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# Purchaser Response for Genetically Different Boars and Boar Semen

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**Abstract**
Sales records on boars sold from a breeding company and semen sold from a boar artificial insemination stud were evaluated to assess the emphasis placed on performance data and costs by buyers of semen and boars, and to determine what affects boar semen price. Two data sets, that consisted of (1) numbers of boars sold in a given breed and genetic evaluation subclass and (2) units or dollars of semen sold for a boar over a specific sales period, were used. These sales were expressed as a percentage (market share) of the total sales over the 2-yr period. Equations to predict percentage market share (% MS) for boar sales included the fixed effects of period and breed and covariates for boar price and genetic evaluation within breed. All effects were important ($P<.01$), and $R^2$ was .83. Percentage MS for units of semen sold was estimated using a model that included the fixed effects of period and breed and the covariates for cost per unit (CPU) of semen and backfat and gain within breed. Individual performance was more useful in predicting % MS and CPU than was any index. Subjective scores on mothering ability, size, soundness and libido were useful in predicting % MS units and CPU. For predicting % MS units, $R^2$ values were as high as .44 for models with scores. Results indicated that buyers were willing to pay more per unit and purchase more volume of semen from boars that had test information.

**Keywords**
Boars, Genetic Merit, Price, Market Share

**Disciplines**
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**Comments**
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# PURCHASER RESPONSE FOR GENETICALLY DIFFERENT BOARS AND BOAR SEMEN[1,2]

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## Summary

Sales records on boars sold from a breeding company and semen sold from a boar artificial insemination stud were evaluated to assess the emphasis placed on performance data and costs by buyers of semen and boars, and to determine what affects boar semen price. Two data sets, that consisted of (1) numbers of boars sold in a given breed and genetic evaluation subclass and (2) units or dollars of semen sold for a boar over a specific sales period, were used. These sales were expressed as a percentage (market share) of the total sales over the 2-yr period. Equations to predict percentage market share (% MS) for boar sales included the fixed effects of period and breed and covariates for boar price and genetic evaluation within breed. All effects were important ($P<.01$), and $R^2$ was .83. Percentage MS for units of semen sold was estimated using a model that included the fixed effects of period and breed and the covariates for cost per unit (CPU) of semen and backfat and gain within breed. Individual performance was more useful in predicting % MS and CPU than was any index. Subjective scores on mothering ability, size, soundness and libido were useful in predicting % MS units and CPU. For predicting % MS units, $R^2$ values were as high as .44 for models with scores. Results indicated that buyers were willing to pay more per unit and purchase more volume of semen from boars that had test information.

(Key Words: Boars, Genetic Merit, Price, Market Share.)

## Introduction

Swine producers have been encouraged to use information from on-the-farm testing or test station information to identify superior boars for use in their herds.

Results covering relationships between differences in test performance and sales demand and price for test station sales indicate that buyers placed most of their emphasis when purchasing boars on days to 154 kg and backfat (Neville et al., 1976) or on average daily gain and backfat (Rothschild et al., 1981). Rothschild et al. (1981) found that buyers of all breeds paid more for boars with lower backfat and higher average daily gain though breed differences existed. Producer purchasing response was not consistent with the relative economic weights used in the test station indexes.

Results in dairy cattle by Bell and McDaniel (1976), Palmer and Mao (1977), Adkinson et al. (1978) and Crain et al. (1981) suggested that price and sales of the semen increased as the predicted difference (PD) for milk and type increased.

The purposes of this study were to (1) examine factors that affect boar sales from a breeding company and boar semen price and sales from a boar stud, and (2) determine the relative importance of the different traits and sources of records on boar semen sales and price.

## Materials and Methods

Data consisted of sales records and performance information for boars sold from a large breeding company and sales records of semen sold and performance information of boars from an artificial insemination (AI) stud. Data for both the breeding company and the boar AI stud were of sales from October 1978 through September 1980.

