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STAFF PAPER

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Abstract

Several physical quality characteristics are important in pricing feeder pigs. This study identifies and estimates the discounts associated with various characteristics. Weight, weight squared, lot size, lot size squared, weight-lot size interactions, health, and lot uniformity were the most important physical traits affecting feeder pig price differentials. In addition, time of sale, changes in expected finished hog prices, and fluctuations in expected feed costs of finishing the pigs also had significant impacts on feeder pig prices.

Introduction

Feeder pigs are a major cash commodity in the North Central and Southeast regions of the U.S. For example, sales of 3.9 million head of feeder pigs were recorded in Iowa in 1978. In selected Southeastern states, feeder pig sales accounted for up to 38% of the sales of all hogs and pigs in 1978 (Van Arsdall and Nelson). Although these percentages may have declined in recent years, the production of feeder pigs as a cash commodity remains widespread.

Feeder pig production tends to be a risky enterprise, since wide swings in the prices received for pigs often occur.[1] Over time, feeder pig prices would be expected to respond to the supply and the demand generated by expected slaughter hog prices and costs of finishing hogs (Reid and Reed). However, prices received for feeder pigs also vary dramatically in the short run. The prices received on a given day, at a particular auction, would be expected to vary because of differences in the physical characteristics of the feeder pigs being sold. The objectives of this study are to identify the characteristics that most significantly influence feeder pig price differentials and to quantify the market values of specific feeder pig characteristics.

Several studies have examined the impact of physical characteristics on feeder cattle price differentials (Schroeder et al.; Faminow and Gum; Sullivan and Linton). In general, these studies concluded that the traits related to the feeder cattle in a particular lot, including sex, breed, weight, muscling,

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[1] *For example, in the data used in this study, the coefficient of variation for prices of homogeneous lots of healthy feeder pigs of similar weight, over a 10-week period, exceeded 20%.*

frame size, health, condition, fill, head per lot, and time of sale, impacted short-run feeder cattle price differentials. Considerable work also has been directed at identifying desirable traits and associated values of slaughter hogs and carcasses (Hayenga et al.; Grisdale et al.). VanTassell et al. determined that daily gain, feed efficiency, backfat, and overall performance were significant factors explaining the pricing structure of tested boars in Tennessee. However, we are unaware of any recent research investigating the relative values of specific feeder pig characteristics. The demand for specific characteristics should be derived from the expected feeding performance of the pigs, feeding costs, and the potential value of the finished hogs.

Many of the characteristics that impact feeder pig prices can be directly influenced by management of the breeding herd and the feeder pigs. Very short-term marketing decisions such as whether or not to sort pigs into uniform lots, the number of head per lot, and the weight at which to sell the feeder pigs may have significant price impacts. In addition, evaluating management practices such as routine vaccination, docking of tails, castration, maintenance of good skin condition, and a sound health program requires a comparison of the expected payoff when the pigs are sold relative to the costs of performing such tasks. Longer-term decisions, such as choosing breeding stock characteristics to produce feeder pigs with the most desirable traits, also will be influenced by the relative premiums and discounts associated with those traits.

A large percentage of feeder pig sales are directly from the producer to the finisher. For example, 46% of the feeder pigs sold in the North Central U.S. in 1980 were marketed by feeder pig producers directly to finishers (Van

Arsdall and Nelson). This research provides a source of information to help hog producers make more equitable and informed direct price negotiations.

Pricing Model

Feeder pig prices should reflect the local demand and supply of feeder pigs at a particular location. On a given day, at a particular auction market, the supply of feeder pigs will be fixed. Thus, the price will be determined by the demand for the specific feeder pigs being offered for sale. The demand for feeder pigs will be related to the potential profitability of each particular lot of pigs. Thus, the feeder pig price on a particular day should be related to the expected finished hog price and expected costs of finishing the pigs. Price differentials across lots of pigs on a given day should reflect the differences in the characteristics of the feeder pigs that are expected to impact the growing efficiency, costs of production, or revenues from the sale of finished hogs. This suggests that the short-run feeder pig price can be modeled as follows:

$$\text{Price}_{it} = \sum_{k} v_{ikt} C_{ikt} + \sum_{h} r_{ht} M_{ht} \qquad (1)$$

where i refers to the lot of feeder pigs, k refers to specific animal trait, h refers to market influence, and t represents the auction date. The specific animal characteristics are represented by C, and v represents the marginal implicit value of each specific animal trait. The market fundamentals are represented by M, and r is the price effect of the fundamental market forces. Equation (1) states that the price per hundredweight of each lot of feeder pigs will be the sum of the marginal implicit values of each lot's characteristics (Ladd and Martin) and the sum of the market fundamentals.

