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Animal evaluation review: a breed challenge

Animal Evaluation Review

A Breed Challenge

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Project Report

for

Kellogg Rural Leadership Programme

Contents

I wish to acknowledge the support and encouragement of my wife, and the assistance of the following Livestock Improvement Staff: Brian Wickham, Bevin Harris, Rob Jackson and Jason Clark.

1. Introduction

Livestock Improvement Corporation is presently undertaking a major review of genetic and production evaluations it provides to the New Zealand dairy industry.

The **Animal Evaluation Review** is investigating the use of a sophisticated method of producing animal evaluations known as the **Animal Model**. The review is now looking into methods of combining the individual trait outputs from the Animal Model into predictors of animal genetic and productive performance. It intends to provide evaluations across breeds.

The output Indexes will be expressed on a per hectare basis. Worldwide, no previous attempts have been made to evaluate dairy cattle across breeds in this way. The Review has proceeded to the point of combining the individual trait outputs with considerable acceptance from potential users of the evaluations. The method of combination and in particular the relative importance given to each trait evaluated is now the subject of research and user education and comment.

The foundation material for assessing traits of importance, the Animal Model, and methods or units of expression of trait values are documented.[i] An outline of the presently proposed method of trait combination is also documented.[ii]. The traits of importance proposed are protein, milkfat, milk volume, liveweight and survivability.

The purpose of this paper is to look at the possible consequences of evaluating across breeds, potential effects from appearing to rank one breed above (or below) other breeds, and to provide some conclusions concerning the breed issue.

The objective of the animal evaluation system is to provide the industry with the tools to choose the most appropriate animals for production and breeding use. The definition of "most appropriate" requires definition. The breeding objective proposed for the Animal Evaluation Review is to "**maximise nett farm profit per hectare**".

To satisfy the objective one must:

- Identify which measurable traits are of importance in satisfying the breeding objective.
- Identify the relative importance of those traits in satisfying the breeding objective.
- Combine the trait information according to their relative importance to produce tools for the dairy industry whereby it may satisfy the breeding objective.
- Implement the system in such a way that the new tools achieve a satisfactory level of acceptance within the industry.

There is potential for the latter two conditions to derail the Review objectives. In particular the potential for breed groups to either feel disadvantaged or to use a perceived advantage to their own ends by reinforcing that advantage publicly.

2. Farm Model

Since the breeding objective is stated "per hectare" the relative weight given to each trait value must be expressed in terms of its value to nett farm profit per hectare. The method proposed by the Review team to derive the trait value to nett farm profit per hectare is known as the **Farm Model.** This is a mathematical model in which the impact of one unit of trait value is determined over a 20 year time horizon. The Model tracks the various pathways for say, 1 unit of protein superiority, genetically within the national herd via the various genetic pathways and produces a 20 year cashflow. It then compares that cashflow with the cashflow without that 1 unit of protein superiority. The difference between the nett present values of the two cashflows are annualised to produce a weight or relative importance of that trait unit.

The Model assumes a feed supply and then matches stocking rate energy requirement to feed supply using cows from the base group (1985 born animals) for which averages such as milkfat, protein, and milk volumes/cow/year are known. Also liveweights at various stages of life, survival rates and replacement rates are known from industry data. It uses other industry data such as milk volume for each age group and liveweight profile for the herd to complete the physical side of the Model.

The economic side of the Model assumes current values for milkfat and protein a cost per litre of milk, value per kg for cull cows, bull calves and bobby calves, and variable costs per cow, per hectare and fixed overheads.

The object is to set up a comprehensive mathematical structure of an operating farm so as to express a total nett farm profit per hectare.

Refer to (Harris BL LIC 1994)[iii] for a more complete view.

3. Farm Model Input Variables

Debate will occur as to input variable importance to the Farm Model. Is the value of labour assessed correctly? Is it apportioned between the costs per cow and costs per hectare properly? Does the replacement rate accurately reflect practice within the industry? Is the assumed amount of grass grown realistic? And so forth. That debate must be allowed to happen. Without debate farmers and others will assume that issues are being hidden.

One variable which is already attracting debate is the long term **price ratio** of milkfat/protein. Clearly this is the major avenue whereby future market returns are reflected in the indexes to be used by farmers and providers of genetics to farmers. It is particularly important that product pricing is brought into the Farm Model in a way that most accurately reflects present reality and future trends.

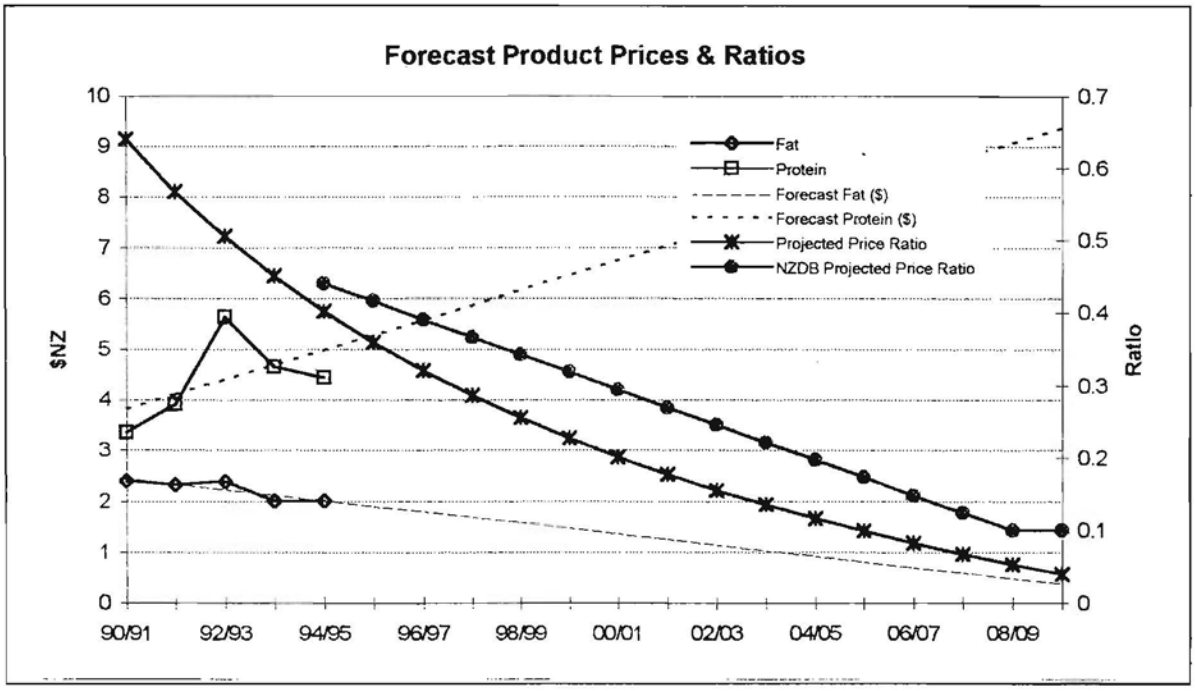
Of the assumptions which the Farm Model makes, most affect the output weights for Milkfat and Protein equally or nearly so. The exceptions are the starter values for Milkfat, Protein and Milk Volume, and the long-term price ratio for Milkfat.

The starter values for Milkfat, Protein and Milk Volume are fixed by the market and while subject to debate cannot be altered. However the long-term price ratio is an easy target for dispute at the present time since it appears to be based on little or no product orientated research.

4. Milkfat/Protein Price Ratio

The New Zealand Dairy Board provides an analysis of the past season's payments expressed in $ per kg of milkfat and protein. The previous season's actual figures are only used as a starting value for the Farm Model. The value of protein is assumed to be constant over the 20 year time horizon while the value of milkfat is assumed to drop to 10% of the protein value over 15

Figure 4-1 Forecast Product Prices & Ratios



years and stay constant thereafter. This is a projection which is provided to Livestock Improvement by the New Zealand Dairy Board. The same forecast has been in place for five years. The ratio sat about 0.66 in 1989 and has declined over the years to be presently at 0.44. Some contend that the forecast ratio figure of 0.1 is unrealistically low. Figure 4-1 illustrates the situation.

However if a linear forecast is seen as a reasonable way of projecting forward in time with the data we have the inevitable conclusion is that the 0.1 price ratio is possible over a 15 year time span.

It is also important to note that cashflows arising from low forecast milkfat values are well out in time. These cashflows are discounted by the nett present value analysis and therefore count for less than the cashflows which are closer to the present.

Without better data one must conclude that the current forecast is adequate. There is however a definite need for better market return data for all milk components

The price ratio is an important input to the Farm Model since the ratio will have a profound effect on the relative ranking of the dairy breeds in New Zealand.

