Farmers Should Continue to Farm Holstein Friesian Cows

[New Zealand Milk Pricing Models have to change!]

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Executive summary

Throughout this report, comparisons will be made between High Milksolids milk [typified by average Jersey composition] and Low Milksolids milk [typified by average Holstein Friesian composition].

New Zealand basic milk payment model is 25 years old and no longer accurately translates milk value from products sold to the farm gate milk price, it never did.

The farm gate milk price carries the greatest economic weight by the Animal Evaluation Unit in when determining the most profitable animals to breed from. The current A + B – C payment model significantly distorts true milk values at the farm gate.

New Zealand is rapidly breeding away from the traditional Holstein Friesian animal. By 2012 the Holstein Friesian/Jersey cross bred animal will dominate New Zealand's national herd.

There is a near perfect substitution relationship between Fat and Lactose. Increasing the Fat content of Milksolids decreases the energy cost of Milksolids and decreases product yields more. Reducing the Fat content of Milksolids increases Protein and Lactose content, lowers the total energy requirement for milk and increases product yields on a Milksolids basis. The yield increases far out weight increased manufacturing costs associated with more Lactose. This is not apparent in the current payment model.

The selection for apparent favourable [or populous] gene alleles is driving Lactose out of our milks. Yet manufacturers are moving toward producing more milk powder where Lactose has a high economic value. The cost of volume is less than the cost to "buy in" or "internally recover" Lactose.

The bundling of Lactose value into the Protein payment causes a subtle, but significant, shift in milk value from Low Milksolids / High Lactose milks to High Milksolids / Low Lactose milks. For every 10c of Lactose value unbundled from the Protein payment, 0.8c / kg MS will be added to the difference between High and Low Milksolids milks At $1.57 / kg Lactose, Synlait's proposed price, they will value Holstein Friesian milk 12c / kg MS higher than Jersey milks when compared to Fonterra payments.

The Animal Evaluation Unit uses the Value Component Ratio [Fonterra's term for Fat value / Protein value] in determining the future value of milk. In a milk powders environment 65% of Protein value comes from Lactose and minerals and that is ignored by the AEU who dogmatically insist that they must evaluate to the actual farm gate price, not for overall industry efficiencies.

Over the study period [1996-2008] the average VCR for New Zealand has been 0.412. The true VCR, especially when making Milk powders, is nearer 0.35 indicating a strong payment bias for Fat.

Fat has an energy requirement [56 MJME / kg] which is significantly higher that the energy requirement for Solids Not Fat [30 MJME / kg]. Revenue from Fat [as Butter] is virtually equal to Solids Not Fat [as Skim Milk Powder] implying that Solids Not Fat is 66% more efficient in converting feed energy into milk revenue.

When compared with Whole Milk Powder the average revenue generated by Butter + Skim Milk Powder is 96.6%. There 3.4% revenue penalty through not making Whole Milk Powder. The variation in revenue yield fluctuated markedly throughout the study period suggesting no clear signal for selection for "more Fat" or for "more Solids Not Fat". Regardless of the relative commodity prices, the SNF profit per unit feed is higher than for Fat.

Casein and Cheese for the most part yielded less revenue than if that milk had been applied to milk powders. It is only when Whey products are included as part of the revenue stream does a slight advantage emerge for these products. Whey related products are primarily Lactose based.

The implementation of the A + B – C milk payment model can influence milk value at the farm gate. Fonterra implementation of the formula is consistently paying a 1-2c / kg MS lower difference between Low MS% vs. High MS% milk than does Westland or Tatua. Fonterra uses average Milksolids value when redistributing Volume costs. Westland and Tatua use the separate Fat and Protein values when redistributing Volume costs

The manufacturing revenue models developed for this report reflects work carried out by Massey University researcher N Lopez-Villalobos and consistently shows that current model is under valuing Low MS% / High Protein & Lactose milks by 2-5% relative to High MS% / Low Protein & Lactose milks.

The initial modelling used Fonterra's costs for Volume charges and $1,000 / t Lactose. At these values the model estimates that Fonterra is under rewarding Low Milksolids milks by 1-4 %.

Using Synlait's volume charges and $1,500 / t Lactose values the model's outcomes are within 1 % of Synlait's proposed payout. When Lactose is valued at Milk Powder prices, when making milk powders, lift the difference to over 8%

The models support the premise that the current milk payment models based on Fat, Protein and Volume, under reward Low Milksolids / High Protein milks.

New Zealand should move to a three component, Fat, Protein and Lactose. This payment model would ensure that the right milk value signal is being delivered to the farm gate. With the right price signal, our animal breeders will be selecting the most profitable animal for the Industry as a whole, rather than trying to optimise breeding to a flawed farm gate price.

The future of the New Zealand dairy industry is centred Milk Powders where Protein and Lactose are the main ingredients. To make Cheese and Casein, without utilising whey is less profitable than Milk powders and Butter. The importance of Lactose in optimising yields cannot be ignored.

Farmer should continue to farm Holstein Friesian animals.

1. Introduction

Dairy farmers take feed and convert that to milk and other farm products which are converted, typically in New Zealand by member co-operatives, into marketable products for sale. The net revenue is distributed back to members through various payment models with the aim of providing clear market signals as to the value of their milk. Correct interpretation of those pricing signals should lead to the development of optimised systems to produce the right raw materials for more products.

Could those signals in the New Zealand be so distorted that we are breeding for a less efficient animal than we could and destroying value?

Today, for most suppliers, the market price is signalled to farmers through a Fat + Protein – Volume pricing model. It will be shown that this model is deficient in returning the correct pricing signals and is creating inefficiencies on farm and during manufacturing. More closely matching milk supply to finished product will improve on farm efficiency to converting feed to milk and manufacturing efficiencies in turning milk into products.

The Animal Evaluation Unit has strived to optimize on farm performance matching animal performance to the milk payment model. With a penalty for Volume and no payment for Lactose, these attribute are being bred against. The manufacturer is striving to optimising costs by demanding a low volume and high Milksolids milk and signalling that in the payment model. While both parties are trying to maximise efficiencies, are they matched? The payment models are for manufacturers to maximising milk value, not maximising the "whole system" value.

Analysis of the payment model shows an economic bias to High Milksolids/ High Fat milks. The subtle shift of Lactose value through the Protein payment offers a generous transfer of wealth from the traditional Holstein Friesian animal to the Jersey and Cross Bred animal.

Since 1998 there has been an upward change in the national trend for Milksolids concentration which previously was trending lower. The genetic makeup of the national herd is migrating quickly from the Holstein Friesian type cow to a Holstein/Jersey crossbreed cow colloquially coined "Kiwicross™" by LIC.

The use of Breeding Worth [BW] animal index suggests that use of high BW bulls will lead to breeding the most profitable animal to farm. Jersey and Kiwicross™ rank highly in BW sires. Jersey cows rank highest amongst dams.

Potential heterosis [hybrid vigour], through cross breeding, is another driver that is encouraging cross breeding between Holstein and Jersey animals. Maximum heterosis generally occurs at the first cross. Subsequent crosses have little additional benefit and generally have to be to a third breed or back to one of the original breeds.

The rate of outbreeding from Holstein is around 1.4% pa and from Jersey is around 0.2% pa with the number of crossbred animals increasing at 1.6% pa. The rate of out breeding is not proportional to the numbers of each parent breed indicating that out breeding from Holstein Friesian is more intense than from Jersey.

New Zealand dairying is experiencing increasing staff shortages. The adoption of Once a Day [OAD] milking partially addresses this. The low milk volume characteristics of the Jersey cow are better suited to OAD milking when compared to Holstein Friesian.

Is a Jersey / Cross breed style cow and higher Milksolids milk the most efficient way to transform feed into the most profitable milk for the dairy industry?

This paper will demonstrate through feed conversion models, manufacturing yield models and economic models that the genetic shift from Holstein Friesian to Jersey is not the most efficient way to convert grass to true profit. Nor are some genetic selections that are occurring. The exclusion of Lactose in the current payment models causes a shift of milk value from High Lactose milks to Low Lactose milks and masks a significant error in manufacturing costs especially for CODEX milk powders.

Much of the existing research has been sponsored by overseas corporate manufacturers who wish to ensure that they are not over paying for raw milk. This is a markedly different from the co-operative where milk payment is the distribution of profit from the manufacture and sale of their member's milk. New Zealand research by Nick Lopez-Lillalobos [1] confirms that the current payment models do not accurately translate milk value to milk supply.

2. New Zealand Animal Evaluation Unit and Breeding Worth

National Breeding Objective

The New Zealand dairy industry's breeding objective is to identify animals whose progeny will be the most efficient converters of feed into farmer profit. (www.aeu.org.nz)

2.1. Breeding Worth Model

Excluding farmer's own objectives the responsibility for evaluating the profitability of dairy animals in New Zealand has primarily fallen into the hands of the Animal Evaluation Unit [AEU]. They have developed a profitability index called "Breeding Worth" [BW] which is used to measure the long term profitability of dairy animals. The index measures an animal's own performance and incorporates performance data from other animals that share its genetic makeup. Two other minor indexes exist, Production worth [PW] which measures an animal's own life time performance and Lactation Worth [LW] which measures an animal's performance in its current lactation.