The data used in this study consisted of both cross sectional and time series data. Thus, in order to incorporate the changes in average price

level, it was necessary to include changing market fundamentals over time in the model. The market fundamentals examined included the expected finished hog price, the expected feed costs associated with finishing the feeder pigs, the auction location, and the time during the auction when the pigs were sold. The live hog closing futures price on the day of the auction for the contract maturing most closely to (but not before) the anticipated feeder pig finishing date was used as a proxy for the finished hog price expected by feeder pig finishers. The October 1988 live hog futures contract price was used as the expected finished hog price. Corn and soybean meal futures prices (July 1988 contracts) were used to construct a proxy for expected feed costs. The expected feed cost variable was a weighted average of the total corn and soybean meal costs expected to be required to finish the feeder pigs to a slaughter weight of approximately 240 pounds.

Data

The feeder pig characteristics and prices were collected from two Kansas feeder pig auctions over a 10-week period from May 5 through July 12, 1988.[2] As each lot of feeder pigs was sold, the time, average weight, lot size, breed, predominant color, muscling, frame size, health, structural soundness, uniformity of the lot, and sale price were recorded. It was also noted whether the pigs were castrated; had tails docked; were vaccinated, sprayed, or treated for internal or external parasites; or had any ruptures or visible lumps. The data set included all feeder pigs sold weighing between 20 and 99 pounds and consisted of 918 lots of feeder pigs containing 21,036 head.

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[2] *The data were collected by trained evaluators from the Junction City, and Marysville, Kansas feeder pig auction markets.*

The averages and standard deviations of the feeder pig prices, live hog futures prices, corn futures prices, and soybean meal futures prices during the period of data collection are reported in table 1. The average price for the 40-59 pound feeder pig category was $84.27/cwt or approximately $42.14/head for 50-pound feeder pigs. The average feeder pig price changed dramatically over the data collection period. The highest daily average price for 40-59 pound feeder pigs was $107.67/cwt on May 17, 1988. However, as the severe drought in the cornbelt drove corn and soybean prices dramatically higher, and the live hog futures prices declined by more than $3/cwt, the average 40-59 pound feeder pig price at the two auctions dropped to less than half that of a month earlier, as low as $50.16/cwt on June 21, 1988.

Results and Discussion

The values associated with various feeder pig characteristics were estimated using the model presented in equation (1). The model contains both continuous and discrete (binary) variables. The continuous measures included price, weight, lot size, hog futures price, and feed costs. Squared values of weight and head were included in the model to allow for nonlinearities in these factors. Squared terms for the hog futures price and feed costs also were tested and found to be insignificant. Thus, only the linear components of these factors were retained for the model reported. Interactions between head and weight also were included in the model. The specific characteristics and market fundamentals examined are described in table 2.

A unique least squares solution for the model parameters does not exist when all classification variables are included (i.e., the matrix of explanatory variables is not of full rank). Thus, to estimate the model, it is necessary to define a standard type of lot by which to compare all others.

The chosen standard was a lot of healthy, cross-bred, predominantly white pigmented, medium framed, medium muscled, feeder pigs that had no structural problems or ruptures; had not been treated for parasites, wormed, vaccinated, sprayed, or castrated; and had not had their tails docked. The choice of standard is arbitrary and has no effect upon the inferences drawn from the analysis.

The model includes a total of 41 explanatory variables, an intercept, and an error term. The model was initially estimated using ordinary least squares (OLS). Heteroscedasticity of the OLS residuals was examined and was not found to be a problem. Significant within day first-order, residual autocorrelation was detected in 4 of the 20 days on which the data were collected. Thus, the model was re-estimated adjusting for the within-day autocorrelation by using the standard data transformation for first-order autocorrelation (Johnston, p. 321).

