RELATIONSHIPS BETWEEN INCOME OVER VARIABLE COSTS, FEEDING SYSTEMS AND BREEDING VALUES IN A QUOTA PAYMENT AND PASTURE BASED DAIRY INDUSTRY[1]

K.R. PHILLIPS[1], J.F. TAYLOR[2], J.P. WALTER[2], and M.A. TOMASZEWSKI[2] and R.D. LACEWELL

INTRODUCTION

The herd breeding program is an integral component of the farm business and the most rational breeding objective is to breed cows to improve farm profit. Production costs and resource constraints differ among dairy farms and are the primary reason for different profit levels at constant production and milk supply quota levels. Traits such as milk, milk fat and protein yields influence profit through their contribution to income.

A number of traits have been combined in indexes intended to predict profit, especially that component due to the present value (PV$) of semen (5, 9, 11). Most indexes have incorporated feed cost as a fixed proportion of milk income, assuming a constant relationship between feed cost, production, feed conversion efficiency and breeding value. Further, these procedures may not apply to a pasture based industry, where seasonal effects are of considerable importance to management, production and prices and physical inputs to maximize profitability may vary throughout the year.

The objective of this study was to develop a model for Income over Variable Costs (IOVC) for New South Wales dairy herds using predicted breeding values and farm physical inputs and outputs. The fitted model is intended for use to estimate marginal values of traits, to allow the construction of profit maximizing PV$ selection indexes (5, 9, 11) that may vary among production and economic environments.

MATERIALS AND METHODS

Data were obtained from the NSW Agriculture and Fisheries' monthly farm accounting service, MILKCOST for November, 1987 through December, 1989 and comprised 1,008 herd-month observations on 65 herds following edits for milk recorded, Holstein herds reporting quota and production levels. Variables recorded included income from milk, stock sales and other sources; costs and units of; 1) Feed - grain, dairy

[1] North Coast Agricultural Institute, Wollongbar, NSW.
[2] Department of Animal Science, Texas A & M University.
[3] Department of Agricultural Economics, Texas A & M University.

meals, protein meals, by products, milk replacer, purchased hay, home grown grain and roughage; 2) Paddock - fertilizer, seed, chemicals, irrigation power and tractor fuel; 3) Herd - veterinary, herd recording, AI, agistment and stock purchases, and 4) Farm - dairy requisites, repairs, maintenance, electricity, additional labor and hired machinery. Where a resource was not used, a zero value was recorded for the month. Fertilizer usage and costs were allocated over a 3 month period assuming 40%, 30% and 30% efficacies in the first through third month, respectively. Monthly milk income was verified using the prevailing payment formulae for quota and over quota milk. The correlation between calculated and reported monthly milk incomes was .92.

IOVC was calculated for each herd month by accumulating quota and over quota milk income, cow disposal and income from other sources and deducting the accumulated total herd costs due to labor, feeds, paddocks, herd and farm sources as previously described. Labour was valued at A$1,000 per month IOVC was then computed on a per milking cow per day basis by dividing the herd-month IOVC by the number of milking cows and days in each month.

Australian breeding values (ABV) for 305d-2X-ME milk, milk fat and protein of sires and cows derived under a mixed linear animal model (4) were obtained from the Australian Dairy herd Improvement Scheme Pty Ltd.

A model was fitted using the SAS (7) General Linear Model procedure including terms for year of observation (1987 through 1989), month of observation (January through December), quota milk produced (L milking cow^{-1} day^{-1}), over-quota milk produced (L milking cow^{-1} day^{-1}), the no. fo milking cows in the herd. the percent of replacement heifers reared relative to no. of milkers the percent of dry cows maintained relative to no. of milkers the percent of dry cows maintained relative to no of milkers the no. of hectares (ha) of pasture used for dairy purposes, the amount of fertilizer used adjusted for efficacy period (kg. ha^{-1} d^{-1}), amount of grain fed (kg milking cow^{-1} day^{-1}) amount of hay fed (kg milking cow^{-1} day^{-1}) amount of processed dairy meal fed (kg milking cow^{-1} day^{-1}) amount of by-products fed (kg milking cow^{-1} day^{-1}), amount of milk replacer fed to calves (kg milking cow^{-1} day^{-1}), herd average predicted breeding value for mature equivalent milk (L milking cow^{-1} $3\text{-}5^{-1}$).

All variables were observed on a herd-month basis. Quadratic terms and interactions were included to allow for the potential of detecting turning points at which further increases in inputs result in diminished (or possibly enhanced) levels of IOVC.

RESULTS AND DISCUSSION

The data reflect the NSW industry's seasonality and reliance on rainfall to produce pasture. Average IOVC across herd-months was A$2.29 per cow per day. In August through December, overquota production was greatest and variable costs of production were least, leading to IOVC values that were higher and less variable than in months when pasture is of poorer quality and cows require feed supplementation to maintain production. Further, the amounts of grain and hay fed tended to be greatest in the winter months (May through August) when pasture availability is limited. Grain tended to be fed in more uniform amounts throughout the year than hay to maintain dietary energy and production levels.

Across herds, the average number of cows per labour unit, herd improvement and veterinary costs per cow were uniform throughout the year. Combined herd improvement (herd recording and AI) and veterinary costs per cow were small when compared to IOVC, averaging A$.16 per cow per day, or 6.8% of the variable costs of milk production. Hence the potential for returns from investment in genetic, herd health and management programs using herd recording would appear to be sufficient to readily offset the cost of these programs. The proportion of income derived from cow sales in these herds was less than 3% of milk income. Hence selection for traits intended to enhance the value of sale cattle, independent of contribution to returns from milk or cost of culling, is not economically sound.