The current base of the Breeding Worth index is the average 1995 cow. Her revenue potential and energy requirements for live weight and milk form the reference point from which Breeding Worth is measured. The recent shift from 1985 to 1995 for the base cow has been done to exaggerate "apparent" difference between animals. There has been approximately BW$61 added to the base cow. A corresponding BW$61 has been deducted from all current animal BW estimations.
The AEU felt that farmers needed to refocus on the selecting the highest BW sires to maximise genetic gain in New Zealand. For example, the apparent difference between two sires ranked, BW200_{[1985]}$ and BW261_{[1985]}$ is smaller [261 / 200 = +31%] than the same sires ranked BW139_{[1995]}$ and BW200_{[1995]}$ [200 / 139 = +44%]. The AEU intends to move the genetic base every 5 years so that the base cow will remain closer to the current average thus maintaining an exaggerated view of the small value differences between animals.

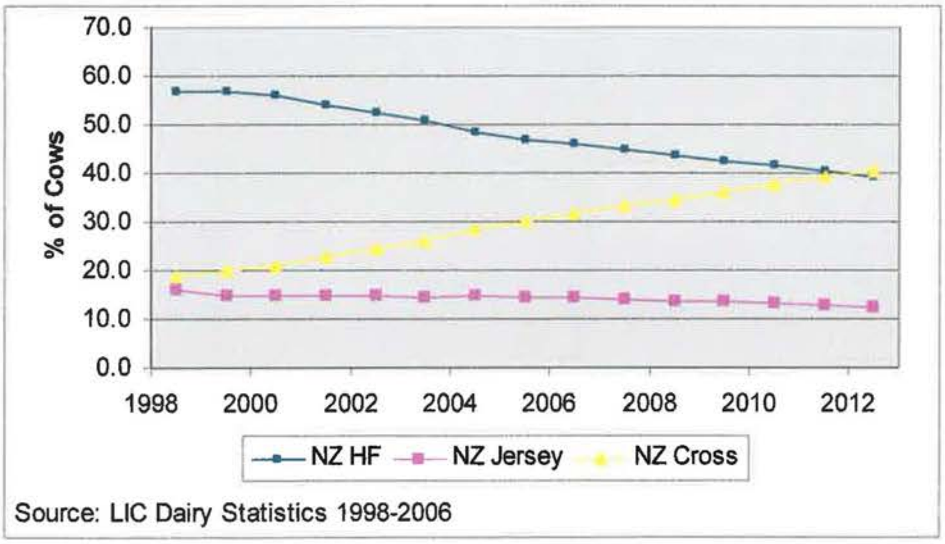
Fundamental to the AEU model is an animal's efficiency in converting feed energy into farmer profit at the farm gate. The model converts feed inputs into energy equivalents and applies those energy inputs to identified revenue streams at the farm gate. The total revenue is divided by total energy needs and becomes the proxy [opportunity] cost of energy. Milk components and Live Weight have different energy requirements. Allocating the opportunity cost of energy to the revenue stream of each element of the model allows comparisons to determine the most profitable allocation of feed energy.

In the milk production part of the model, the AEU allocates energy to producing Fat, Protein, Lactose and Volume. This is where a serious error occurs. Traditional milk payment models recognise Fat, Protein and Volume. The discrepancy occurs when energy applied to Lactose production receives no farm gate revenue despite forming a significant portion of the revenue streams of the manufacturer. Lactose can contribute up to 38% of gross revenues when making milk powders. [See Appendix 1 for simplified application of Animal Evaluation]

It is important to note that the AEU accepts, without question, that the farm gate price accurately reflects the revenue potential of milk. They claim that it is not their place to speculate the accuracy of the farm gate payment or whether other components, such as Lactose, should be included.

The current implementation of the evaluation model was introduced in 1996. It takes two years before any progeny enter the national herd. Since 1998 there has been a persistent shift from Holstein style cows to the intermediate cross bred style of cow. There has been a much smaller shift from Jersey to cross bred cows. At the current rate of change Cross Breed cows will out number Holstein cows by about 2012. The number of cross bred calves reared in 2007 out numbered Holstein calves.

Graph 2.1: New Zealand Breed Trends



International Comparison

The trend in New Zealand is unusual from an international perspective. Most dairy nations strongly favour the Holstein Friesian cow. New Zealand, as a dominant dairy nation, is out on its own.

Table 2.1: HF proportion of National Dairy Herds

	All Cows	Holstein Friesian	
	m	m	%
Japan	1.01	1.00	99%
Argentina	1.80	1.70	94%
UK	1.95	1.82	93%
Canada	0.99	0.92	93%
US	9.22	8.57	93%
UK	1.95	1.82	93%
Ireland	1.30	1.20	92%
Australia	1.81	1.21	67%
Chile	0.60	0.40	67%
France	3.90	2.18	56%
New Zealand	3.83	1.76	46%
South Africa	0.19	0.09	45%

Source: World Holstein Friesian Federation [www.whff.info]

We are led to believe that our New Zealand bred cow is the most efficient in producing Milksolids on a pasture based production systems.

The New Zealand style cow is efficient in producing Milksolids due to the drivers of our milk payment model but not for industry profit.

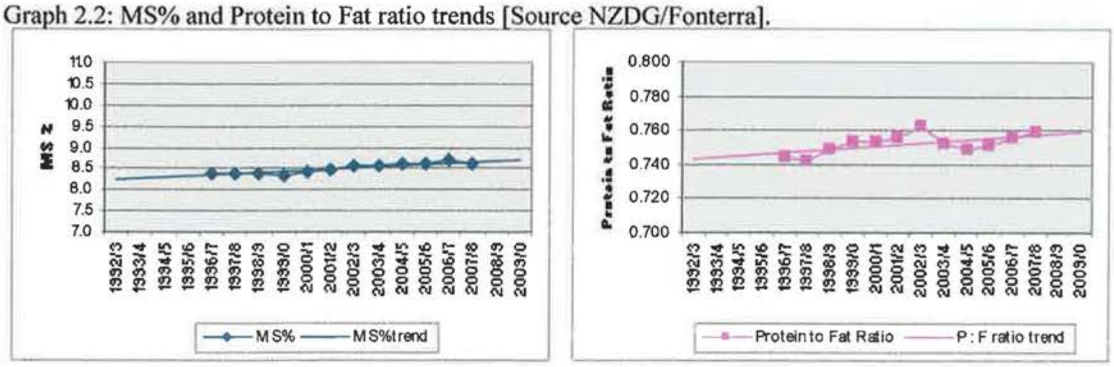
Other dairy nations are more strongly influenced by their payment models to optimise the Protein content of milk and frequently penalise excess Protein by not paying for Protein supplied in excess of a minimum percentage.

The US Federal Order Class system more closely relates returns from product value than the New Zealand system, which muddles value through the Fat and Protein payment.

2.2. Changes in Milk Composition

There has been a national shift in the composition of milk. While there are seasonal influences there is a definite shift toward a higher Milksolids in milk and an increase in the Protein to Fat ratio.

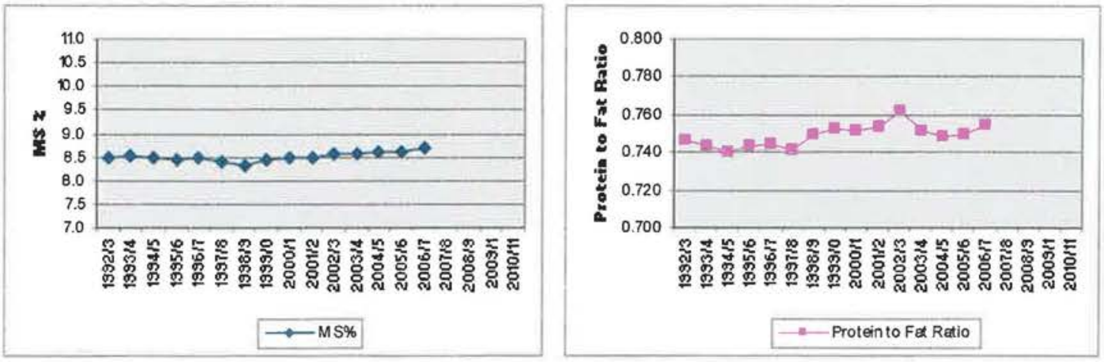
Graph 2.2: MS% and Protein to Fat ratio trends [Source NZDG/Fonterra].



This limited data set came from New Zealand Dairy Group and Fonterra annual payment explanations and shows that since the introduction of the Breeding Worth model in 1996 there has been a steady increase in Milksolids concentration and Protein: Fat ratio.

It is useful to contrast this with an extended data set derived from LIC New Zealand Dairy Statistics. Prior to the introduction of the Breeding Worth index farmers selected sires based on a Breeding Index [BI] model which ranked animals within herds and within breeds, but not between breeds. This index selected the best performing animals without consideration to energy requirements or efficiency in converting feed to farm gate profit. Under the BI model the production of more Protein was most favourable and without the restraint of energy conversion efficiency, farmers were favouring a Holstein Friesian style cow which produces more Protein, Volume and Lactose.

Graph 2.3: MS% and Protein to Fat ratio trends [Source: LIC NZ Dairy Statistics].