Figure 4-2 Component Value Weights

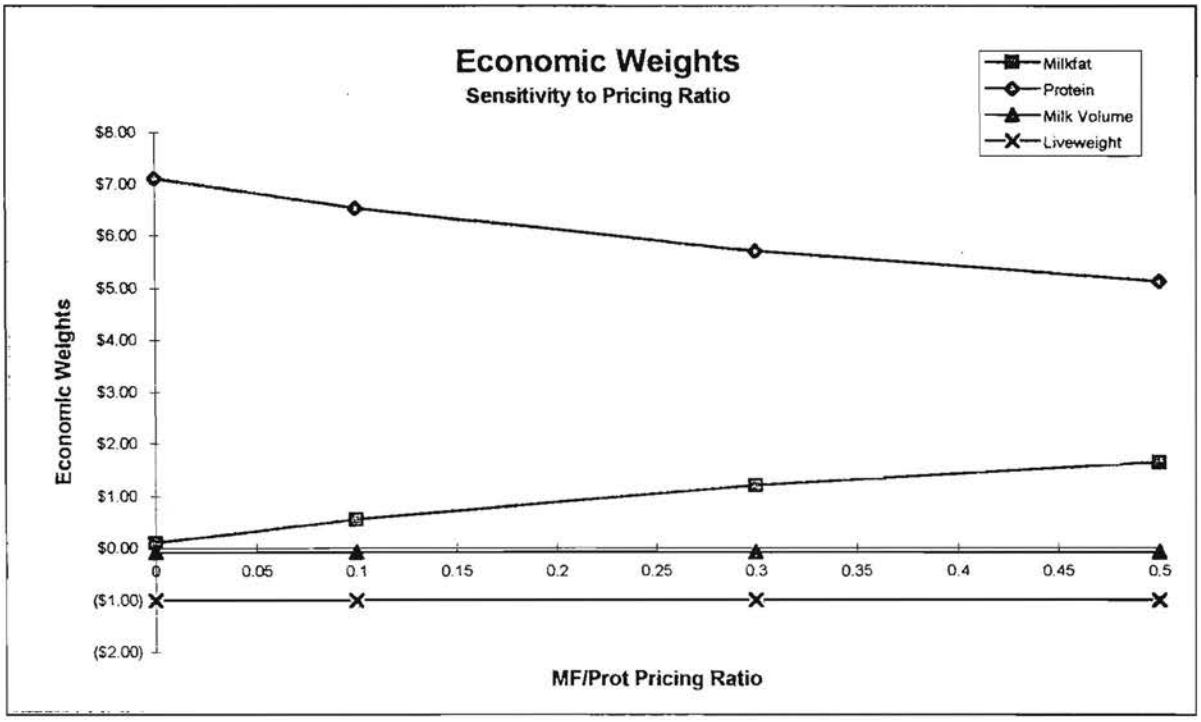


Figure 4-2 shows the effect on the component weights with changes to the Price Ratio. These changes then give rise to changes in the way the various breeds are evaluated under the proposed system.

The Dairy Board is undertaking a review of product returns which will put more certainty into this forecast. Influences such as resolution of the GATT round must be taken into account on a product by product basis.

5. Output Indexes

The Animal Model will output Breeding and Production Values (BV's and PV's) for each trait. These will indicate differences relative to a base year of 1985 born cows.

For example the following evaluations could arise for a cow's milk yield:

Milk BV =	+250 ltr indicates that the cow, on average, will be able to transmit an additional 125 ltr of milk to her offspring above that supplied by an average base cow (1985)
Milk PV =	+250 ltr predicts that the cow, on average, will produce 250 ltr of milk above an average base cow (1985) in each lactation over her whole lifetime.

The Farm Model will produce economic weights which will allow the BV's (PV's) to be combined to form an economic index.

The Economic Index is an estimate of an animal's contribution to nett farm profit per hectare. They are a means of combining all of an animal's trait BV's (PV's) into a single figure which can then be used to assess the animal's overall worth relative to other animals.

The Economic Index is a weighted sum of the form:

Economic Index =	$Milkfat x Milkfat BV (PV)	+
	$Protein x Protein BV (PV)	+
	$Milk x Milk BV (PV)	+
	$Liveweight x Liveweight BV (PV)	+
	$Survival x Survival BV (PV)	

where:

BV (PV) = an animal's Breeding or Production Value for Milkfat, Protein, Milk Volume, Liveweight and Survival traits respectively

$Milkfat, $Protein, $Milk, $Liveweight and $Survival = the dollar ($) value of 1 BV or PV unit for Milkfat, Protein, Milk Volume, Liveweight and Survival in terms of nett farm profit per hectare.

The economic index for genetics is currently known as **Genetic Worth**, and the economic index for production is known as the **Cow Index**

6. Discussion

The following is based on herds involved in the Animal Evaluation Review User Group Trial

Referring to Table 6-1 Breed Group Parameters it is clear that the Jersey, Ayrshire and Friesian-Jersey Cross breed groups in the trial are not representative of their breeds. The Friesian breed group is representative of the national herd. This limitation in the available data has had an effect on the way conclusions can be drawn.

Table 6-1 Breed Group Parameters

	Cows in Trial	*Average Genetic Worth* of Trial Herds*	*Average Cow Index* of Trial Herds*	*Average Genetic Worth* National Herd*	*Average Cow Index* National Herd*
Holstein Friesian	14112	42.370	1014.10	42	986
Jersey	8082	42.191	950.60	25	906
Ayrshire	629	42.360	989.20	26	931
Friesian-Jersey Cross	4952	47.467	1061.85	37	1009
					*Price Ratio 0.1

The trial herds, being Livestock Improvement Regional Directors' and some Breed Society members' herds, are characterised by:

- Good animal recording over a long period.
- Attention to culling, breeding and replacement retention by appropriate indexes

Why the Jersey breed as a whole should lag behind those in the trial probably has more to do with those not in the trial than it has to do with those in it. There appear to have been opportunities available to the Jersey breed not taken up by many of those herds not represented in the trial.

The data given in Table 6-1 and extended by Price Ratio is presented graphically in Figure 6-1. In order to place the trial herd data in context with the national herd I have made the assumption that the slope of a regression line through the points for each breed in Figure 6-2 will be the same for the national herd. Given that the conclusions being drawn from the data are purely qualitative, I feel justified in making such an assumption.

Figure 6-1 Breed Genetic Worth - Trial Herds

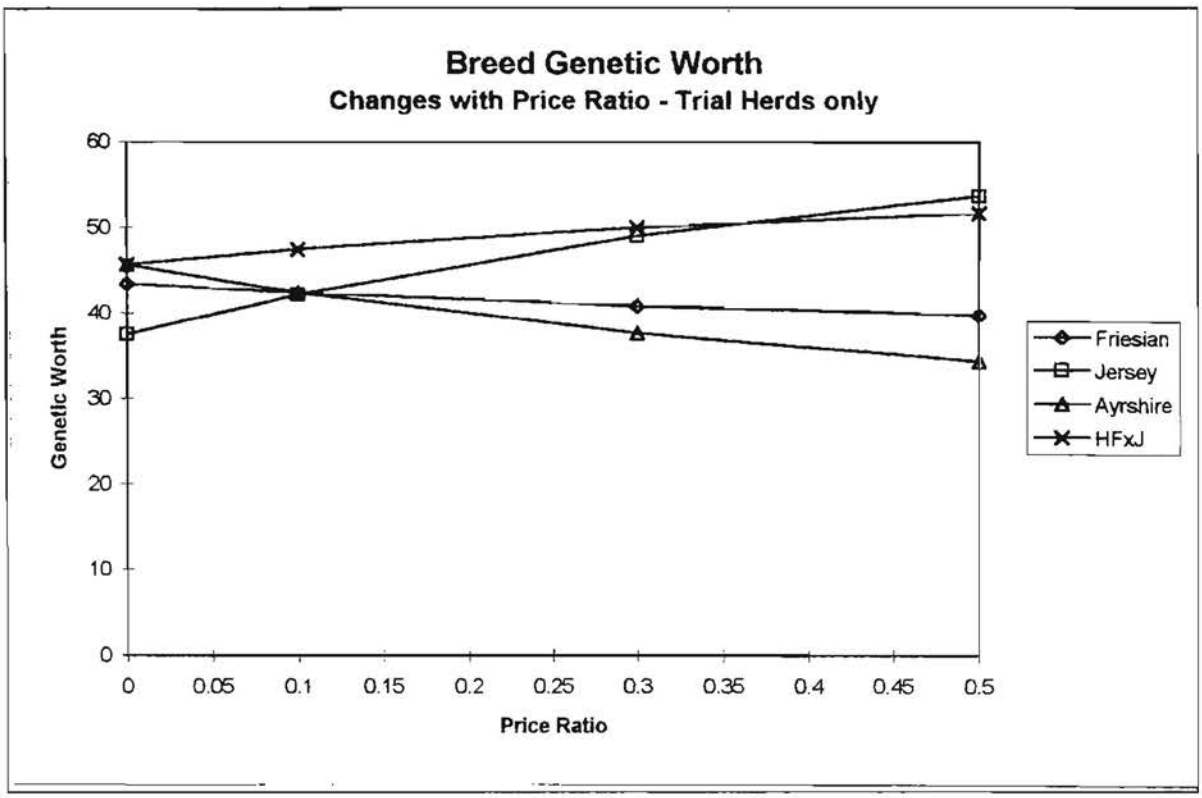
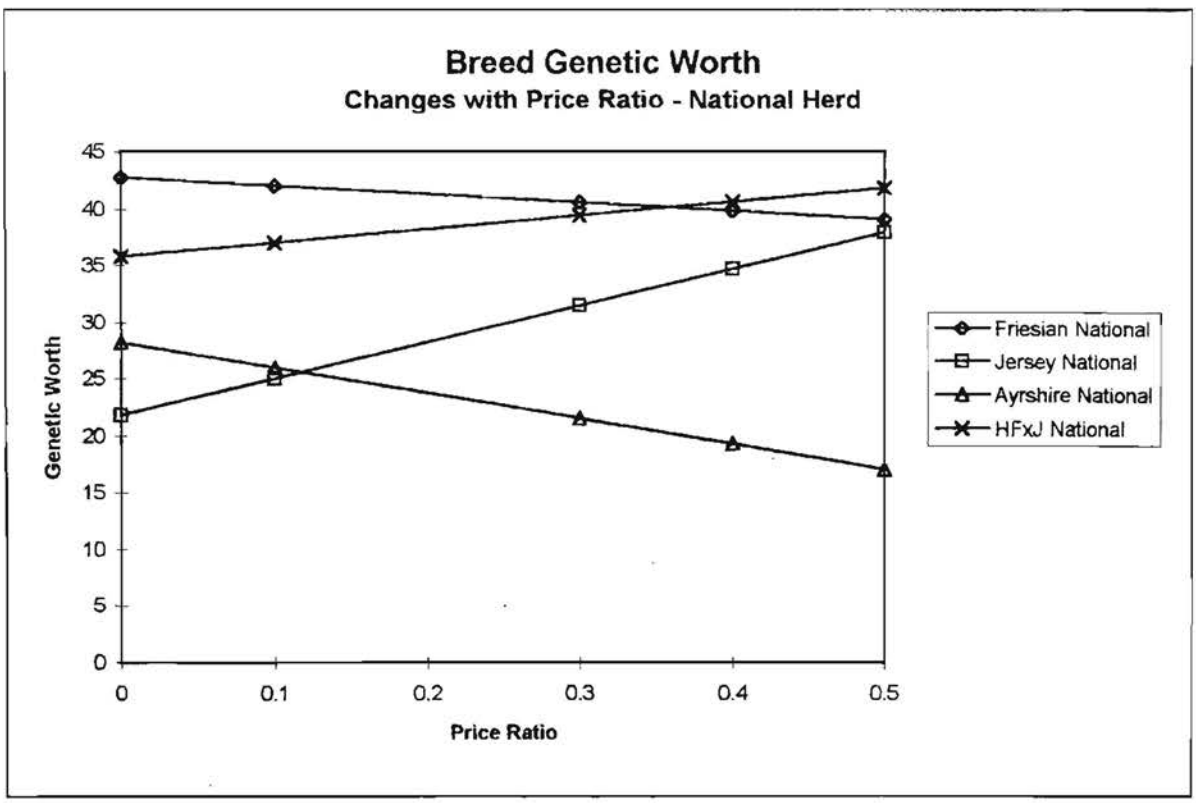