Records from the breeding company included

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number of boars sold, their price and their genetic evaluation. The genetic evaluation consisted of grouping boars on the basis of index scores. The company's index was calculated using the days to 100 kg and backfat probe (BF) and is similar to the NSIF index (Hubbard, 1981). Index scores of the boars offered for sale ranged from 80 to above 140, with a mean of 100 and standard deviation of 25. The boars were grouped into seven groups by the company in the following manner: 80 to 89, 90 to 99, 100 to 109, ..., >140. Seven breeds, of which four were purebred and three crossbred, were represented such that there were 49 breed-genetic group subclasses. The data were divided into four time periods corresponding with changes in pricing. Percentage market share (% MS) was determined using the following formula:

% MS = (No. boars sold/breed-genetic group and time period)/[Total boars sold (October 1978 through September 1980)] × 100.

Data from the boar AI stud included cost per unit (CPU) of semen, total dollars of semen sold and units of semen sold per month on each boar. Because semen of a boar may not have sold each month, sales were grouped into four 6-mo periods. Sales data were expressed in terms of % MS where % MS equals semen sales in a 6-mo period as a portion of total semen sales over the 2-yr period times 100. The amount of performance information varied across boars since some were bought from test stations and others from farms. An initial analysis which included all boars that had % MS >0 was completed to evaluate differences in CPU and % MS for boars with some vs no performance information. The data were then edited which formed a final group of 148 observations from 50 boars. The observations included test records for average daily gain (ADG), BF, test index (index calculated at the test station where the boar was tested), and the NSIF index (Hubbard, 1981). Also included were stud gain (an index for ADG computed by the stud that combined ADG of the individual and that of his centrally tested penmate sibs) and stud BF (an index for BF calculated in a manner similar to that for stud gain). Stud personnel subjectively scored each boar separately for length, meatiness, bone, capacity, height and soundness using a scale ranging from 1 to 5. Libido was scored after boars were collected and mothering ability was assigned using information on the boar's dam supplied by his previous owner. Type scores for each trait were listed separately by the stud but combined for the purposes of these analyses.

Analyses of the breeding company data were completed by using the model:

$$\mathbf{y} = \mathbf{X}_1\beta_1 + \mathbf{X}_2\beta_2 + \mathbf{e},$$

where

- $\mathbf{y}$ = % MS for a breed-genetic evaluation time period group,
- $\beta_1$ = fixed effects of time period, breed and their interaction,
- $\beta_2$ = regressions of market share on price and on genetic merit within breed,
- $\mathbf{X}_1$ = incidence matrix,
- $\mathbf{X}_2$ = matrix of genetic evaluations and boar cost,
- $\mathbf{e}$ = random vector of residuals.

It also was assumed that $E(\mathbf{e}) = \mathbf{O}$ and $Var(\mathbf{e}) = I\sigma_e^2$. The model for the boar stud data was:

$$\mathbf{y}^* = \mathbf{X}_1^*\beta_1^* + \mathbf{X}_2^*\beta_2^* + \mathbf{e}^*,$$

where

- $\mathbf{y}^*$ = % MS or CPU,
- $\beta_1^*$ = fixed effects of breed and time period,
- $\beta_2^*$ = regressions of MS on CPU and MS on performance and type (% MS analyses) and regression of CPU on performance and type (CPU analyses),
- $\mathbf{X}_1^*$ = incidence matrix,
- $\mathbf{X}_2^*$ = matrix of performance records, type scores and CPU,
- $\mathbf{e}^*$ = random vector of residuals.

It also was assumed that $E(\mathbf{e}^*) = \mathbf{O}$ and $Var(\mathbf{e}^*) = I\sigma_{e^*}^2$.

Multiple-regression techniques were employed to compare the different performance records and type score used to predict CPU or % MS.

## Results and Discussion

*Breeding Company Data.* The analysis of variance is presented in table 1. All effects were significant. The $R^2$ was .83, suggesting that the effects in the model explained much of the variation in % MS sales of boars. Estimates of % MS of boar sales by period and breed are presented in table 2. Prices were set by breed and sales period and increased according to

TABLE 1. ANALYSIS OF VARIANCE OF PERCENTAGE MARKET SHARE FOR COMPANY BOAR SALES[a]

| Source | df | Mean square |
|---|---|---|
| Time period | 3 | 2.98** |
| Breed | 6 | 2.71** |
| Period X breed | 18 | .24** |
| Covariates: | | |
| Genetic merit (breed)[b] | 7 | 3.12** |
| Cost | 1 | .97** |
| Residual | 160 | .10 |

[a]$R^2$ = .83.