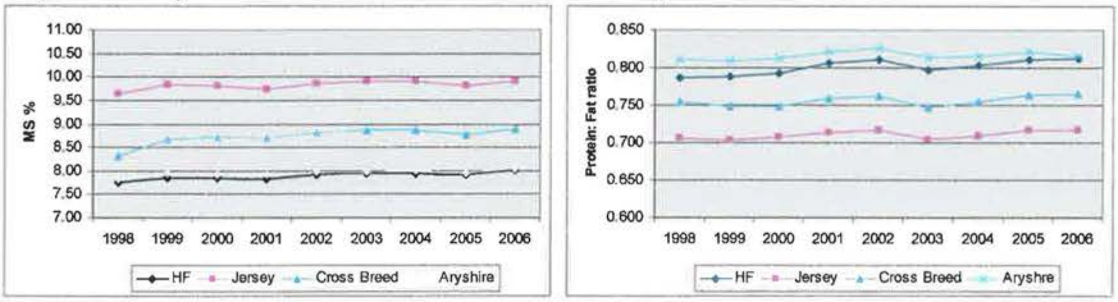


The transition from the BI to BW is apparent with a shift in the trend for Milksolids concentration and the Protein to Fat ratio that occurred from 1998 onward when the first BW selected progeny entered the national herd. At a 20-25% replacement rate, it takes 4-5 years before the progeny of the selection process become significant in the national herd and dominate the composition of milk output.

The new Breeding Worth model places significant constraints on producing more Lactose and Volume because there is no farm gate price for Lactose and Volume is penalised. Under the new model breeders are selecting sires that produce more Milksolids with more Protein with less Lactose/Volume. The partitioning of energy from Lactose will automatically promote an increase in Milksolids and Milksolids concentration.

Not all of this change in national milk composition is due to the changes of breed numbers. Changes in milk composition within breeds' shows that other selection criteria are being applied that are increasing the Milksolids concentration and the Protein: Fat ratio.

Graph 2.4: Changes in MS concentration and Protein to Ratio by Breed.



These changes are much smaller and are likely to be genetic in nature. Selection for change using genes is less reliable due to the random distribution of gene alleles during breeding.

2.3 Patented Genes

LIC has patented two genes, Optimum and Quantum. LIC semen catalogues describes both genes.

Optimum gene:

The gene has two alleles, A and T.
The T allele is associated with more Fat and Protein and less Volume.
The A allele is associated with less Fat and Protein and more Volume.
LIC estimates that having two copies of the T allele is worth BW$30 more than having none.
The T allele is present in about 80% of Jersey animals.

Quantum gene:

This gene has two alleles, F and P.
The P allele is associated with more Protein and Volume and less Fat
The F allele is associated with less Protein and Volume and more Fat.
The P allele is estimated to be present in 20% of Jersey animals and 50% of Holstein animals.
LIC places no economic weight on this gene other than to state breeding for the P allele will improve BW especially for Jersey animals.*

* Realistically the P allele is less favourable. New Zealand payment models penalize extra Volume [generally associated with more Protein] and the evaluation model penalizes the energy cost of more Lactose, further lowering the potential value of the P allele of this gene. There is a high incidence of the P allele in Holstein animals and a low incidence in Jersey animals. The Kiwicross™ should have a balanced mix of P and F alleles. In 2007 and 2008 LIC Alpha catalogues, the F allele is overly represented in their Kiwicross™ sires, indicating a selection bias against the P allele. The P allele is likely to be breed out eventually if the current payment models persist.

The A2 Corporation has patented the A2 gene variant of the Beta-Casein protein.

A2 Beta-Casein:

Two main gene variants exist for the Beta-Casein protein, A1 and A2.
The A2 variant is exclusive to many mammalian species, including humans
The A2 variant is regarded as the true allele and the A1 allele the genetic mutation
The A1 variant exists mainly in western dairy breeds
The A1 variant is being associated with diabetes and heart disease

The A2 Corporation has built its business on the marketing milk with the A2 variant of the Beta-Casein protein. There is a suggestion that the A2 variant is healthier than the A1 variant of the same Beta-Casein protein. The A2 gene is strongly associated with the Optimum gene and the T allele through the Jersey breed which has a higher incidence of both gene alleles together.

Through marketing by both corporations, the supposedly favourable alleles of each gene will be preferentially adopted by farmers. Breeding companies will pre-select sires that meet "the most profitable" criterion or carry the "preferred [populous]" genes.

The following table demonstrates a strong selection bias by LIC to select the Optimum gene T allele, Quantum gene F allele and Beta Casein A2 allele.

Table 2.2: LIC Alpha Sire Catalogue 2008. Gene allele frequency.

	Optimum		Quantum		Beta Casein	
Gene allele	T	A	F	P	A1	A2
Holstein Friesian	96 %	4 %	38 %	*62 %	28 %	72 %
Jersey	100 %	0 %	82 %	18 %	4 %	96 %
KiwiCross™	92 %	8 %	62 %	38 %	6 %	94 %
Average frequency	96 %	4 %	57 %	43 %	17 %	83 %

* The high frequency of the Quantum gene P allele for HF reflects the very high frequency historically present in the breed.

So within each breed the [supposedly] less favourable alleles are being bred out.

Within breeds there is a strong correlation between the occurrence of the Optimum gene T allele and the Beta Casein A2 allele and selecting for either will involuntarily select for higher Milksolids concentration and A2 Beta Casein Protein.

From the descriptions it is understandable that little emphasis is being placed on the Quantum gene P allele. In other countries, dominated by a fluid milk market, the P [more Protein and Volume] allele is valuable. A view not reflected in New Zealand where Volume is penalised and Lactose is not rewarded.

2.4. Artificial Breeding Company's Marketing Strategies

Much of the choice surrounding breeding options are pre-determined by breeding companies who try to gauge where the market is going or create a market space that they intend to fill.

Kiwicross™

LIC's adoption of "Kiwicross™" sires rather than "Crossbred bulls" creates a distinctive marketing point of difference which cannot be used by its competitors.
LIC has developed new indexes, such as the Once a Day index, creating other points of difference for their products and services.

Ambreed: New Zealand Merit Index

Ambreed have introduced their New Zealand Merit Index [NZMI] which emphasises traits usually preferred by overseas farmers. The AEU BW index places about 66% economic weight on milk production, where as Ambreed's NZMI places 43% economic weight on milk production. Further Ambreed's index does not appear to place energy efficiency constraints on their breeding program and like the old BI system, more focus has been placed on total production performance and animal durability [able to survive more lactations].

Fresh Semen Markets

The use of bull teams in the fresh semen market leaves most of the breeding decisions with the breeding companies rather than with the farmer. The breeding company pre determines a "Bull Pack" and markets them as a team. A popular choice for LIC clients is their Premier Sire Team.

They have selected a small team, around 7-10 sires per breed that have what LIC believe are the best traits.

These marketing strategies also make it difficult for farmers to adopt alternative strategies. New Zealand farmers have to put considerable faith in the processes behind breeding company sire choices.

2.5. Farm Management and Milk Composition

How cows are managed can influence milk composition.

Adoption of Once a Day Milking

Upward of 5% of the National Herd is estimated to be farmed Once A Day [OAD] for most of the season. The rational for OAD is varied and includes, improving fertility, reduced staff requirements, life style choices and better utilisation of limited capital resources [shed size].

Table 2.3: Impact of OAD milking on Milk Composition

	FTAD	FOAD	JTAD	JOAD
Stocking rate	3	3.5	3.6	4.2
Days in Milk	205	189	204	194
kg Milk/cow	3398	2353	2428	1868
kg Fat/cow	148	104	136	109
kg Protein/cow	116	84	96	77
kg Lactose/cow	163	112	119	89
kg MS/cow	264	188	232	186
kg MS/Ha	792	658	835	781
kg TMS/cow	427	300	351	275
Fat w/w	4.36%	4.42%	5.60%	5.84%
Protein w/w	3.41%	3.57%	3.95%	4.12%
Lactose w/w	4.80%	4.76%	4.90%	4.76%
Ratio Lactose/Protein	1.41	1.33	1.24	1.16
Ratio Protein/Fat	0.7838	0.8077	0.7059	0.7064

Source: Westpac Trust Agricultural Research Station, Taranaki, Clair Cooper 1999/2000

Adoption of Once a Day milking practices has seen a significant increase in Milksolids concentration for that milk. With milk not being extracted twice daily the Volume and Lactose output becomes fixed due to the osmol function that Lactose has on the mammary gland. Lactose concentration tends to be fixed at about 5.0% w/v. Fat and Protein have little osmol function and can continue to be secreted into milk lifting Milksolids concentration.

Manufacturers, looking solely at Milksolids concentration, might conclude that OAD milk will give processing advantages.

In a milk powders environment any volume advantage is lost though lower yields for milk powders or the extra costs needed for standardizing when making CODEX powders.

The standardizing costs tend to be applied as a function of average Protein and thus the deficiency of Lactose in OAD milk becomes a socialised cost to the industry.

Thrice a Day

This option is seldom practiced in New Zealand. US trails show that there is a decrease in Milksolids concentration and an increase in Lactose output.

Diet and milk composition

Trials have shown that diet can be used to influence milk composition. Diets high in soluble carbohydrates will tend to drive Milksolids concentration down while increasing Protein and lactose outputs. Diets rich in Fats or Oils [> 4% of dietary intake] will increase Milksolids concentration and lower Protein and Lactose output.