The parameter estimates of the model describing feeder pig price differentials are reported in table 3. The model explained 80% of the feeder pig price variability, and the majority of the coefficients were significantly different from zero at the .05 level of significance.

Weight and Lot Size

Weight, lot size, and weight-lot size interactions had significant impacts on feeder pig price. Average premiums of greater than $13/cwt were received for 40-pound feeder pigs sold in lots of approximately 60 head relative to single head lots (figure 1). Buyers preferred common truckload lot sizes. As the feeder pig weight increased, the largest premiums occurred at smaller lot sizes, reflecting the need for fewer pigs to fill a truck.

There are clear price advantages to marketing feeder pigs in lot sizes of 40 or more head.

The impact of average weight on feeder pig price is illustrated in figure 2. In general, price declined as weight increased. However, little price difference was found for pigs weighing between 20 and 40 pounds. Above 40 pounds the price discount increased fairly rapidly. Lighter weight pigs (20-30 lbs.) require more intensive management and a longer feeding period, increasing production and marketing risks for the feeder pig finisher, which may contribute to their having little or no premium relative to 40 pound pigs especially in relatively small (20 head) lot sizes.

Health and Health Program

As expected, health was the physical characteristic that had the largest impact on feeder pig price. Stale pigs received approximately $8.76/cwt discounts relative to healthy pigs. Pigs that were sick or ruptured or had lumps or structural problems received in excess of $35/cwt discounts on average, netting prices that were only 50% to 60% of the average price of healthy pigs.

The health program also influenced price. Lots of feeder pigs that were announced by the auctioneer as having been vaccinated (typically a "3-way" vaccination for rhinitis, erysipelas, and pneumonia) received $2/cwt premiums on average over other lots. Pigs that had been castrated received $3/cwt premiums on average relative to boar pigs. The announcement by the auctioneer that the pigs had been sprayed, wormed, or treated with other parasite preventatives had no significant direct influence on price. It is likely that feeder pig finishers perform many of these tasks routinely upon receiving the pigs, since they typically have no means of verifying that the treatments have

been done. However, in no way does this imply that these routine health treatments are not cost effective for the feeder pig producer. The value of a good health management program is reflected in the discounts that stale, sick, and crippled pigs receive and in the reduced death losses and increased feeder pig production efficiency associated with a sound health program.

Breed and Skin Pigment

Breed type had little impact on price. The only recorded breed receiving a significant discount (at the .10 level) relative to cross-bred pigs were Landrace feeder pigs. This discount likely reflects the lower efficiency of feed utilization that is sometimes associated with finishing Landrace pigs (Johnson). In general, skin pigment also had little influence on price. Lots containing predominantly brown/red colored pigs, however, did receive premiums relative to those with predominantly white colored pigs, possibly reflecting some perceived or actual profitability differences for different skin pigments.

Frame Size, Muscling, and Other Characteristics

Frame size and degree of muscling were not found to have a very significant impact on feeder pig price. Less than 8% of the lots were judged as having frame sizes that differed from average, which may have contributed to the lack of significance. The $1.72/cwt premium for heavy muscling was the only exception, since it was significant at the .11 level. Thus, the premium for heavy muscling may have some credence.

Lot uniformity had a significant impact on price. A $2.19/cwt discount was received on average for feeder pigs sold in lots containing animals that were not uniform in size. It was hypothesized that sorting out sick or crippled pigs after the lot had entered the sales arena may create a level of

uncertainty for bidders about the remaining pigs in the lot and result in a discount for the lot. However, sorting abnormal pigs from the lot following entry into the sales arena had no significant influence on price.

Market Fundamentals

Time of sale had a significant impact on the price received for feeder pigs. Pigs sold during the 3rd and 4th quarters of the sale received $3/cwt and $5.37/cwt discounts, respectively, relative to lots sold during the first quarter of the sale. This result reinforces the conclusion made by Buccola at feeder cattle auctions. Buccola argues that buyers offer their full reservation price for a lot of animals. Since different buyers likely have different reservation prices because of cost of production and risk aversion differences, the price for homogeneous lots will subsequently decline as the most eager buyers become satiated and cease bidding.