[b]Within breed.

**P<.01.

genetic merit group; they ranged from $385 to $1,250. Number of boars sold was highest in the fall of 1978 (period 1), reflecting the nature of the hog market over that 2-yr period. Crossbred boars sold a larger % MS than did purebred boars.

TABLE 2. LEAST-SQUARES ESTIMATES OF PERCENTAGE MARKET SHARE FOR COMPANY SALES BY PERIOD AND BREED

| Period[a] | % MS |
|---|---|
| 1 (Oct. 78–May 79) | 42 ± 2 |
| 2 (June 79–Sept. 79) | 15 ± 2 |
| 3 (Oct. 79–May 80) | 25 ± 2 |
| 4 (June 80–Sept. 90) | 18 ± 2 |

| Breed[b] | Type | % MS |
|---|---|---|
| Duroc | PB[c]-paternal | 7 ± 2 |
| Hampshire | PB-paternal | 4 ± 2 |
| Landrace | PB-maternal | 4 ± 2 |
| Yorkshire | PB-paternal/maternal | 14 ± 2 |
| Black-line | CB[d]-paternal | 28 ± 2 |
| M-line | CB-maternal | 19 ± 2 |
| White-line | CB-paternal/maternal | 24 ± 2 |

[a]Represent estimable functions of period differences averaged equally over breed and breed X period interactions.

[b]Represents estimable function of breed differences averaged equally over period and period X breed interactions.

[c]PB = purebred.

[d]CB = crossbred.

TABLE 3. AVAILABILITY OF BOARS BY GENETIC MERIT LEVEL

| Genetic merit level | % available[a] |
|---|---|
| >140 | 6.95 |
| 130–139 | 7.65 |
| 120–129 | 12.28 |
| 110–119 | 16.85 |
| 100–109 | 19.71 |
| 90–99 | 19.71 |
| 80–89 | 16.83 |

[a]Percentage available should be the same for each breed.

Because boars were grouped by index and the index was assumed to be a normal distribution, the percentage of boars available for sale was less at the higher genetic levels (table 3). This caused the partial regressions of % MS on genetic merit within breed to be negative (table 4). However, because these partial regressions of % MS on genetic merit within breed were different, they require further consideration. The Landrace and the M-line (Yorkshire-Landrace $F_1$) are the only two breeds considered strictly maternal. Among purebreds, the Landrace had the smallest negative partial regression coefficient, as did the M-line among the crossbreds. This suggests that, as genetic merit increased, the loss of sales for these two breeds was less than for other purebreds or crossbreds. It seems that buyers of boars of maternal breeds were anticipating improvement of maternal traits in addition to performance traits and therefore were willing to buy the higher indexing and

TABLE 4. PARTIAL REGRESSION ESTIMATES OF MARKET SHARE ON GENETIC MERIT WITHIN BREED FOR COMPANY BOAR SALES

| Breed ID | Type | b | SE |
|---|---|---|---|
| Duroc | PB[a]-paternal | −.021 | .004 |
| Hampshire | PB-paternal | −.015 | .004 |
| Landrace | PB-maternal | −.012 | .004 |
| Yorkshire | PB-paternal/maternal | −.029 | .004 |
| Black-line | CB[b]-paternal | −.044 | .004 |
| M-line | CB-maternal | −.030 | .004 |
| White-line | CB-paternal/maternal | −.043 | .004 |

[a]PB = purebred.

[b]CB = crossbred.

TABLE 5. COMPARISON OF TEST INFORMATION VARIABLES USED TO PREDICT COST PER UNIT OF SEMEN

| Model No. | Variables | | | | | $R^2$ |
|---|---|---|---|---|---|---|
| | Discrete | | Continuous | | | |
| 1 | Period | Breed | Test gain (B)[a]** | Test BF (B) | | .30 |
| 2 | Period | Breed | Stud gain (B)** | Stud BF (B) | | .33 |
| 3 | Period | Breed* | Test index (B)* | | | .22 |
| 4 | Period | Breed | Stud index (B)** | | | .28 |
| 5 | Period* | Breed* | NSIF index (B)* | | | .22 |
| 6 | Period | Breed* | Test gain (B)** | Test BF (B)** | Type (B)** | .66 |
| 7 | Period* | Breed** | Stud gain (B)* | Stud BF (B)** | Type (B)** | .65 |
| 8 | Period* | Breed** | Test index (B) | | Type (B)** | .53 |
| 9 | Peirod* | Breed | Stud index (B)** | | Type (B)** | .60 |
| 10 | Period* | Breed* | NSIF index (B) | | Type (B)** | .50 |

[a](B) = within breed.