Figure 6-2 Breed Genetic Worth - National Herd



The slope of the lines for each breed in Figure 6-1are certainly related to basic milk composition characteristics for each breed. To suppose that the trial herds have different milk characteristics from the breed as a whole seems very unlikely.

Figure 6-2 shows adjusted lines where the breed value for Price Ratio = 0.1 conforms with the national average for each breed as given in Table 6-1.

Clearly both Jersey and Ayrshire breeds are at a disadvantage.

7. Breed Consequences

It is an objective of the Animal Evaluation Review to evaluate dairy cattle across breeds. It is implied therefore, that Index values are independent of breed. Most dairy farmers have treated the present set if indexes as independent of breed. That has not been the case.

There is an expectation that at least the three major breeds, Holstein-Friesian, Jersey and Friesian-Jersey cross are of similar genetic merit and should carry similar figures for genetic worth. That expectation is unrealistic. In fact it is a near certainty that one or other of the breeds will lose out at the implementation of an across-breed evaluation system.

It has become part of the diary industry scene to make comparison between cattle using BI as an indicator of value. That will continue using the new Genetic Worth and Cow Index numbers. It must therefore be presumed that very close scrutiny will be applied to the performance of the new indexes as they apply across the breeds.

Exploiting a Genetic Worth difference may generate an advantage to breed interests. It is not hard to see how the debate over differences between breeds could gather a momentum of its own, independent of Livestock Improvement.

Some breeders may demand to be able to use different assumptions in their own individual Farm Model. In particular the Price Ratio could prove to be a target for individual farm values.

It has been shown[1] that for bulls evaluated under the proposed system that the top group in each breed have equivalent Genetic Worth values. There will therefore be little motivation to change breeds because of the effect of new indexes on potential sires. Cows presently in the national herd have not been selected using the new set of rules and will not rank the same as they do now.

Referring to Figure 6-2 it can be seen that movement of the price ratio affects the major breeds differently. An increasing price ratio has the effect of increasing the Genetic Worth of the Jersey and Friesian-Jersey Cross breeds, but decreases the Genetic Worth of the Friesian and Ayrshire breeds.

There is no point where the major breeds rate similarly.

We appear to be at a crossroads for breed composition within the national dairy herd.

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[1]Harris BL, Johnson DL, Clark JM, Garrick DJ (1994) New systems for identifying dairy cattle of high genetic and economic merit. Ruakura Farmers Conference.

[1] see Table 12 - Animal Evaluation Review - Herd Reports LIC 1994 - distributed to farmers involved in the Animal Evaluation Review Users Trial.

It is difficult, though, to extrapolate from avreages of the national herd to individual herds. It would be instructive to look at herds individually and extract herds which have significant numbers of straight bred Holsteins-Friesians and Jerseys represented. Say in excess of 20% of both breeds. The Genetic Worth profiles for the breeds in each herd could then be analysed. The actual reaction from those individual farmers could then be gauged. If similar breeding and recording schemes have been in place for each breed in mixed herds then cows in those herds may well be comparable for Genetic Worth.

The consequences for the Jersey breed may be somwhat negative but it must be borne in mind that:

- Sires for Jerseys selected under the new rules are similar in Genetic Worth to sires of other breeds.
- Allowance for heterosis must be made by the breeder when forecasting the productive worth of a crossbred animal from the Genetic Worth values of the parents. The Friesian-Jersey Cross is seen as the most productive breed of all major players. To maintain the crossbred cow will require a strong presence for the Jersey in the New Zealand national herd.

It is obvious that:

- It is encumbent on Livestock Imporovement to get the structure of the new Animal Evaluation system 100% correct since the likely effects on milk flows and milk composition are very considerable.
- Likewise the onus on the New Zealand Dairy Board is considerable. The forecasts for Price Ratio will have a profound effect on the outcome for dairy cattlebreeds in New Zealand.

However it must be said that the Animal Evaluation Review is all about choosing the right animal for New Zealand dairying. If the breeds are as divergent as they now appear, we need, as an industry, the Review more than ever. The economic consequences for the Review could be greater than previously thought.

8. Implementation

Any system which while true in theory is not widely accepted in practice, is limited at the outset. It is crucial to bring the eventual user base along with developments as they occur. This is possible with large portions of the proposed evaluation system but nearly impossible in others. The Animal Model portion of the new system must be treated as a "black box" by the user base. Users must trust the outputs from the "black box" as reliable, accurate and real. It is critical that users buy in to the proposed system at least as far as output from the Animal Model. That appears to have been the case so far.

How that acceptance can be brought right through to the implementation of the final Indexes will be a challenge. That challenge can best be overcome by acting in pace with the users of output from the Animal Evaluation system. Too slow and the industry will get frustrated: too fast and they will be left behind without necessary understanding of and support for the new system.

An important area of understanding which may be hard to get across to users will be the effect of heterosis. The Genetic Worth index will understate productive worth for cross-bred cattle. Cow Index over Genetic Worth graphs in the graphical appendix illustrate this point for Friesian-Jersey crosses. That the cross-bred cow is the most productive must be understood by a good fraction of the industry.[2]

As was pointed out in the last section - if the breeds are as distinct in economic performance as they are beginning to appear then the industry needs the new Animal Evaluation system in place for the sake of its own economic efficiency.

[2] see Table 12 - Animal Evaluation Review - Herd Reports LIC 1994 - distributed to farmers involved in the Animal Evaluation Review Users Trial.