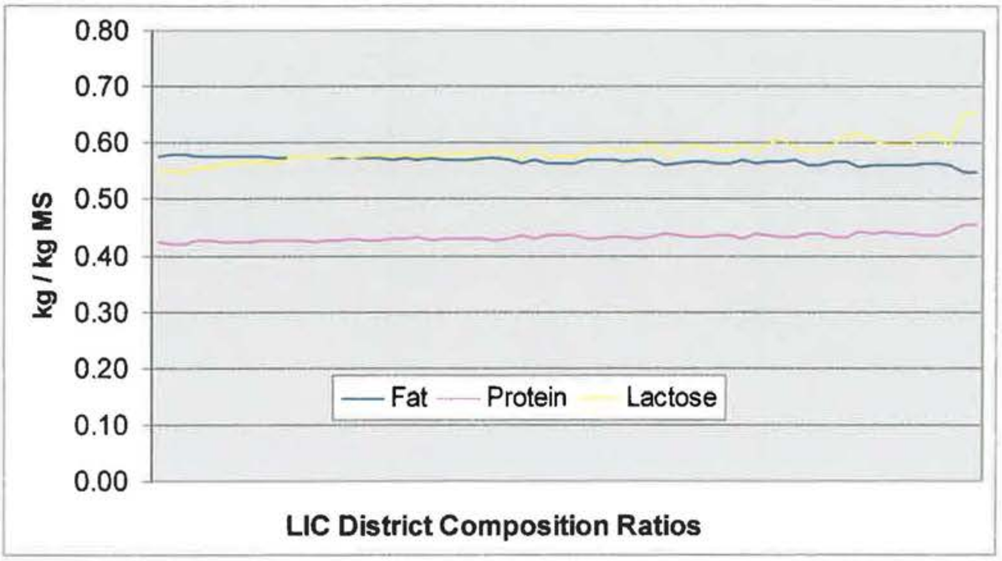
2.6. Relationship between Milk Components

Influencing the output of one component tends to have a flow on effect to the other milk components. Several data sets have been studied which confirms an approximate mathematical relationship.

Protein = r (Fat + Lactose)

This relationship was identified by New Zealand Dairy Group [NZDG]. NZDG and the subsequent Fonterra Milk Pricing Group have used this relationship, assuming that Lactose has no value, to justify the push for more Fat and less Volume. The working groups have remained focused solely on manufacturing benefits and not optimising the whole farm to customer system.

Graph 2.4: Ratio of Fat, Protein and Lactose [per 1 kg Milksolids]



This chart is based on data for the 64 LIC districts and displays the relative ratios of Fat, Protein and Lactose relative to 1 kg MS. The data has been sorted by increasing Protein. As Protein content increases the amount of Fat declines and the output of Lactose increases.

The Fonterra Milk Price working Group, using a similar graph, suggested that the cost of processing the additional Lactose, related to the increased Protein output, out weighed the economic benefit of the additional Protein. It will be shown that the feed energy cost of more Fat with less Lactose has a lower economic benefit than pursuing more Protein and Lactose.

Using the NZDG relationship equation Protein = r (Fat + Lactose)

For this data set $r = 0.375 \pm 0.005$.

This relationship can be used to model how milk composition changes.

$$\begin{aligned} \text{Protein} &= r\,(F + L) \\ &= r\,((F - x) + (L + x)) \end{aligned}$$

Holding Protein constant, the relationship shows that Fat will be substituted by a similar amount of Lactose.

Applying this relationship to breed milks we can simulate the change from Jersey to Holstein style milk. Starting with average Jersey milk we can determine the quantity of each main milk component. Applying the relationship formula we will substitute Fat with Lactose until we match the Protein to Fat ratio of Holstein milk [approximately 7 kg]. There is a decline in Milksolids and an increase in Lactose. Rescaling the modified milk formulation to 100 kg Milksolids, we find that it closely resembles Holstein milk demonstrating a degree of validity of the relationship.

Table 2.4: Changes in Milksolids Composition between Jersey and Holstein Milksolids

	P: F Ratio	Fat	Protein	Milksolids	Total Milk Solids	MJME
Jersey	0.717	58.2	41.8	100.0	150.8	6118
Fat change		-7.0		7		-217
	0.815	51.2	41.8	93.0	150.8	5901
Rescaling		55.1	44.9	100.0	162.2	6346
Holstein	0.816	55.1	44.9	100.0	162.9	6363

Source: Composition, LIC Dairy Statistics 2006/7

This relationship can be used to study the impact of compositional changes on milk energy requirements.

Table 2.5: Change in Energy requirements from Jersey to Holstein Milksolids

	P: F Ratio	Milksolids	Total Milk Solids	MJME	MJME / kg MS	MJME / kg TMS	Litres
Jersey	0.717	100.0	150.8	6118	61.2	40.6	1016
Fat change		7		-217			
	0.815	93.0	150.8	5901	63.5	39.1	1156
Rescaling		100.0	162.2	6346	63.5	39.1	1243
Holstein	0.816	100.0	162.9	6363	63.6	39.1	1258

Source: Composition, LIC Dairy Statistics 2006/7

The energy saving in substituting 7 kg Fat with Lactose saves 217 MJME for the same quantity of Total Milk Solids. To view that as a loss of 7 kg Milksolids is misleading. The saved energy can be used to produce more milk at the higher P: F ratio.

On a Milksolids basis there appears to be an energy advantage to Jersey:

F 63.6 / J 61.2 MJME per kg MS = 104.0%.

On a Total Milk Solids basis the energy advantage changes to Holstein:

J 40.6 / 39.1 MJME per kg TMS = 103.8%.

Jersey breeders have been able to market themselves on the basis that they are most efficient in converting feed energy to Milksolids. A significant part of that efficiency factor comes from comparing the energy requirements for Holstein Friesian Milksolids and Jersey Milksolids.

The New Zealand Holstein Friesian Association has not been able to make similar claims within the current payment model. Their energy requirement to produce Milksolids is higher than Jersey. Their ability to produce Total Milk Solids is 3.8% better, but in the absence of a three component payment model this advantage is lost.

2.7. Transfer of lactose Value

In a Milk Powder manufacturing environment Lactose has a significant value as an ingredient. The blending of Lactose [or Solids not Fat] value into the Protein payment, shifts value from High Lactose milks to Low Lactose milks.

Table 2.6: Transfer of lactose value between Breed milk types

	Protein %	Lactose Ratio to Protein	Δ Fonterra	Protein: Fat	Protein kg / 100k MS	Lactose Value Lost $1,000 / t	Lactose Value Lost $1,500 / t
Friesian	3.59	1.393	-0.042	0.8154	44,915	-$1,886	-$2,830
Ayrshire	3.61	1.385	-0.034	0.8191	45,029	-$1,531	-$2,296
Friesian OAD	3.67	1.362	-0.011	0.7913	44,175	-$486	-$729
Fonterra	3.70	1.351	0.000	0.7540	42,987	$0	$0
Cross Breed	3.85	1.299	0.052	0.7687	43,460	$2,260	$3,390
Jersey	4.14	1.208	0.143	0.7172	41,765	$5,972	$8,959
Jersey OAD	4.21	1.188	0.163	0.7220	41,928	$6,834	$10,251
					Difference F, J	$7,859	$11,788

Source: LIC Dairy Statistics 2006/7 (adapted)
Dairy NZ OAD Trials (adapted)

The table shows the amount of Lactose that various breed types surrender or take from the company average. Based on the Protein content of 100k Milksolids for each breed, we can estimate the Lactose value that farmers are surrendering to or taking from the company average. This value shift is independent of final payout magnitude

At a minimal value of $1.00 kg Friesian animals are losing 1.89c/kg MS value, while Jersey farmers are reaping a 5.97c/kg windfall. At a more realistic lactose value $1.50 kg the value difference is much greater. The difference between Holstein and Jersey of 7.8c /kg MS and 11.8c/ kg MS represents a 1-3% error in payout value.

The impact of Lactose on BW value can be simply estimated. The current BW model currently includes revenue streams and costs [including Lactose]. The change in MS value can be applied directly to BW values. The following table illustrates he impact a Lactose value of $1.00 and $1.50 will have on BW.

Table 276: Potential Change in BW adjusting for Lactose value

	BW	MS Production	BW Change $1.00 kg	New BW	BW Change $1.50 kg	New BW
Friesian	61	335	6	67	9	70
Ayrshire	5	297	5	10	7	12
Crossbreed	83	334	-8	75	-11	72
Jersey	95	296	-18	77	-26	69

Source: AEU BW as at 6 October 2008

Using the current BW methodology and allowing for Lactose value the BW differences between the 3 dominate animal types close. Should Lactose be valued closer to its true revenue value, about 70% of the Milk Powder, the BW advantage currently enjoyed by Jersey and cross breed animals will be eroded and the true BW Holstein Friesian will be recognised.

3. Milk Payment

3.1 How we got here.

To make the right breeding choices, the right market signals have to be sent to producers. For dairy farmers this is the farm gate price of milk. Fonterra has made it quite clear that the traditional farm gate milk price of milk is not the right market signal for milk production and has invested an enormous amount of time and effort in trying to establish the right "Milk Price".