Feeder pig prices across auction days adjusted to changes in the October 1988 contract live hog futures price. The impact of the futures price was allowed to differ across feeder pig weight ranges, since changes in the expected finished hog selling price, with all else constant, were anticipated to have different profitability implications for hogs of differing weights. An F-test indicated that the four weight ranges selected had significantly different futures price coefficients at the .001 level of significance. The feeder pig price increased (decreased) on average by $2.57/cwt to $2.86/cwt, depending upon feeder pig weight, for each $1/cwt increase (decrease) in the live hog futures price.

The feed cost variable, reflecting expected changes in the costs of corn and soybean meal required to finish the hogs, had a highly significant price impact. For every $1/head increase in the expected feed cost variable, the

feeder pig price declined an average of $1.53/cwt. The expected feed cost was a very important factor in the feeder pig price movements. The severe drought and uncertainty regarding feeding costs that occured during the data collection period elevated the risks associated with feeder pig finishing, particularly in middle to late June, when feed grain prices were rapidly increasing.

Conclusions

Feeder pig prices vary widely on a given day at a particular auction market. This study identified several factors that helped to explain a large portion of the short-run (within day and across days) variability in feeder pig prices. Physical characteristics of the feeder pigs and changing market fundamentals during the data collection period were able to explain 80 percent of the variability in prices. The most significant physical characteristics affecting price included weight, lot size, health, structural soundness, lumps, ruptures, and lot uniformity. There are incentives for feeder pig producers to attempt to sell feeder pigs in healthy, structurally sound, uniform-sized lots of 40 or more head.

Even over short periods of time, it is evident that the feeder pig market reacts to changing fundamentals. Changes in expected finished hog prices were quickly incorporated into feeder pig auction markets. In addition, changing feed cost expectations were rapidly reflected in the prices being offered for feeder pigs. Thus, informed feeder pig buyers must closely monitor expected revenues and costs when making bids especially during periods of volatile corn, soybean meal, and/or finished hog markets.

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Table 1. Price Means and Standard Deviations over the May 5, 1988 through July 12, 1988 Period.[a]

Commodity	Mean Price	Standard Deviation
Feeder Pigs[b]		
20-39 lbs.	$86.37/cwt.	$21.77/cwt.
40-59 lbs.	$84.27/cwt.	$18.88/cwt.
60-79 lbs.	$74.24/cwt.	$17.25/cwt.
80-99 lbs.	$58.71/cwt.	$11.63/cwt.
October Live Hog Futures[c]	$43.90/cwt.	$1.75/cwt.
July Corn Futures	$2.67/bu.	$0.54/bu.
July Soybean Meal Futures	$263.08/ton	$37.00/ton

[a]Prices are Tuesday and Thursday prices during the 10-week period. Feeder pig prices are from the Junction City and Marysville, Kansas weekly feeder pig auctions.

[b]Includes all healthy, structurally sound, feeder barrows and gilts with medium frame size, medium muscling, tails docked, sold in uniform-sized lots.

[c]Futures prices are the closing futures price for the days of the auctions.

Table 2. Feeder Pig Characteristics and Market Forces Examined.

Item	Description
Dependent Variable:	
Price - the price paid for the feeder pigs in each lot ($/cwt.)	
Physical Characteristics:	
Weight - the average weight per pig in the lot (lbs./hd).	
Weight Squared - the average weight squared (lbs./hd-squared).	
Lot Size - the number of head per lot after any sorting (head).	
Lot Size Squared - the number of head squared (head-squared).	
Weight x Lot Size - weight times lot size, total weight of lot (lbs.).	
Weight x Lot Size Squared - total weight of lot squared (lbs.-squared).	
Health - categorized as a set of binary variables equal to 1 if the pigs in the lot were i)healthy, ii)stale, iii)sick, or iv)ruptured or v)had lumps or vi)structure problems and equal to 0 otherwise.	
Health Program - categorized as a set of binary variables equal to 1 if it was announced by the auctioneer that the pigs in the lot had been i)treated for internal and external parasites, ii)wormed, iii)vaccinated, iv)sprayed, or v)castrated or vi) had tails docked and equal to 0 otherwise.	
Breed - categorized as a set of binary variables equal to 1 if the pigs were i)cross bred, ii)Hampshire, iii)Yorkshire, iv)Duroc, v)Landrace, or vi)other breeds and equal to 0 otherwise.	
Skin Pigment - categorized as a set of binary variables equal to 1 if the pigs in the lot were predominantly i)white, ii)brown/red, iii)black, or iv)mixed and equal to 0 otherwise.	
Frame Size - categorized as a set of binary variables equal to 1 if the pigs were i)large framed, ii)medium framed, or iii)small framed and equal to 0 otherwise.	
Muscling - categorized as a set of binary variables equal to 1 if the pigs were i)heavy muscled, ii)medium muscled, or iii)light muscled and equal to 0 otherwise.	
Uniformity - the pigs in each lot were judged for size uniformity with uniform lots set equal to 0 and lots that were not uniform equal to 1.	
Sorted - lots containing pigs that were sorted out while in the sales arena were assigned a 1, lots not sorted in the arena were assigned a 0.	