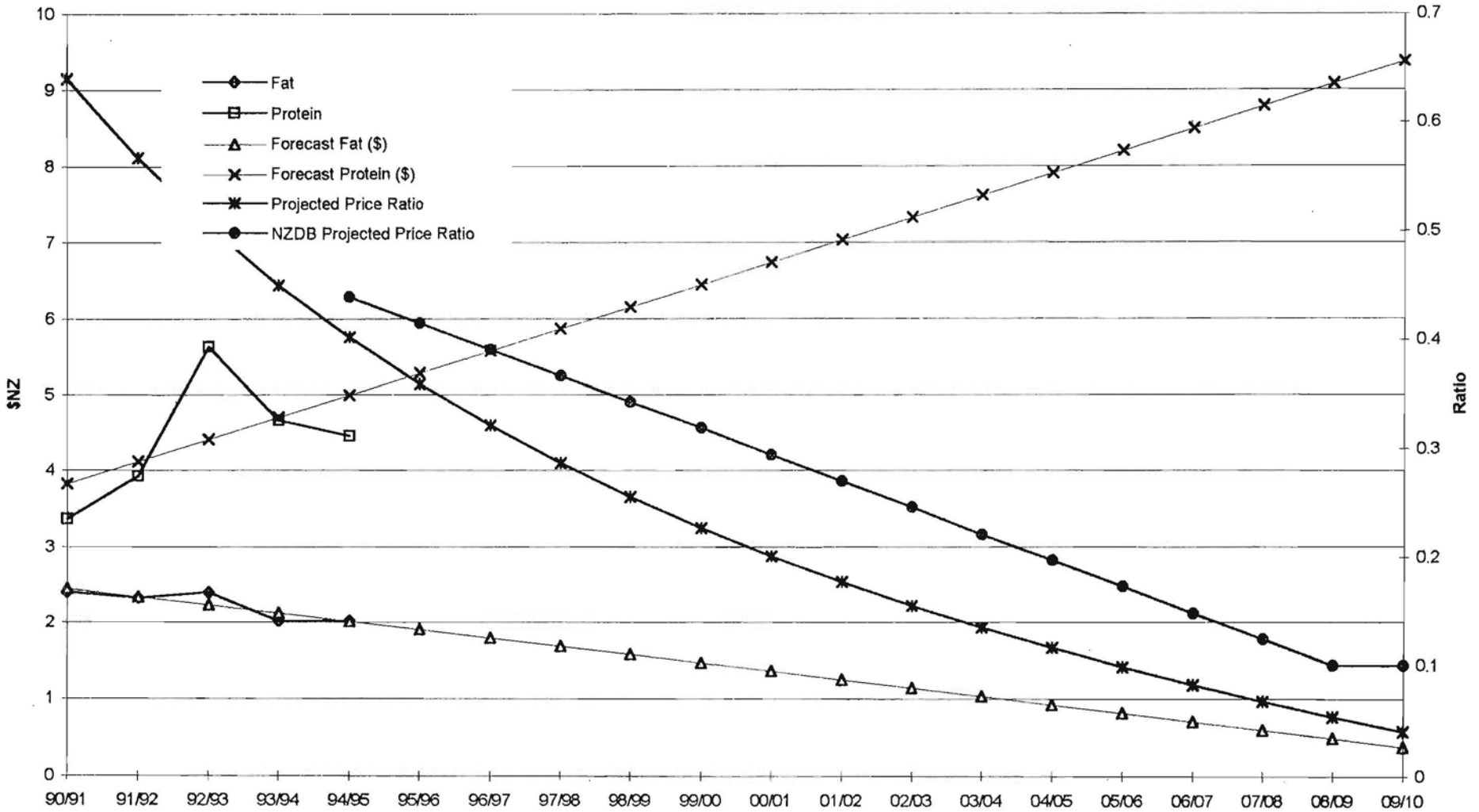
9. Conclusions

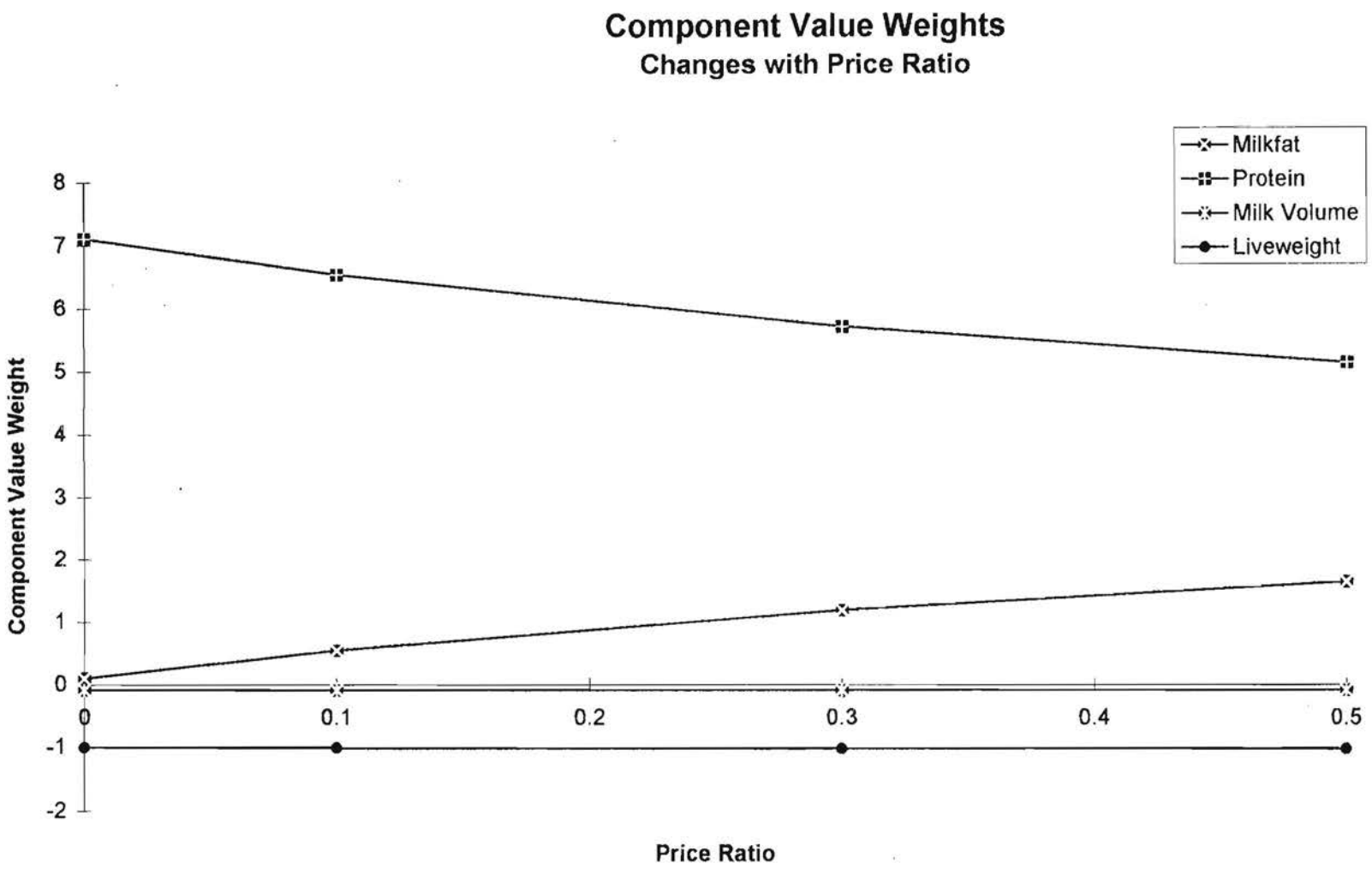
- The Animal Evaluation Review is set to alter the dairy industry's view of the genetic worth of Jersey and Ayrshire cows within the national herd.
- There are profound flow-on effects for milk processors and marketers if a changed view of breed leads to a structural change in the breed of the national herd.
- While both groups will have been fully aware of their responsibilities to accuracy, both Livestock Improvement and New Zealand Dairy Board staff will soon be aware of how sensitive the breed makeup of the national herd could be to market sourced information.
- The challenge for successful implementation is increased by what will be seen as a threat to breeder interests.
- That challenge can best be met by continuing to draw users along with developments within the Review. Too fast and users will be left behind, too slow and Livestock Improvement appears sluggish.