Two important issues have been identified; the return on investments [not related to milk supplied] and return on investments that adds value to milk supplied. The first is related to member's investment in the co-operative and its subsequent investments in other businesses. The later can relate to; alternative uses of milk, different product choices, adding value through branding, adding value by recovering product that make have traditionally been discarded.

The traditional equation for co-operative milk payments would be:

Milk Payout = (Sales Revenue – Cost of Sales) / Milk supplied

Fonterra wants to redefine how payout is developed. Central to this proposal is the separation of the basic milk price, value added to milk and return on investments. Investment returns do not form part of this paper's discussion because it is a function of investment and not milk production.

Important to this paper though is how milk payout is distributed and how market signals are interpreted by producers and evaluation models.

The foundation of our current model emerged from work carried out by the New Zealand Dairy Board [NZDB] in the early 1980's. As the common marketer for New Zealand dairy products, their payment model became the basis of Dairy Co-operative payments to member suppliers. The NZDB pooled revenue from sales and determined the average value of milk and the average cost of manufacture when determining payments to companies. In managing the market the NZDB would direct production at the company level to optimise the best returns for all. Incentives were provided to companies that had to produce more costly or complex products. However the underlying price of milk was the same for all companies.

At this time, a strong interest was emerging for Protein products. Rapid milk testing machines, capable rapid determination of Milk Fat and Protein, had entered the market. Two smaller companies, Rangitaiki Plains Dairy Co-operative and Moa Nui Dairy Co-operative introduced Protein to their payment models reflecting their manufacturing capability for specialised Protein products. The importance of Protein was soon established in determining the yields of many other dairy products such as Cheese, Casein and Milk Powders. Fat was no longer regarded as the best indicator of milk value. By 1985 most dairy co-operatives had adopted the Fat + Protein – Volume [A + B - C] payment model to their members. During the next 20 years the economic weight of Fat declined.

The following table lists the relative economic value of Fat and Protein. Fonterra refer to it as the "Value Component Ratio [VCR]". This ratio is independent of actual payout price. It shows what proportion of payout is paid for Protein and for Fat. Simply calculated it is the Fat price divided by the Protein price. Once the ratio is developed it can be scaled to any given payout price.

Using VCR may introduce a minor error when distributing payout derived from investment activity. This part of payout needs to be distributed on a share [usually equal to Milksolids produced] ownership basis. To date this part of payout has been relatively small and the error should not be significant.

Table 3.1: Value Component Ratios.

	NZ Ave	Fonterra	Tatua	Westland	Synlait
1987/88	1.03				
1988/89	0.74				
1989/90	0.65				
1990/91	0.60				
1991/92	0.60				
1992/93	0.60				
1993/94	0.48				
1994/95	0.44				
1995/96	0.44				
1996/97	0.47				
1997/98	0.48				
1998/99	0.47				
1999/00	0.47				
2000/01	0.46	0.46	0.46	0.46	
2001/02	0.42	0.42	0.42	0.46	
2002/03	0.36	0.36	0.42	0.46	
2003/04	0.35	0.35	0.37	0.46	
2004/05	0.36	0.36	0.37	0.46	
2005/06	0.39	0.39	0.37	0.46	
2006/07	0.39	0.39	0.32	0.46	
2007/08	0.36	0.36	0.28	0.46	# 0.30
2008/09		* 0.35			# 0.30

Since 2000/1 Fonterra's VCR has been used as the NZ average because they process 95% of all milk produced and the other company ration will have minimal impact.

* Projected VCR for 2008/9

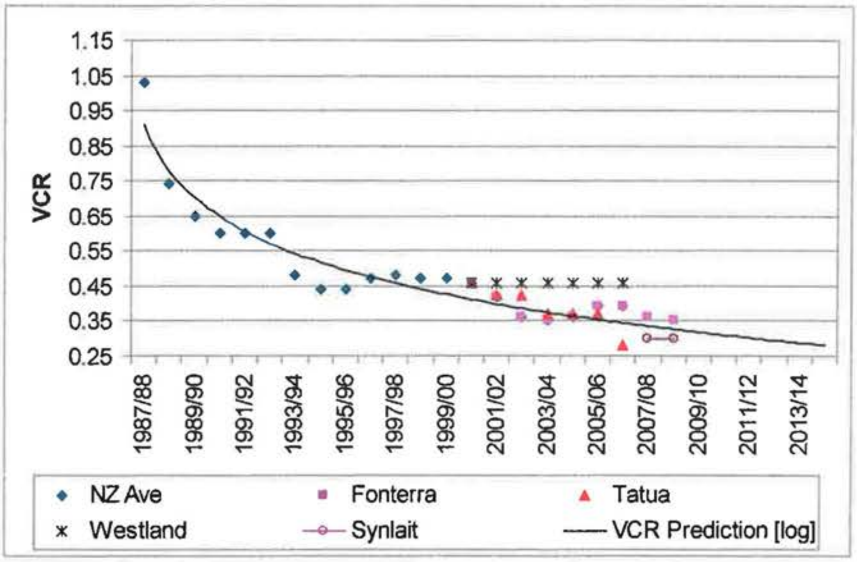
\# Estimated VCR adjusted for Lactose payment

In 1989 58.7 % of a farmer's apparent income was derived from the sale of Fat. Today this has reduced to 33.2%. It will be shown that Protein derived income has not increased by this amount and that income from the sale of Solids not Fat [SNF] that has led to the high apparent Protein price. Lactose value should be separated from the Protein payment.

In January 2006 the Animal Evaluation Unit commissioned a report, prepared by LIC [2], to determine the economic weights to be used in calculating Breeding Worth. Included in their work was a graph portraying some of the above data. They recommended that a log-log specification be used in extrapolating that data to determine the future value of Fat relative to Protein. They do not seem to have considered determining a value for Lactose.

The following graph replicates the log-log extrapolation of the New Zealand average data set. Included in the graph are the VCR's of other dairy companies. They have diverged from Fonterra with each company determining a VCR that reflects the relative values they place on Fat and Protein.

Graph 3.1: Value Component Ratio within the New Zealand Dairy Industry



The long term trend is downward. The working group initial recommendation, "That the ratio would continue downward", was tempered by an expectation that the world consumption of fat bearing products would increase significantly. [Of the four commodity products that were included in the report, Butter, Cheese and WMP consumption was expected to rise and SMP to decline. Perversely, the yield of Cheese, WMP and SMP are dependant on Protein, not Fat. In most milk, Fat is produced in excess of the Protein requirements for Cheese, SMP and WMP.] As more whole milk powder is produced the VCR will be weighted closer to the natural VCR of WMP or 0.35.

Westland, who has adopted a policy of "Consistency" and has not changed their VCR at all since leaving the New Zealand Dairy Board.

Tatua has trended downward more rapidly than Fonterra or Westland. This reflects its manufacturing expertise in specialised Protein products and lessor dependence of Fat products. Tatua has traditionally not derived an income from Lactose. In 2007/8 Tatua has entered into an arrangement with SourceNZ to market a Lactose based feed supplement. This may decrease VCR further. Any value derived from the sale of Lactose is likely to be assigned to Protein portion of payout.

Fonterra on the other hand actively changes their VCR stating that it reflecting accurately market conditions. Their VCR has yet to fall below 0.35 indicating a stronger preference for Fat production than for Protein.

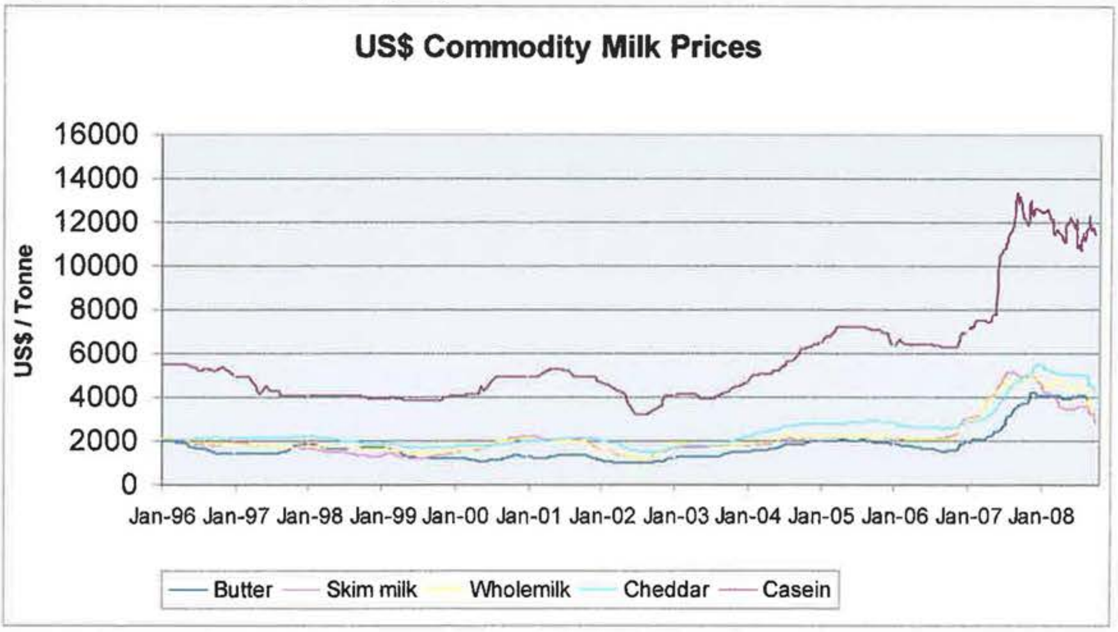
Synlait's has a raw VCR of 0.34 when it excludes Lactose. This value cannot be compared directly with those of Westland, Tatua or Fonterra. Lactose is typically bundled into the Protein payment. If Lactose is bundled into Synlait's Protein payment their VCR falls to 0.30. This low ratio is mainly due to the lower value they place on Fat and the higher value they place on SNF in their milk powder production environment.