Table 2. (continued)

Item	Description
Market Fundamentals	
Market Differential	- the prices across the two market locations were allowed to differ by setting the market differential variable equal to 0 for one market and equal to 1 for the other market.
Time of Sale	- time of sale was split into quarters and one of four binary variables was assigned a 1 if the lot was sold from i)1:00 p.m. to 1:19 p.m., ii)1:20 p.m. to 1:39 p.m., iii)1:40 p.m. to 1:59 p.m., or iv)2:00 p.m. or later and assigned a 0 otherwise.
Hog Futures Price	- the October 1988 live hog futures contract closing price ($/cwt.) on the day of the auction was allowed to vary across feeder pig weight ranges of i)20-39 pounds, ii)40-59 pounds, iii)60-79 pounds, and iv)80-99 pounds.
Feed Cost	- the expected feed cost variable differed across weight ranges with approximate total corn and soybean meal requirements for finishing to a weight of 240 lbs. assumed as follows i)20-39 pound pigs, 11.6 bushel of corn and 126.4 lbs. of soybean meal per pig; ii)40-59 pound pigs, 10.95 bushel of corn and 116.2 lbs. of soybean meal per pig; iii)60-79 pound pigs, 10.3 bushel of corn and 105.9 lbs. of soybean meal per pig; and iv)80-99 pound pigs, 9.46 bushel of corn and 92.8 lbs. of soybean meal per pig (derived from Figurski and Pretzer). Prices used were the July 1988 contract closing futures prices on the day of the auction.

Table 3. Estimated Feeder Pig Price Differentials, May 5, 1988 through July 12, 1988.

Characteristic[a]	Parameter Estimate	t-statistic
Weight and Lot Size		
Weight	0.7324	2.29**
Weight squared	-0.00874	-2.78**
Weight x lot size	-0.0172	-3.50**
Weight x lot size squared	1.527×10^{-6}	2.25**
Lot size	1.162	4.69**
Lot size squared	-0.00647	-3.59**
Health		
Stale	-8.758	-3.03**
Sick	-35.554	-11.27**
Ruptured	-36.256	-16.07**
Lumps	-45.134	-9.64**
Structural problem	-41.640	16.19**
Health Program		
Parasite treatment (internal and external)	1.085	1.01
Wormed	0.244	0.24
Vaccinated	2.015	1.94*
Sprayed	1.680	1.51
Castrated	3.014	1.91*
Tails docked	0.487	0.37
Breed and Skin Pigment		
Hampshire	4.688	0.09
Yorkshire	-1.573	-0.43
Duroc	-1.786	-0.35
Landrace	-17.841	-1.89*

Table 3. (continued)

Characteristic[a]	Parameter Estimate	t-statistic
Other	5.091	0.38
Brown/red	5.913	2.23**
Black	1.587	0.57
Mixed	0.519	0.56
Frame Size and Muscling		
Large frame	1.752	0.71
Small frame	1.348	0.43
Heavy muscling	1.727	1.62
Light muscling	1.727	0.89
Other Characteristics		
Not uniform	-2.191	-2.28**
Sorted	-0.327	-0.24
Market Forces		
Market differential	1.301	1.33
Time of sale		
2nd quarter	-1.455	-1.16
3rd quarter	-3.012	-2.28**
4th quarter	-5.374	-4.10**
Hog futures price		
Futures 20-39 lbs.	2.855	19.57**
Futures 40-59 lbs.	2.680	15.80**
Futures 60-79 lbs.	2.572	14.84**
Futures 80-99 lbs.	2.621	14.31**

Table 3. (continued)

Feed cost	-1.530	-23.66**
Intercept	7.401	2.88**
R-squared	.80	
RMSE	$12.97/cwt.	
Equation F statistic	90.63**	
Number of observations	918	

[a]Dependent variable is feeder pig price ($/cwt). Reported coefficients are relative to a benchmark healthy lot of feeder pigs, which had not been treated for parasites, wormed, vaccinated, srayed, or castrated or had tails docked; were a cross breed with predominantly white color; were medium framed and medium muscled; were in a uniform lot that had no sort outs; and were sold in the first quarter of the auction.