10. Graphical Appendix

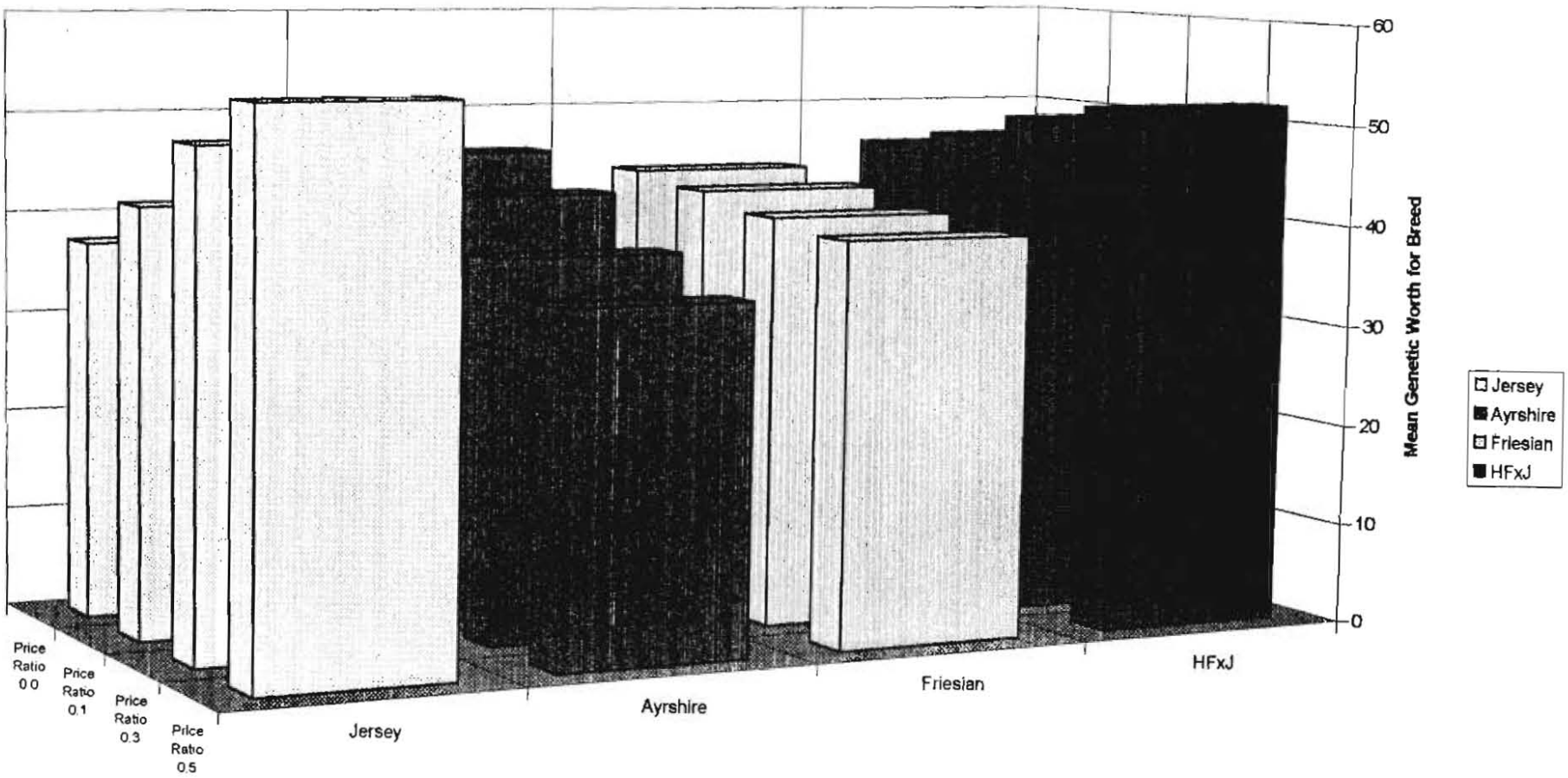
The following pages contain graphical output which is additional to the central theme of the paper. They are provided for those interested in population shapes by breed and index to index correlations.