*P<.05.

**P<.01.

more costly animals from these breeds. The partial regression of % MS on cost of the boar was small (.0007 ± .0002) but positive, suggesting that in general buyers were willing to pay somewhat more for boars of superior genetic merit.

Lack of availability of boars in a few genetic evaluation groups may have biased the partial regressions of % MS on genetic merit within the breed. A buyer had at least three options if no boars were available in some genetic merit class. Boars could be purchased from higher genetic merit classes if they were available, which would tend to make the partial regressions less negative. The buyer could also switch breeds or purchase from a lesser class which would make the partial regressions more negative. Discussions with company personnel revealed that lack of availability was a problem in the Duroc and Hampshire breeds for boars in merit groups over 100 for some time periods. However, good availability seems to have existed for Landrace and Yorkshire boars and good availability for all the crossbreds. It cannot be determined exactly how the lack of availability of Duroc and Hampshire boars affects interpretation of the coefficients. The coefficient for Landrace was significantly less than that of the Yorkshire, suggesting that buyers were more willing to purchase higher performance boars of this maternal breed than those of a breed known for maternal and paternal characteristics. Lack of availability of crossbred boars did not occur during these two years.

It can be concluded that there was a higher demand for boars with higher genetic merit (and higher cost), especially boars from breeds considered maternal. This probably was a result of buyers anticipating saving female replacements from those boars.

*Boar AI Stud Data.* CPU of semen ranged from $7 to $23 during the 2-yr period of this study. An initial analysis using all boars and dividing them into two groups, those with BF and ADG records and those with only one or none of these was conducted. Boars with at least BF and ADG records had significantly higher CPU ($2.50) and significantly higher sales (25%) than those without these records. A variety of models were used to predict CPU (table 5). All models contained the effects of period and breed and those effects generally were significant. Models including the effects of type within breed (models 6 through 10) had much higher $R^2$ than those that excluded type (models 1 through 5). No individual subjective type score was found to be important, but the total of all type scores on a boar was important and was used for all analyses. Although stud gain and stud BF (models 2, 7) was formulated to include sib information, it did not increase the precision of predicting CPU above that achieved by the individual records for ADG and BF (models 1, 6). Indexes that related the value of individual records compared with their

TABLE 6. COMPARISON OF PARTIAL REGRESSION COEFFICIENTS OF COST PER UNIT OF SEMEN ON AVERAGE DAILY GAIN, BACKFAT AND TYPE WITHIN BREED[a]

| Breed | ADG within breed | | BF within breed | | Type within breed | |
|---|---|---|---|---|---|---|
| | b | SE | b | SE | b | SE |
| Duroc | 9.77* | 4.61 | 2.60 | 1.58 | .59** | .11 |
| Hampshire | −7.14 | 27.73 | −12.60** | 3.28 | 1.17** | .23 |
| Landrace | −8.31 | 25.35 | −6.25 | 4.42 | 2.51** | .42 |
| Spotted | 5.64 | 27.33 | −2.00 | 24.20 | .88 | 1.83 |
| Yorkshire | 15.14** | 3.22 | −4.22** | 1.40 | .91** | .15 |

[a]Model 6 table 5.

*P<.05.

**P<.01.

contemporaries were not as valuable as individual records in predicting CPU. Table 6 includes the partial regressions of CPU on ADG, BF and type within breed. More emphasis on the subjective type scores was placed within the Landrace breed.

Comparison of variables used to predict % MS of units of semen is given in table 7. The partial regressions of % MS on CPU within breed also were useful in predicting % MS. As was true for CPU, test records (models 1, 6) were more useful in predicting % MS of semen sales than were index values (models 3 through 5, 8 through 10). These results suggest that producers (buyers) are either not educated fully as to the value of indexes or that indexes reflect economic values different from what the producer considers correct. The addition of the partial regression of % MS on type was significant but added little to the model (model 11). Also, in model 12 the partial regressions of % MS on test BF within breed were not significant. The partial regressions of % MS on type and on CPU (not CPU within breed) were significant.