For a manufacturer having a product mix dominated by milk powders it will be shown that the VCR is unlikely to deviate far from 0.35 being the natural VCR derived from making CODEX WMP. It will be shown that Lactose contributes significantly to the Protein value used to calculate VCR and would significantly change milk value if it were separated. Important to this conclusion is the continued use of the current two component payment model. Should a third component, Lactose, be introduced then the existing VCR become meaningless.

3.2. **<u>World Commodity Milk Prices</u>**

The value of New Zealand milk and its components is primarily determined by the world prices for commodity products. The small amount of specialty product sold into market represents a Value Add opportunity and is generally shared on a Milksolids basis rather than being applied to Fat or Protein.

Graph 3.2: World Commodity Prices [US$]



Source Agri-Fax, Farmers Weekly and Straight Furrow

For the most part, commodity products have traded in a relatively small price band until January 2007 when a number of global factors saw commodity milk prices rise sharply.

The four most important factors were:

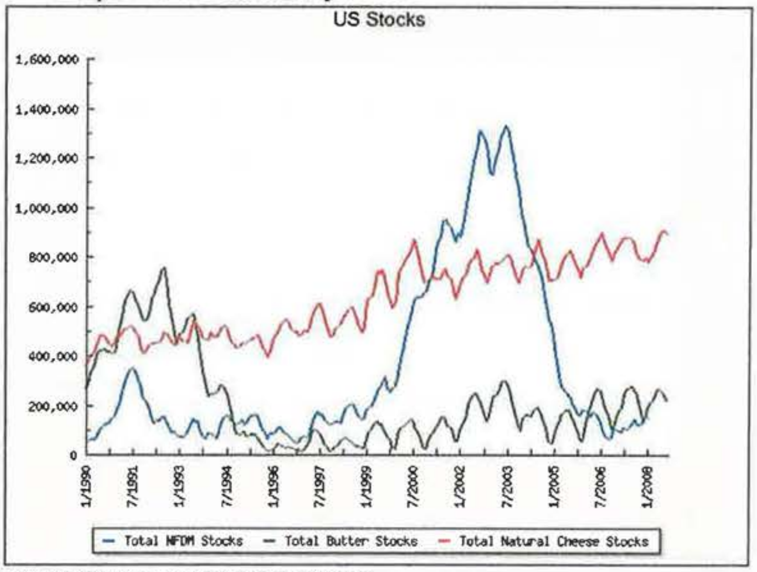
- Decline of US intervention stocks.
- The prolonged drought conditions in Australia where milk production has declined by over 20%. The absence of milk surpluses reduced their global output.
- Drought conditions in California.
- US policy for Bio-fuels which lifted commodity feed costs which was reflected in increased food prices.

3.3. US intervention stocks

The US market has a significant bearing on the world price of milk. Their policy of purchasing intervention stocks had a significant impact on maintaining US output of milk far in excess of demand. This had a subduing effect on milk powder prices. By 2003 the US stocks reached 1.3b lbs [590m kg] of milk powder. This is equivalent to about 60% of Fonterra's annual output. US production had slowed and a huge milk powder mountain loomed over world commodity milk powder price.

Fonterra entered into a marketing arrangement with Dairy Farmers of America and during the period from 2003 to 2005 was able to assist the US dairy industry to dispose of their significant Skim Milk Powder [Non Fat Dried Milk, NFDM] stocks onto the world market. During this period the controlled release of product enabled the world price of milk powders to remain relatively stable though at a lower value than if no intervention stocks had existed. In real terms milk powder prices were depressed and the relative value of Butter rose during this period.

Graph 3.3: US Commodity Stocks



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In 2005 droughts hit Australia and California. There were no stocks available to meet world demand for dairy products. The input cost of feed, inflated by bio fuel demand, caused commodity prices to rise dramatically. By mid 2008 there was a softening of market prices driven by reduced demand and an expected increase in output by the US.

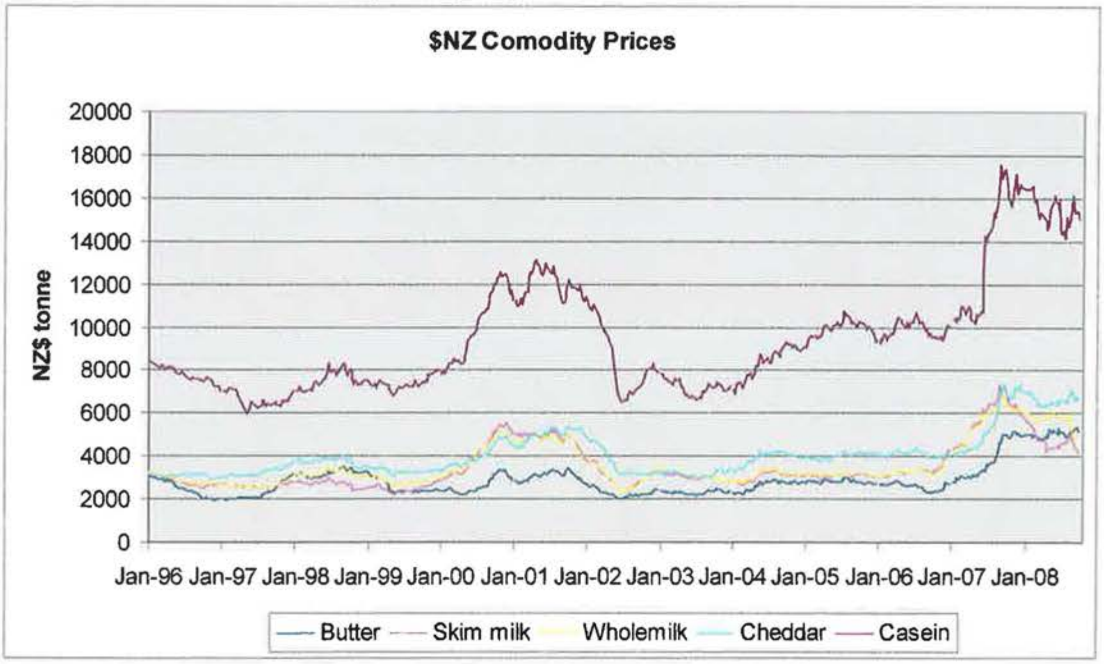
The continued upward trend in cheese stocks mirrors the increased consumption of cheese rather than the development of a cheese stock mountain. Cheese requires several months to mature and develop characteristic flavours. To meet increasing demand for more cheese there has to be a coresponding increase in inventory stocks to allow maturation of product before it can be sold. Most of the US increase in dairy production has been toward cheese manufacture. Any excess SMP or Milk Protein Concentrates in the US market is used to assist cheese making yields and mop up surplus fat present in milk supply. There remains a surplus of milk powder manufacturing capacity.

The US Butter market has also matured and no longer holds excessive stocks, as it did in the early 1990's. The US Butter demand is in balance with its butter stocks.

It is expected that US production will be ramped up, capitalising on the higher world commodity prices. As long as world demand continues to expand this should not overly depress the current buoyant market prices.

This surge in the US commodity values was not totally reflected into the New Zealand market where the very high exchange rate eroded some of the extraordinarily high value that existed in the market during the 06/7 and 07/8 dairy seasons. The fall in world commodity prices during the current 08/9 has been moderated by the significant drop in the $NZ/$US exchange rate. To date we have not seen significant commodity price drops [in $NZ] except for WMP which has tumbled significantly more than Butter, SMP, Cheese and Casein.

Graph 3.4: New Zealand Commodity Price [$NZ]



The New Zealand Commodity price reflects the US commodity price and differs only by the exchange rate at the date of conversion. The ability to maximise milk value becomes determinate on the relative value of commodity products, not their absolute price.

At any given payout the ratio of component values and the yield characteristics of milk types determine milk value. The current A + B – C does not translate characteristics of milk yield to milk value.

3.5. Milk Component Valuation

There are many approaches that can be taken in valuing milk components which vary in complexity and accuracy. The more accurate the process is the more complex it becomes and costly to implement. The trade off to cost will always compromise accuracy. In addition the payment model may be manipulated by the manufacturer to try and achieve a change in behaviour and type of milk produced. The later should only be attempted if there is a clear market signal to do so. In reviewing the Commodity Product prices during the study period shows that there is no concrete assurance that we can accurately predict future pricing behaviour of commodity products.

The market suggests that there will be a continued demand for more high quality Protein and less demand for Fat in diets. In reality, as markets become more affluent, there tends to be an increased demand for luxury products and Milk Fat plays and important role in that.