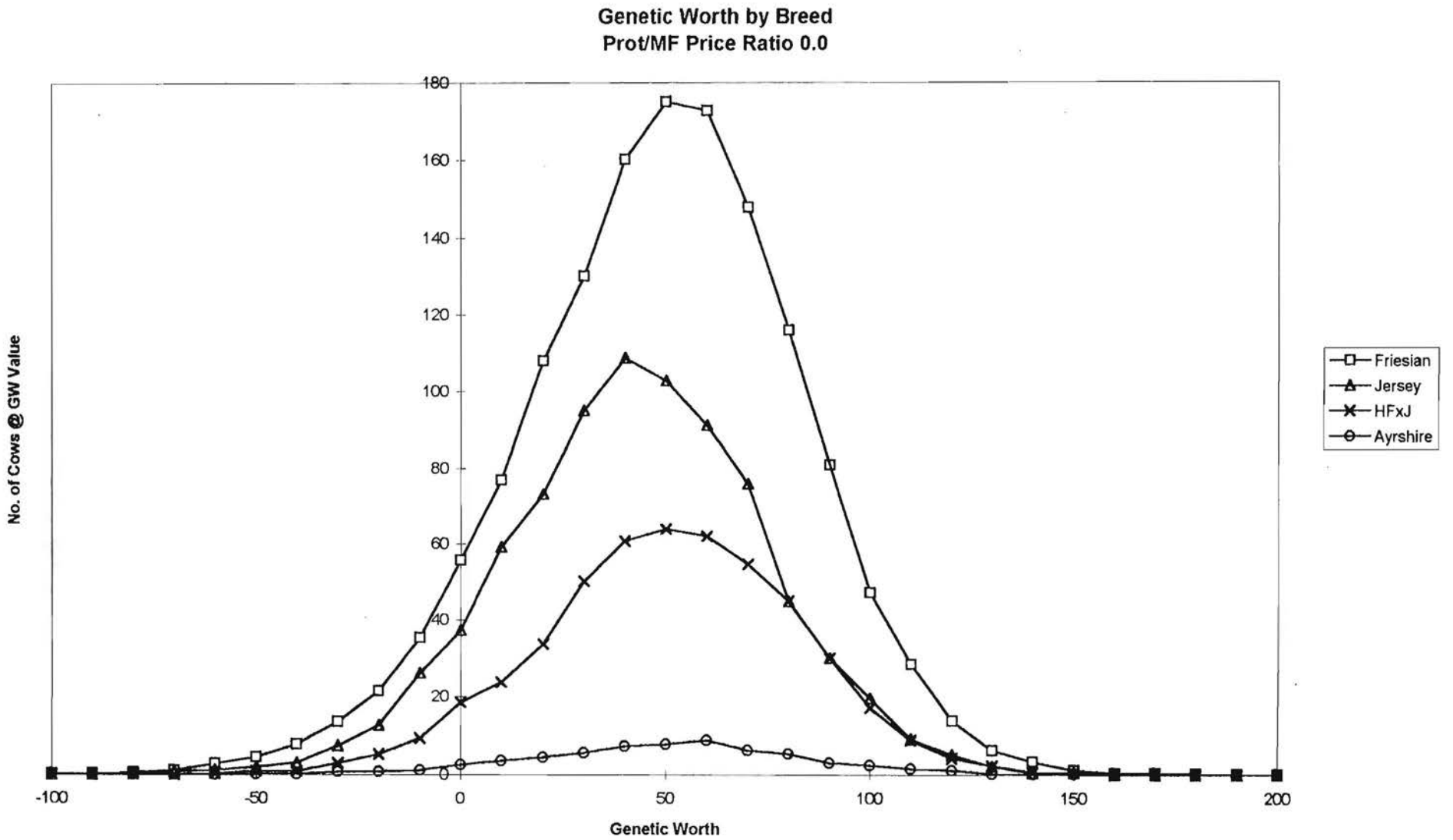
Forecast Product Prices & Ratios

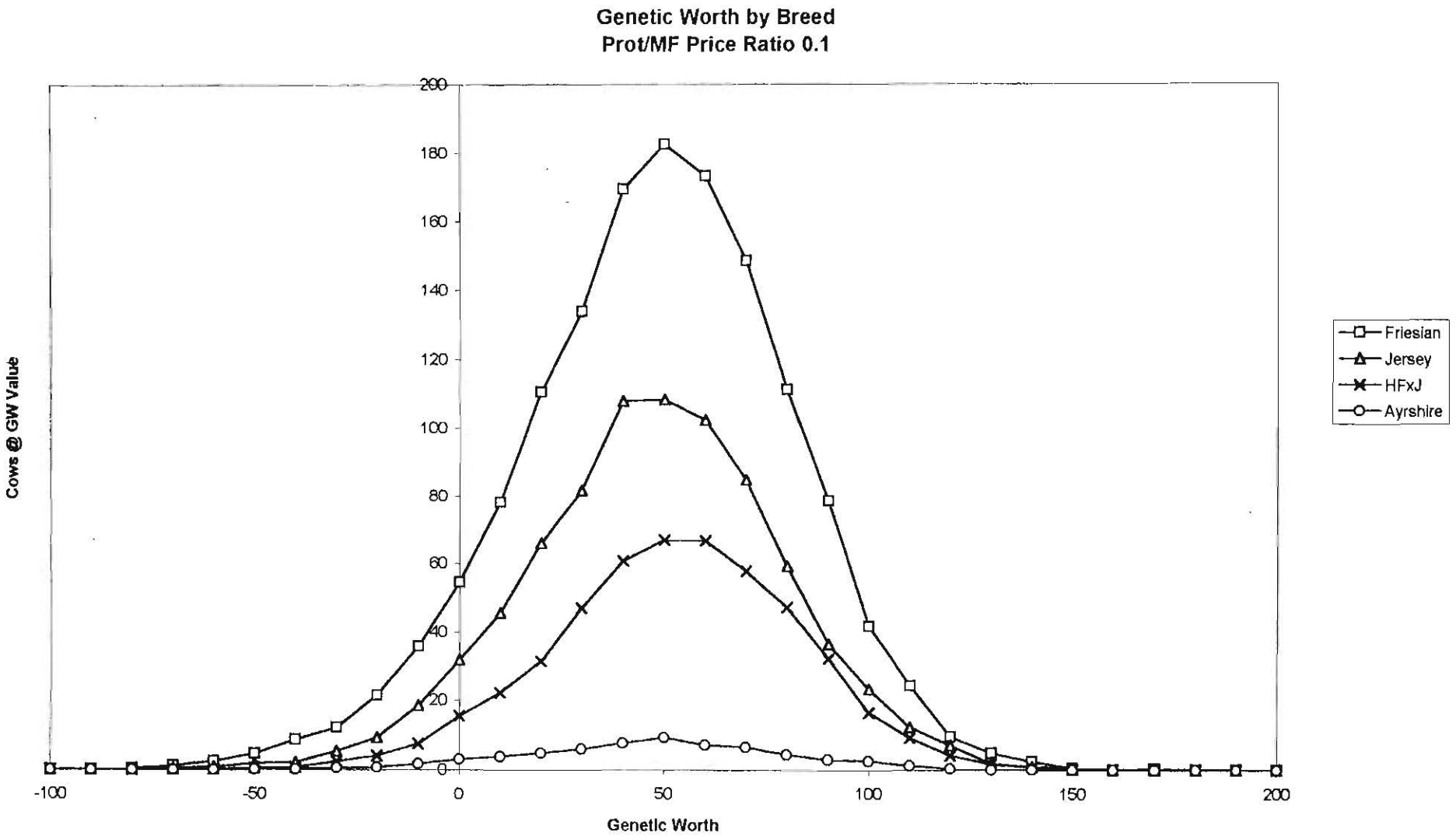


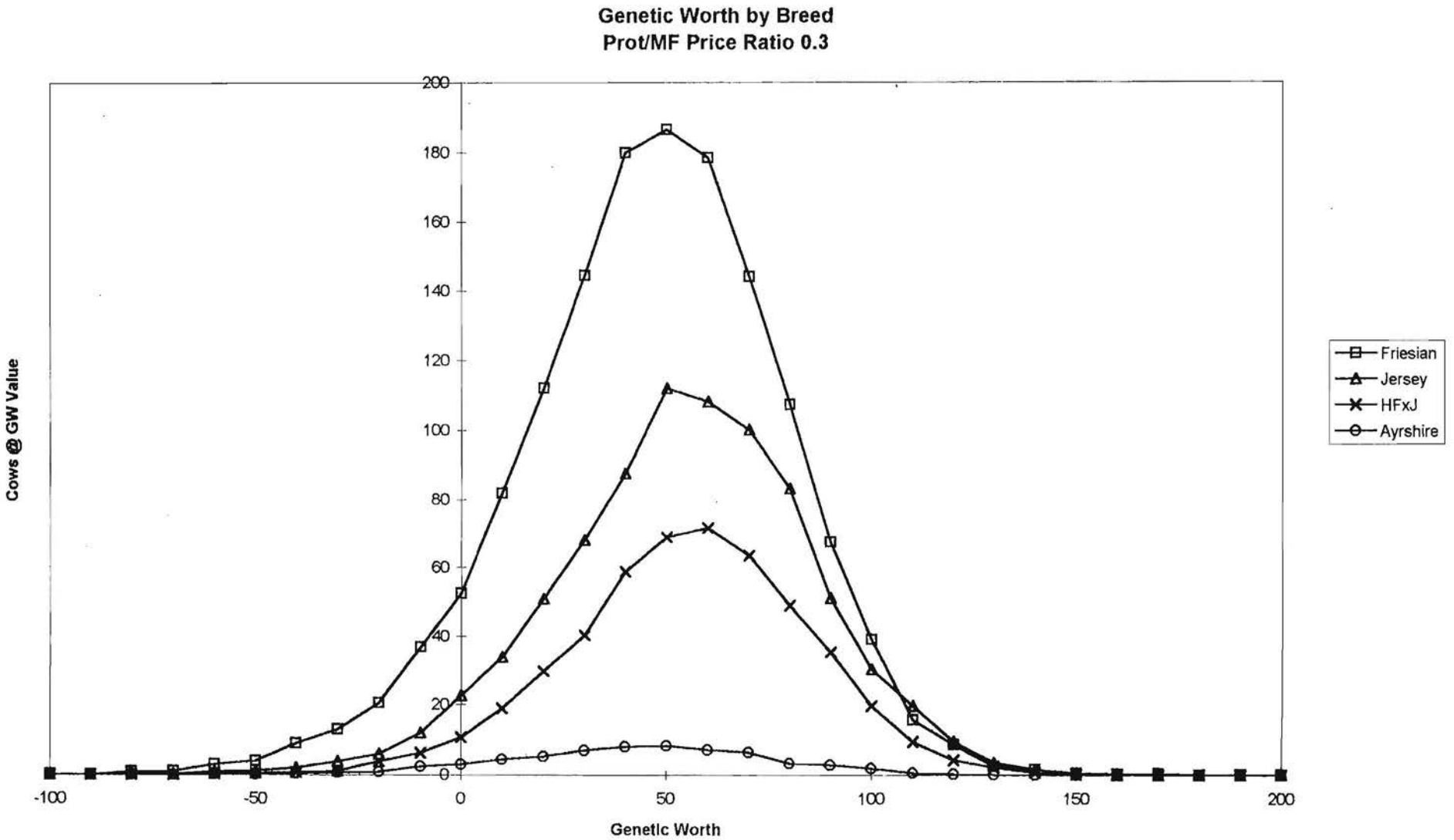

Component Value Weights
Changes with Price Ratio
Milkfat
Protein
Milk Volume
Liveweight
Component Value Weight
8
7
6
5
4
3
2
1
0
-1
-2
0
0.1
0.2
0.3
0.4
0.5
Price Ratio

Genetic Worth Means at Differing Price Ratios




Genetic Worth by Breed
Prot/MF Price Ratio 0.0
No. of Cows @ GW Value
180
160
140
120
100
80
60
40
20
0
-100
-50
0
50
100
150
200
Genetic Worth
Friesian
Jersey
HFxJ
Ayrshire


Genetic Worth by Breed
Prot/MF Price Ratio 0.1
Cows @ GW Value
200
180
160
140
120
100
80
60
40
20
0
-100
-50
0
50
100
150
200
Genetic Worth
Friesian
Jersey
HFxJ
Ayrshire


Genetic Worth by Breed
Prot/MF Price Ratio 0.3
Cows @ GW Value
200
180
160
140
120
100
80
60
40
20
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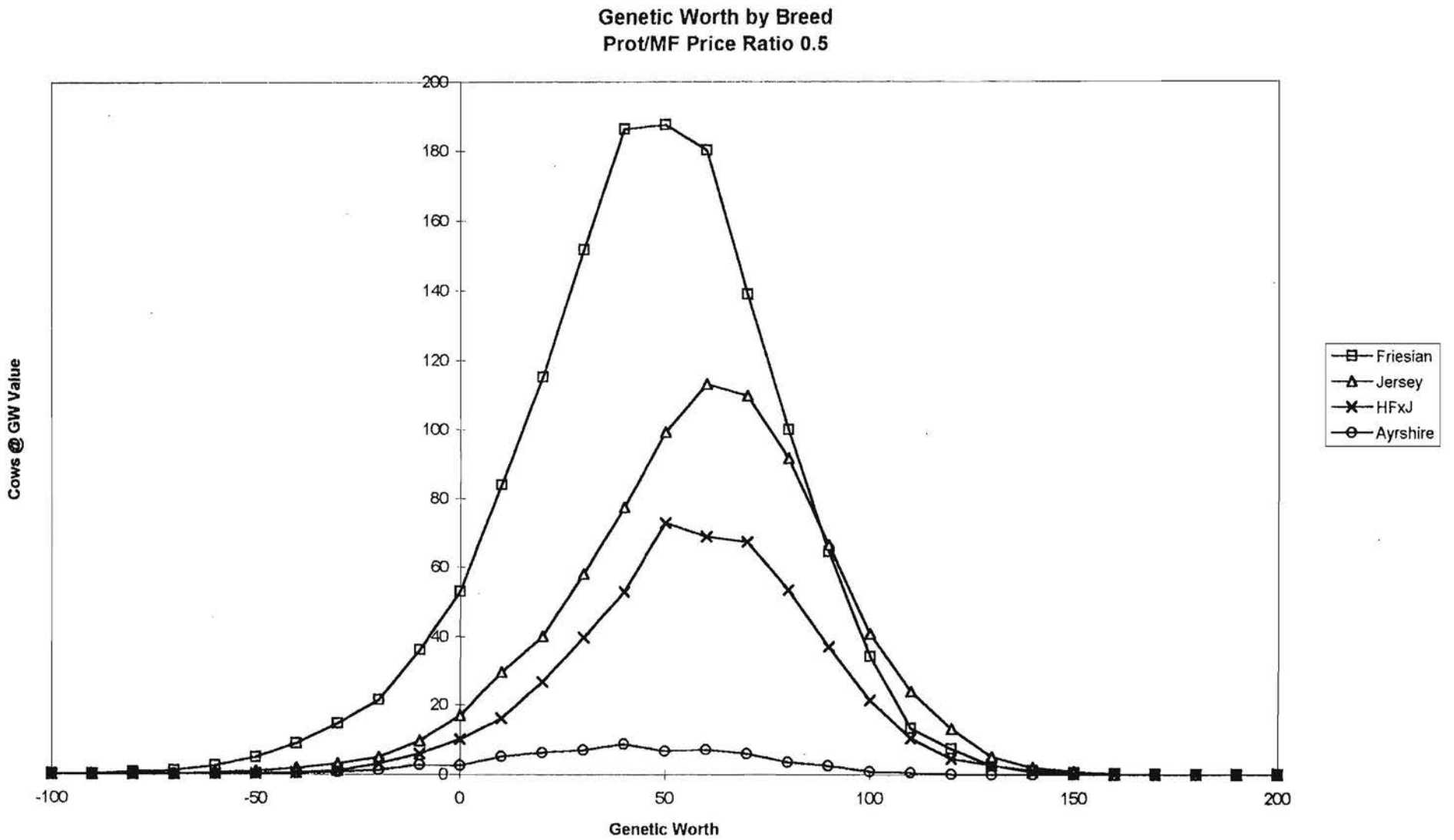
50
100
150
200
Genetic Worth
Friesian
Jersey
HFxJ
Ayrshire