A comparison of partial regressions of % MS on test gain in table 8 suggests that as ADG increases % MS increased in all breeds but was significantly positive only for Hampshires. Buyers of semen of Yorkshires placed negative emphasis on ADG. The coefficients of % MS on BF were not significant. This suggests that buyers were not putting any emphasis on leaner

TABLE 7. COMPARISON OF VARIABLES USED TO PREDICT PERCENTAGE MARKET SHARE UNITS OF SEMEN

| Model No. | Variables | | | | | | $R^2$ |
|---|---|---|---|---|---|---|---|
| | Discrete | | Continuous | | | | |
| 1 | Period | Breed | Test gain (B)* | Test BF (B)* | | | .20 |
| 2 | Period | Breed | Stud gain (B)* | Stud BF (B)* | | | .23 |
| 3 | Period | Breed** | Test index (B)** | | | | .23 |
| 4 | Period | Breed | Stud index (B) | | | | .07 |
| 5 | Period | Breed | NSIF index (B) | | | | .10 |
| 6 | Period | Breed** | Test gain (B)** | Test BF (B)** | CPU (B)** | | .43 |
| 7 | Period | Breed | Stud gain (B)** | Stud BF (B)** | CPU (B)** | | .39 |
| 8 | Period | Breed** | Test index (B)** | | CPU (B)** | | .39 |
| 9 | Period | Breed | Stud index (B) | | CPU (B)** | | .24 |
| 10 | Period | Breed | NSIF index (B) | | CPU (B)** | | .25 |
| 11 | Period | Breed** | Test gain (B)** | Test BF (B) | Type** | | .41 |
| 12 | Period | Breed** | Test gain (B)** | Test BF (B) | CPU* | Type** | .44 |

*P<.05.

**P<.01.

TABLE 8. COMPARISON OF PARTIAL REGRESSION COEFFICIENTS OF PERCENTAGE MARKET SHARE ON TEST RECORD GAIN (BREED)[a]

| Breed | b | SE |
|---|---|---|
| Duroc | 1.27 | 1.16 |
| Hampshire | 4.00* | 1.36 |
| Landrace | 10.55 | 6.28 |
| Spotted | −3.93 | 1.97 |
| Yorkshire | −2.55* | .85 |

[a]Model 12, table 8.

*P<.05.

TABLE 9. PARTIAL REGRESSIONS OF MARKET SHARE ON TYPE AND COST PER UNIT OF SEMEN[a]

| Covariable | b | SE |
|---|---|---|
| CPU | .05* | .02 |
| TYPE | .09* | .03 |

[a]Model 12, table 7.

*P<.05.

pigs in general, perhaps because they thought that these boars were sufficiently lean. More education may be necessary to encourage producers to place more emphasis on leaner, faster-growing boars when buying semen.

Lack of availability of semen from some boars probably did not bias the results. Because it was frozen, orders could be placed in advance and, though temporary shortages may have occurred, semen was available sometime during the 6-mo sale period. Conversations with AI stud personnel revealed that, when semen was not available for a boar, buyers commonly switched to semen of a boar of the same breed and genetic merit. This, therefore, should not bias results and their interpretations.

The partial regressions of % MS units on CPU and on type were both significantly positive (table 9). These results suggest that buyers were willing to pay more for semen they believed to have come from better boars and that subjective scores on boars were useful in predicting sales. The positive regression coefficient for % MS on CPU was similar to that found by Crain et al. (1981) in Louisiana for dairy bulls.

Buyers, in general, were willing to spend more money to purchase semen of superior boars though differences did exist between breeds in performance and its relationship to sales. The moderate $R^2$ of .44 for prediction of % MS units of semen sold suggests that buyers may be placing emphasis on other things, such as pedigree and their own visual appraisal of the boar.

In both semen data and boar sales data the seller has set the price. The relationships between sale price and genetic merit could be better evaluated if this had not been the case. An objective was to see how the purchaser responds to different prices set on animals and semen representing different genetic merit. Given the constraint of the seller setting the price it appears that the buyer was often willing to pay more for semen or boars of higher genetic merit.

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