The most appropriate approach for manufacturers is the faithfully reflect current market prices and trends in payout. Most co-operatives use three year rolling averages to smooth out variations when setting component price ratios and use those factors to scale milk payout. Seasonal and additional payments tend to use the same component ratios.

But are those price ratios accurate?

4. Component Valuation

4.1. Determination of Value Component Ratio when manufacturing Whole milk powder

The simplest product to study is whole milk powder where we can apply general principles in determining the VCR. Whole Milk Powder [WMP] consists of Fat, Protein, Lactose and Minerals. Its profit/revenue has to be allocated between the two value components of the payment model, Fat and Protein. Manufacturing costs apply equally to all the components used, with the exception of excess Fat processed into Butter or Lactose bought in for standardizing purposes.

A simple approach would be to allocate all the revenue proportionately between Fat and Protein. Each value component shares equally from the benefits of the non value components, Lactose and Minerals. The VCR would be 1. Any milk price can be used because it applies to all components equally.

WMP = $100 / t   Fat content = 26.5%   Protein content 25.1%
Milksolids content = 51.6%

Fat value	26.5% / 51.6% * $100 = $51.36	or $193.80 / t Fat
Protein value	25.1% / 51.6% * $100 = $48.64	or $193.80 / t Protein

VCR = 1

Alternatively, a proxy for the value of Fat or Protein can be deducted from the net value of WMP and assign the balance of value to the other component. This approach reflects the manufacturing process where Fat [by way of cream separation] is processes separately from Protein. The value derived from Solids Not Fat [SNF] is ascribed to Protein. The difficulty in this approach is that the proxy value may vary considerably from its true market value in Whole Milk Powder.

WMP = $100 / t   Fat content = 26.5 %   Protein content = 25.1%
Fat value =? Protein Value =?

Use Butter to determine the proxy value of Fat.
Butter = $100 / t   Fat content = 82%   Fat value = $122 / t

Fat value in WMP = 26.5% * $122 = $32.33
Protein value = $100 – $32.33 = $67.67 / 25.1% = $269.60 / t

VCR = $122 / $269.60 = 0.45

NB.   SNF value = $67.67 / 70.8 kg = $95.58 / kg

In this example Fat has an economic value of $122, Protein $269.60 and SNF = $95.58. The use of Protein as the value component instead of SNF distorts Protein's true value. Fat, Protein, Lactose and Minerals all have the same true economic value when making Whole Milk powder.

In real terms the natural VCR for CODEX WMP is 0.35. The value derived from Fat is proportional to the amount of Fat used or 1.00 and the value of Protein is derived from the ratio of SNF / Protein used or 2.82

WMP VCR   = ($26.5 F / 26.5% F) / ($70.8 SNF / 25.1% P)
= 1.00 / 2.82
= 0.35

When making WMP there is a surplus of Fat which can be converted to Butter. The value of Fat as Butter may shift the VCR up or down.

Without CODEX standardisation with Lactose the natural yield of Low Milksolids milk is higher that High Milksolids milks making the natural VCR higher for Low Milksolids milks

There is also a Lactose cost for standardizing product when making CODEX milk powders. Either may shift VCR up or down depending on the value assigned to Fat or Lactose.

4.2 Determination of Value Component Ratio when manufacturing Skim milk Powder and Butter

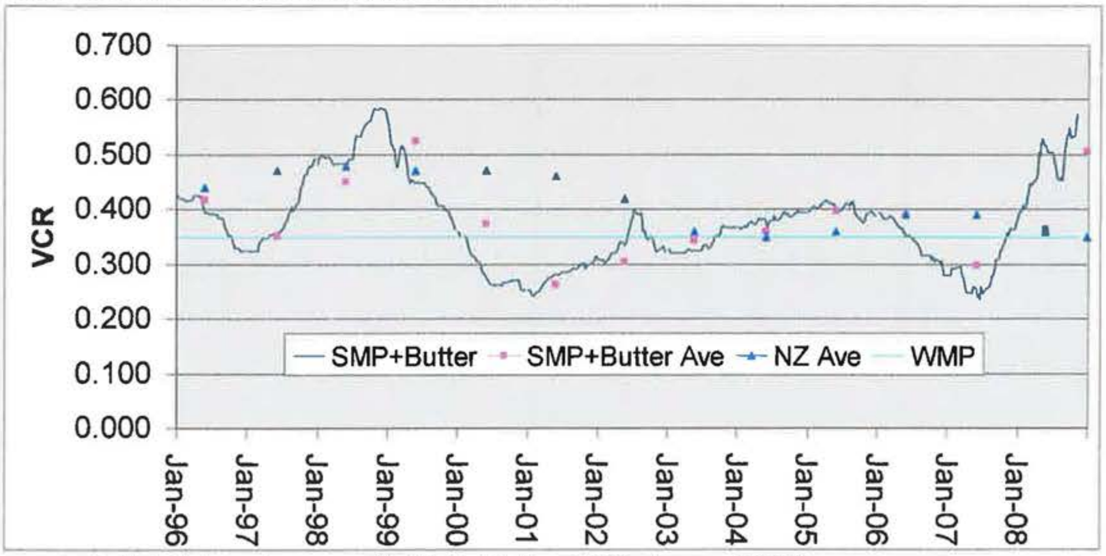
Whole milk is the raw material used to make other types of dairy products. Skim milk powder and Butter are complimentary alternative uses of milk. Another way to determine VCR is to deconstruct WMP into the equivalent amount of Butter and SMP. One ton WMP can be divided into 265 kg Fat and 735 kg SMP. The Fat will yield 323 kg Butter at 82 % Fat content. [For simplicity, the Fat in SMP = SNF in Butter]

The average value of commodity products in 07/08 dairy season: Butter $4,680 / t, SMP $5,820 / t

SMP VCR = Butter$ * Butter kg / SMP$ * SMP kg
= $4.68 * 323 kg / $5.82 * 735 kg
= $1,512 / $4,281
= 0.353

Using the historic prices for SMP and Butter we can calculate VCR over time.

Graph 4.1: Skim Milk Powder / Butter VCR Over time



Included: Annual averages for SMP + Butter, NZ/Fonterra and WMP

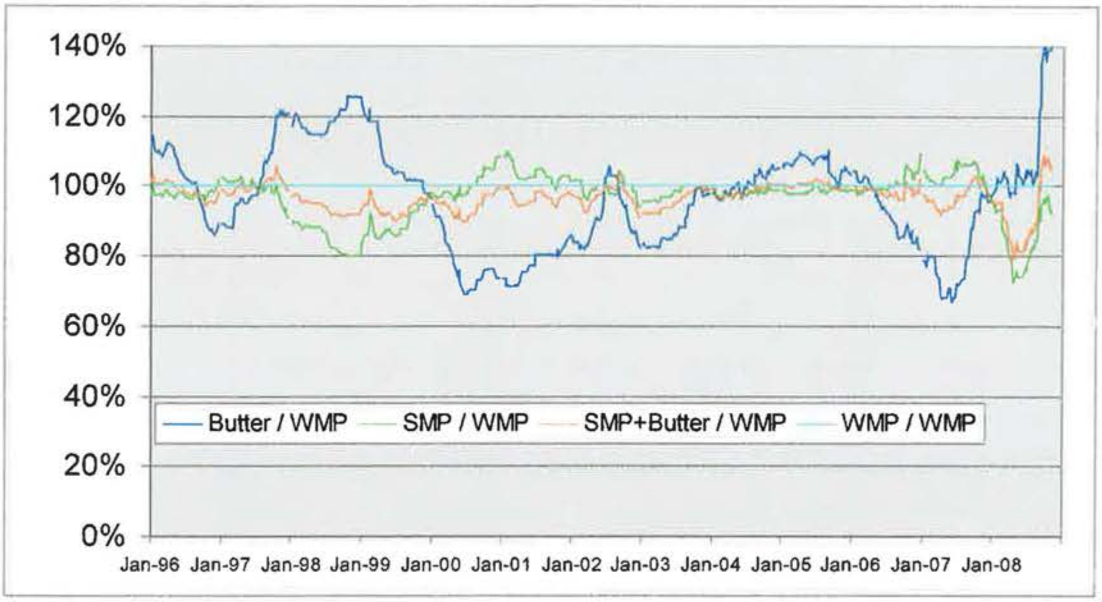
The SMP + Butter VCR swings around the natural value of WMP. In the long term SMP + Butter value cannot deviate far from the WMP value. Any imbalance in the relative values of SMP and Butter is likely to cause an over supply of the complimentary product and depressing over all value.

The average VCR for the study period, using weekly data, is 0.375 whereas the average NZ VCR is 0.412. SMP, Butter and WMP currently comprise over three quarters of NZ product output. The balance of production relates to Cheese, Casein and Whey Protein Products which essentially are Protein products and should decrease NZ VCR. The NZ VCR is too high suggesting a payment bias toward Fat.

4.3. Revenue Potential of Skim milk Powder + Butter to Whole Milk Powder

A further way to view component value is to compare the revenue potential of WMP and the revenue potential of Butter + SMP made from the same amount of milk.

Graph 4.2: Butter, SMP and SMP + Butter value relative to WMP



Source: Agri-Fax [1996-2006], balance Straight Furrow and Farmers Weekly

This time series shows the relative values of Fat [as Butter$ / 82% F] and SNF [as SMP$] over time. Using the same deconstruction values of WMP above [Butter 323 kg and SMP 735 kg per ton] we can combine those values to estimate a composite value for WMP.