*Indicates coefficient significantly different from zero at the .10 level.

**Indicates coefficient significantly different from zero at the .05 level.

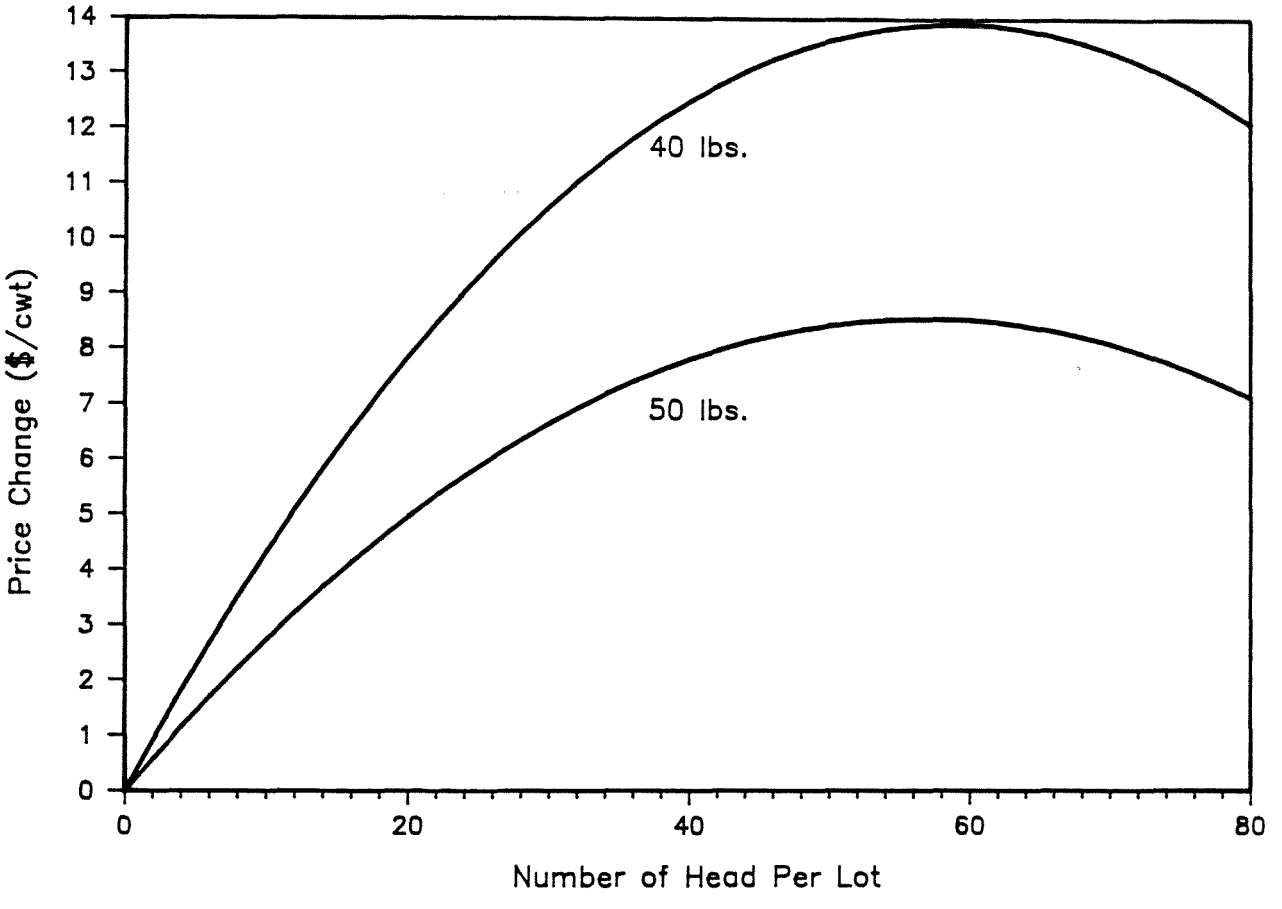