Levels of quota and over quota milk production were major determinants of income and were expected to significantly influence IOVC. Approximate 90% ranges for quota and overquota were 5.0 to 15.0 $L.cow^{-1}$ d^{-1} and 1.0 to 10.0 $L.cow^{-1}$ d^{-1} and within these ranges, IOVC increased by A$3.14 and A$1.61 cow^{-1} d^{-1} respectively. For both variables, estimated linear partial regression coefficients were positive and quadratic coefficients were negative and both were significant for quota milk, yielding a maximum IOVC at 31.6 $l.cow^{-1}$ d^{-1} which was beyond the range of the sample data. This demonstrates the perceived value of quota ownership and the motivation of NSW dairy farmers to produce over quota in order to secure additional farm quota allocations. Further, farmers were able to profit from over quota milk through seasonal management of production.

The 90% ranges for grain and total hay fed and herd average 300d-2X-ME milk breeding values were 0 to 5 kg d^{-1}, 0 to 6 kg d^{-1} and -150 to 150 litres respectively and relationships with IOVC are in Figures 2 and 3. Herds of low average genetic merit for milk (HAVM = 150 l) benefited less from increments of supplemental grain than herds with higher merit cows (HAVM = 150 l). In herds fed one kg d^{-1} of grain, low HAVM herds increased IOVC by A$.21 cow $^{-1}$ d^{-1} and high HAVM herds by A$.32 cow^{-1} d^{-1} when an additional one kg d^{-1} of grain was fed. At 4 kg d^{-1} of grain, low HAVM herds increased IOVC by $.25 cow^{-1} d^{-1} and high HAVM herds by $.28 cow $^{-1}$ d^{-1} with the increment. Further, differences in IOVC were evident at constant levels of grain feeding, at one and five kg d^{-1} of grain fed, high HAVM herds achieved an IOVC of A$.89 and A$1.35 cow $^{-1}$ d^{-1} greater than low HAVM herds respectively. As the amount of hay fed increased from one to six kg cow^{-1} d^{-1}, IOVC increased by A$.06 cow^{-1} d^{-1} in high HAVM herds, but decreased by A$.20 cow low HAVM herds as additional hay was fed. At less than two kg cow^{-1} d^{-1} of hay fed, IOVC were similar for high and low HAVM herds (Figure 3), hence returns due to increased generic merit differed with the amount of hay fed. At six kg cow^{-1} d^{-1} of hay, high HAVM herds returned A$1.28 cow $^{-1}$ d^{-1} more than low HAVM herds.

CONCLUSIONS

Due to the limited sample size and lack of management information of herd age distribution and average number of days in milk for each herd month, these data should be used cautiously in deriving selection indexes for sectors of the NSW dairy industry. Since significant interactions among genetic merit and nutritional environment variables were detected for IOVC, selection indices must be defined considering these and concomitant effects of changes in quota and over quota milk produced per cow as total production per cow is increased through selection. These results support the contention (10) that it is simplistic to evaluate the economic effects of changes in one variable independently of others.

An important finding of this study was the positive association between herd average genetic merit and IOVC. However, under the NSW quota payment system increases in IOVC due to genetic improvement were nonlinear and were influenced by herd quota allocation and nutritional environment. Hence nonlinear indices for AI sire selection may have to be defined that reflect the economic and management environments of individual dairies, or industry sectors, rather than an industry-wide index such as PV$ (8, 9). Additionally, these associations support the finding of studies (2, 3, 6) in other diverse production environments, that increases in profitability due to increases in genetic merit are partly associated with increases in feed conversion efficiency.

REFERENCES

1 Ashwood, A.A., and B. Coote. 1988. "Milkonomic$ MILKCOST program" NSW Agriculture and Fisheries, Sydney. Mimeo 52 pp.

2 Balaine, D.S., R.E. Pearson, and R.H. Miller. 1981. Repeatability of net economic efficiency in dairy cattle and role of some economic variables as its predictors. J. Dairy Sci. 64:96.

3 Gibson, J.P. 1986. Efficiency and performance of genetically high and low milk producing British Friesian and Jersey cattle. Anim. Prod. 42:161.

4 Henderson, C.R. 1984. Application of Linear Models in Animal Breeding. University of Guelph Press, Guelph.

5 McMahon, R.T., R.W. Blake, C.R. Shumway, and M.A. Tomaszewski. 1985. Selection of young and proven Holstein artificial insemination sires to maximize profits from milk. J. Dairy Sci. 68:2303.

6 Pearson, R.E., R.H. Miller, J.W. Smith, L.A. Fulton, M.F. Rothschild, D.S. Balaine, and E.M. Coffey. 1981. Single and multiple trait sire selection. First lactaton milk yield and composition, conformation, feed intake, efficiency and net income. J. Dairy Sci. 64:77.

7 SAS user's guide: Statistics Version 5. 1985. SAS Inst. Inc., Cary N.C.

8 Short, T.H., R.W. Blake, C.R. Shumway, and M.A. Tomaszewski. 1987. Milk yield, sire selection profitability and selection error costs. J. Dairy Sci. 70:2112.

9 Taylor, J.F., K.R. Phillips, and M.A. Tomaszewski. 1988. Net present value and economic merit of sexed semen and splitting units of semen for Australian Holsteins. 1988. J. Dairy Sci. 71:3100.

10 Van Arendonk. J.A.M. 1988. Management guides for insemination and replacement decisions. J. Dairy Sci. 71:1050.

11 Wilcox, M.L., C.R. Shumway, R.W. Blake, and M.A. Tomaszewski. 1984. Selection of artificial insemination sires to maximize profits. J. Dairy Sci. 67:2407.