Genetic Worth by Breed
Prot/MF Price Ratio 0.5
Cows @ GW Value
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180
160
140
120
100
80
60
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20
0
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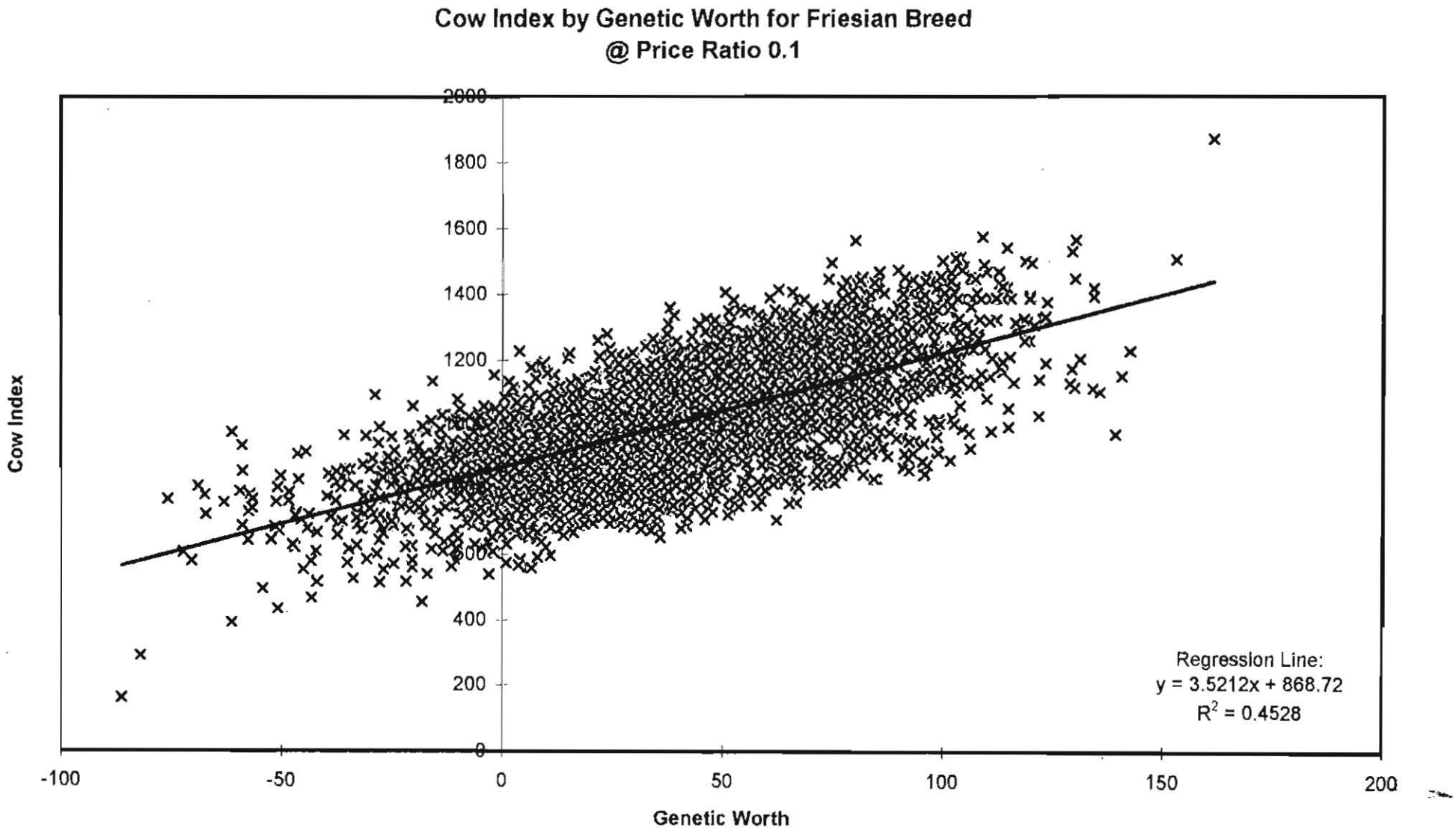
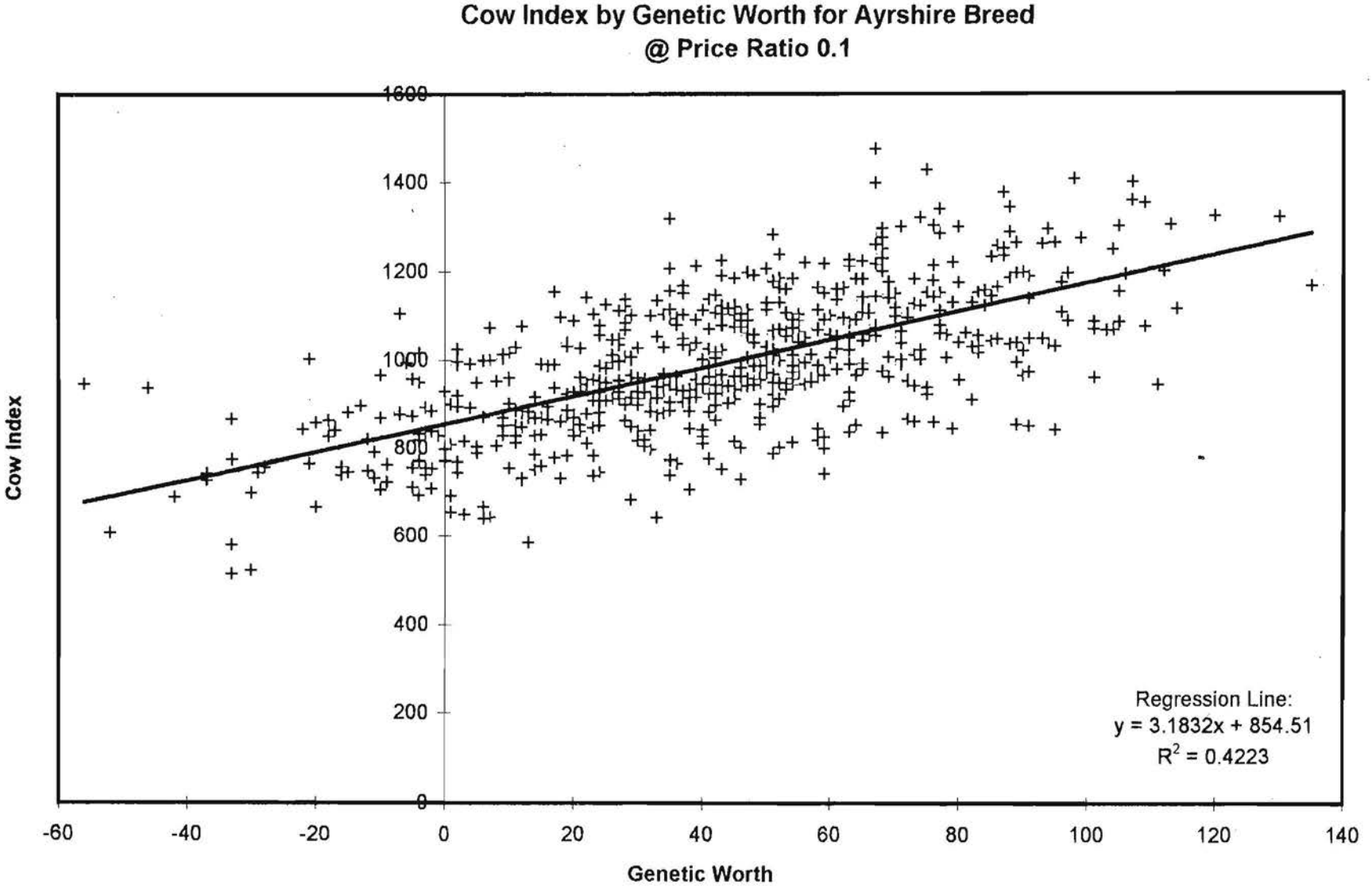
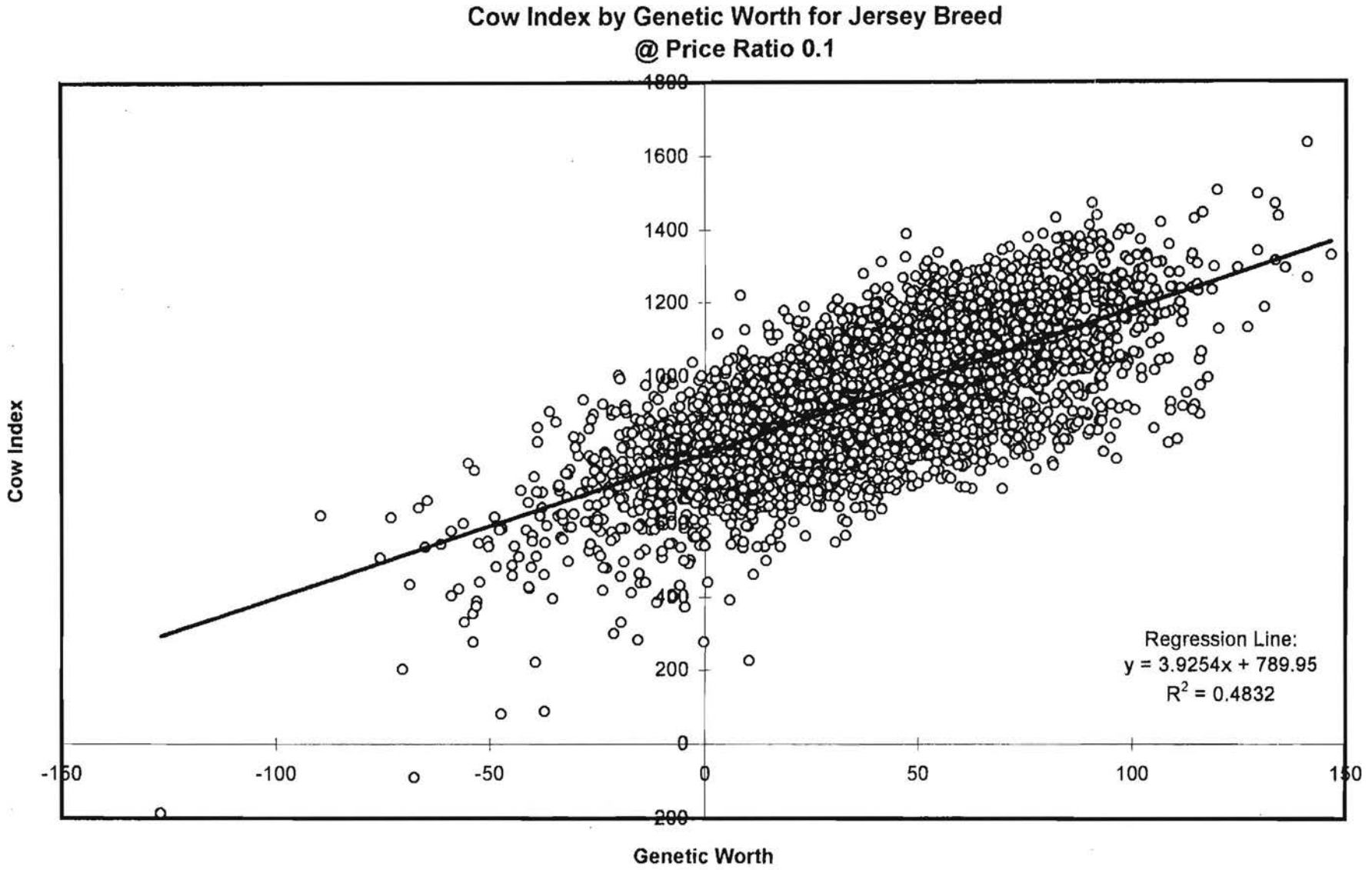
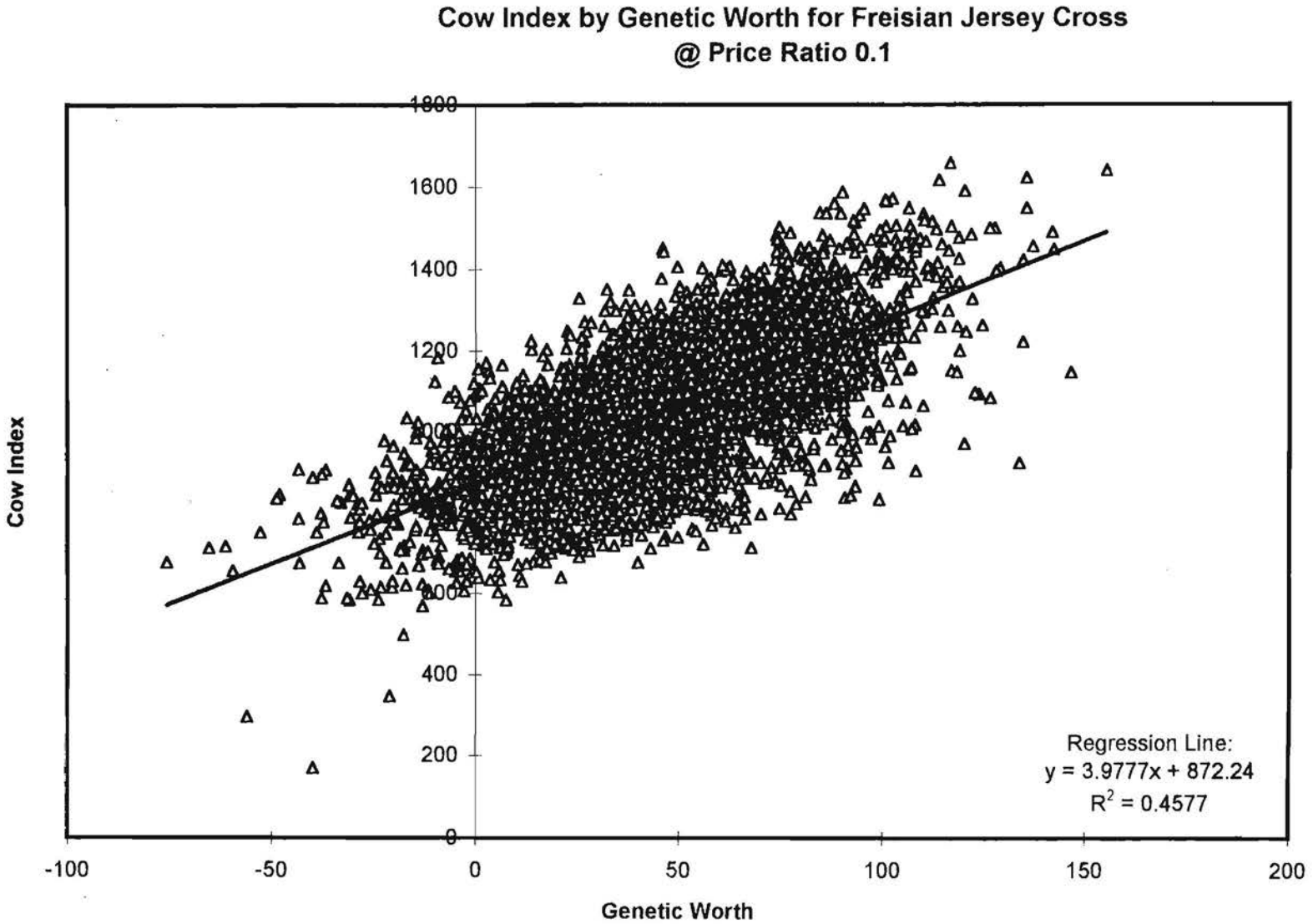
150
200
Genetic Worth
Friesian
Jersey
HFxJ
Ayrshire