Figure 1. Effect of Lot Size on 40 and 50 Pound Feeder Pig Prices

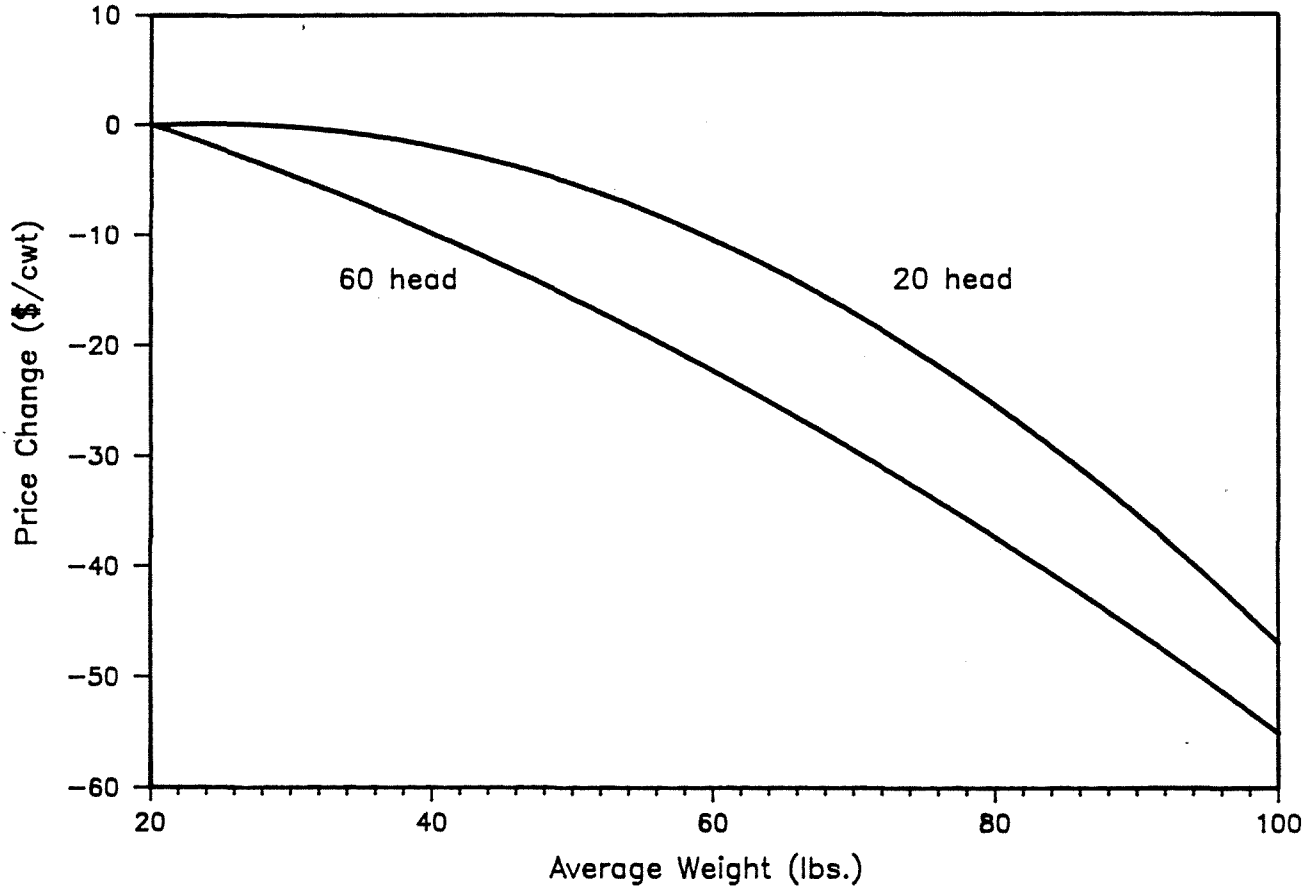

Figure 2. Effect of Weight on Feeder Pig Price of 20 and 60 Head Lot Sizes