings include profits for both beef and pork. IBP reported beef profits increasing nearly 20 percent from 1992 to 1993, but estimated gross margins in this study showed gross margins for beef decreasing from 1992 to 1993. IBP also reported pork margins decreasing by approximately 30 percent from 1992 to 1993, which estimated gross margins in this study declined 6.4 percent. These reported record earnings indicate that the level of estimated gross margins in this study is too low. For all species, estimated gross margins in Tables 2-5 are negative at times for specific categories of cattle, hogs, and lambs, suggesting large negative **net** margins for meat packing firms during those periods. Meat packing gross margins and net margins are likely negative at times and for specific livestock categories. However, public profit reports suggest estimated margins in this study understate actual gross margins in meat packing.

More or better data are needed to accurately estimate gross margins for beef, pork, and lamb. While not detailing data needs here, a couple of examples are provided. One serious limitation for all meats is information on meat sales (i.e., the revenue component of the profit equation for meat packers). Available data do not include boxed cutout values for closely trimmed cuts of beef or data on beef and pork exports. Likewise, insufficient data are available to estimate input costs of livestock as well. Data are needed for hogs and lambs purchased by quality and weight groups as they are for fed cattle. Since the proportions of the sales mix of meat or the input mix of slaughter livestock changes within and between years, more data are needed to fully understand and track meat packing gross margins.

The major issue is the importance of monitoring and tracking meat packing industry performance. An argument can be made for monitoring and tracking performance. However, collecting more or better data comes at a cost, both a private cost for individual firms providing data and a public cost for the Federal government agency or industry organization involved in collecting, summarizing, and reporting market statistics. In the current environment of Federal government budget-cutting, seeking and successfully receiving additional funding to collect the data needed to more accurately estimate gross margins may be difficult. On the other hand, collecting additional data to monitor and track economic performance may be a preventive measure. Assuming structural and behavioral changes in meat packing have not yet led to **serious** economic performance problems, the added cost to collect additional data may be small compared with the larger cost of enforcing regulations after any economic performance problems arise.

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