Cow Index by Genetic Worth for Friesian Breed
@ Price Ratio 0.1
Cow Index
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-100
-50
0
50
100
150
200
Genetic Worth
Regression Line:
y = 3.5212x + 868.72
R2 = 0.4528


Cow Index by Genetic Worth for Ayrshire Breed
@ Price Ratio 0.1
Cow Index
1600
1400
1200
1000
800
600
400
200
0
-60
-40
-20
0
20
40
60
80
100
120
140
Genetic Worth
Regression Line:
y = 3.1832x + 854.51
R2 = 0.4223


Cow Index by Genetic Worth for Jersey Breed
@ Price Ratio 0.1
Cow Index
Genetic Worth
1800
1600
1400
1200
1000
800
600
400
200
0
-200
-150
-100
-50
0
50
100
150
Regression Line:
y = 3.9254x + 789.95
R2 = 0.4832


Cow Index by Genetic Worth for Freisian Jersey Cross
@ Price Ratio 0.1
Cow Index
Genetic Worth
1800
1600
1400
1200
400
200
0
-100
-50
0
50
100
150
200
Regression Line:
y = 3.9777x + 872.24
R2 = 0.4577

11. References

[i] Harris BL, Johnson DL, Clark JM, Garrick DJ (1994) New systems for identifying dairy cattle of high genetic and economic merit. Ruakura Farmers Conference

[ii] Harris BL (1994) Breeding and selecting dairy cattle for the New Zealand Dairy Industry - Livestock Improvement

[iii] Harris BL (1994) Breeding and selecting dairy cattle for the New Zealand Dairy Industry - Livestock Improvement