Table 4.1 Revenue ratio, SMP + Butter / WMP

07/08 Season	$ / ton	Ratio kg	Value		
Butter	4,680	323	1,512		
SMP	5,825	735	4,281	5,793	95.5%
WMP	6,064	1,000	6,064	6,064	

The Whole Milk Powder manufacturing process is similar to that of the SMP + Butter process varying in that there is more Butter and Butter milk Powder made. The energy requirement for WMP is slightly higher, evaporating the water that is retained when making more butter. There is a slight increase in packaging requirements when making SMP + Butter.

Seasonal Average of SMP + Butter / WMP revenue Ratio

Table 4.1: Fat to Protein Seasonal Payout Ratios

Revenue Ratio	SMP + Butter / WMP
1996/7	1.009
1997/8	0.988
1998/9	0.930
1999/0	0.938
2000/1	0.955
2001/2	0.963
2002/3	0.959
2003/4	0.976
2004/5	0.999
2005/6	0.999
2006/7	0.966
2007/8	0.945
2008/9	0.939
Average	0.966

Payout tends to be calculated within the dairy seasons. The average revenue ratios within each season are listed. When SMP + Butter is compared with WMP the revenue value seldom differed by more than 5%. Over the study period, SMP + Butter combined revenue averaged 96.6% of WMP.

Based on the long term average, WMP should be produced in preference to SMP + Butter. Within the study period revenue ratios fluctuate frequently [2-3 year time frames]. Changing breeding direction requires long time frames [4 - 10 years] suggesting that there are no long term benefits in breeding for Fat or SNF based on commodity prices. Breeding must focus on the most efficient conversion of feed energy to milk revenue.

When we study the energy requirements needed to produce Fat and SNF we find that the energy cost for Fat [56 MJME / kg] is about 85% higher than the energy cost for SNF [30 MJME / kg].

Therefore, in WMP or SMP + Butter manufacturing environment, the feed energy needed to produce the Fat portion will generate significantly less revenue than if it were used to produce SNF.

Extending this methodology there should be a drive for more Protein but the associated Volume charges and Lactose energy costs, identified by the AEU evaluation model, prevents any wholesale shift to higher Protein milks with lower Milksolids concentration.

In Section 6 we use models to show that, even after volume related costs, Low Milksolids milks generates more revenue per kg Milksolids and significantly more than is reflected in our current payment models. There has to be a change in the payment models to reflect Lactose value at the farm gate.

4.4. Revenue Potential of Casein and Skim Milk Powder

Casein is an alternative use of skim milk. Casein manufacture evolved as a low cost alternative to making SMP. Historically Casein was an industrial product used for glues and other non-food applications. Having been precipitated from milk it is relatively insoluble. To add value, most Casein is further processes into Caseinate or hydrolysed protein products for use in the food industry.

It is manufactured using two processes, yielding two types, rennet [sweet] and mineral acid Casein. Casein comprises 80% of the crude Protein content of milk. To make 1 ton of Casein requires 3.4 tons of SMP equivalence of milk to make.

SMP = 33% Crude Protein, Casein = 89% Protein.
1000 kg Casein requires 890 kg Casein Protein
890 kg Casein requires 1,113 kg Crude Protein [890 Casein Protein kg / 80% = Crude Protein kg]
1,113 kg Crude Protein requires 3,370 kg SMP [1,113 CP / 33% CP in SMP]
NB. No allowances have been made for process losses, typically 3-5%

For Casein to match the revenue potential of SMP, its price has to be 340% higher. This factor can be lowered if value can be extracted from whey.

Whey Protein comprises 15% of the Crude Protein in milk. It is not precipitated out during the casein making process and was traditionally discarded. Modern technology has enable whey protein to be captured in to a range of products.

The whey can be used in several ways:

- Whey Powder [from rennet casein processes only], ranging from 12% to 25% protein
- Co-precipitate [denatured protein product, generally insoluble]
- Whey Protein Concentrate, ranging from 35% to 85% protein
- Whey Protein Isolates, typically > 90% protein

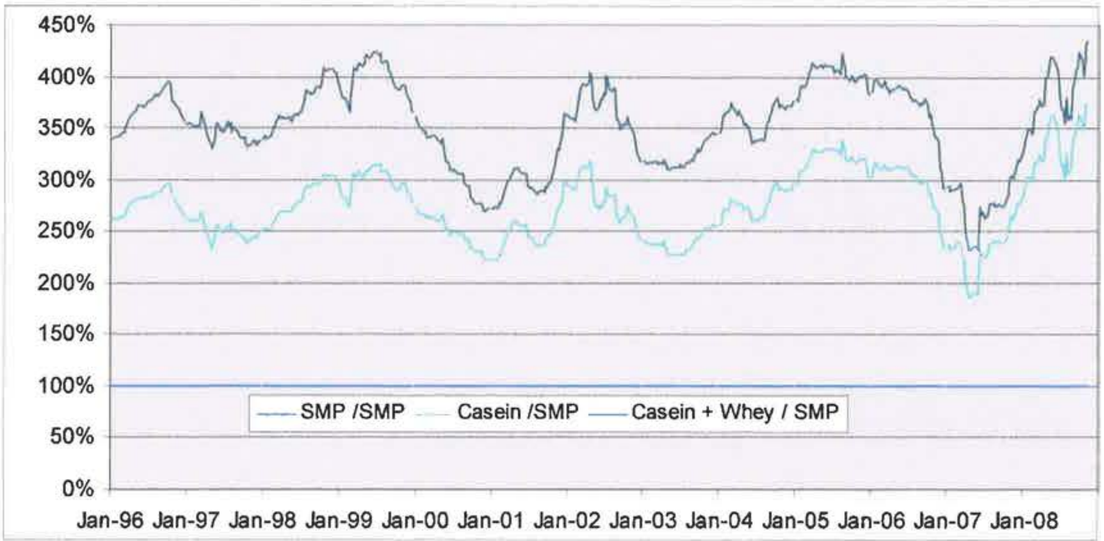
Whey powders are simpler to make than Whey Protein Concentrates. These can be used in making high value infant formula or used in low cost Calf Milk Replacer stock foods. Whey Protein is more digestible than Casein. It has a molecular size one quarter that of Casein.

Co-precipitate is a less favoured product because the protein has been denatured by heat and is relatively insoluble limiting its functionality for other products.

Whey Protein Concentrates and Whey Protein Isolates are extracted in a way that does not denature the proteins which remain soluble. This adds functionality to the proteins allowing them to be used in many food products. Isolating some of the different whey proteins can add value. Due to the high investment in processing technology, whey product revenue tends to be allocated to Milksolids Value add rather than to Protein.

If all Whey Proteins are extracted and recovered at a value similar to Casein then the revenue factor drops from 340% to about 285%, being 340 % * 80 % / 95 % Crude Protein ratio. These two ratios are important in studying the relative value of SMP and Protein products.

Chart 4.3: Casein + Whey Products / SMP revenue ratio.



Unless there are compelling manufacturing advantages in making Casein it can be seen the there are only a few times in the study period where Casein has had a revenue advantage to SMP. Only for short periods have the Casein prices climbed above 340% of the SMP price. Without the addition of revenue from whey products there is little compelling benefit in manufacturing Casein instead of SMP.

During the study period the average revenue ratio to SMP:

Casein only average ratio	= 80.9 %
Casein + Whey [$2,100] average ratio	= 100.0 %
Casein + Whey [$2,500] average ratio	= 103.6 %

The rise in Casein prices between Jan-03 and Jan-06 corresponds to the period where Fonterra assisted the US in disposing of their NFDM stock surplus. It is probable that the relatively high price of Casein reflects the depressed price of SMP during that period.

The industry may have been blind sided when Milk Powder prices rose rapidly in 2007 leaving Casein prices behind. A realisation that Casein has been traditionally undersold may have led to finally obtaining a realistic Casein price from mid 2007 onward.

After whey protein has been extracted from the whey the remaining solids, mostly Lactose, can be extracted as Lactose powder or converted to Ethanol. Depending on the origin of the whey, rennet or acid, limits the processing choice. Rennet whey tends to go to Lactose manufacture and acid whey to Ethanol production. Both co-products tend to have a low economic value when compared to other milk components. The yield of Lactose or Ethanol is relatively low in relation to the Lactose committed to these processes. Up to 50% of Lactose is lost while making Lactose powder and about 5-600 g Ethanol is produced per kg Lactose used.

Opportunities exist to make high value specialised products, such as Pharmaceutical Grade Lactose Powder [>$10,000 / t]. Again these profits go to Value Add, Milksolids rather than Protein or Fat.

Lactose Powder and Ethanol have low economic value. Management see little opportunities for them to add value to milk. The exception is the use of Lactose in standardizing CODEX milk powders. The typical market value of Lactose is about $1.00 kg. Used to standardise milk powders will increase its value to the market price of milk powder, ranging from $US 2,600 (1997/8 season) to $US 6,000 (2007/8 season). Lactose's ingredient value should be the minimum value Lactose has in a milk payment model.

4.5. Revenue Potential of Cheese and Whole Milk Powder

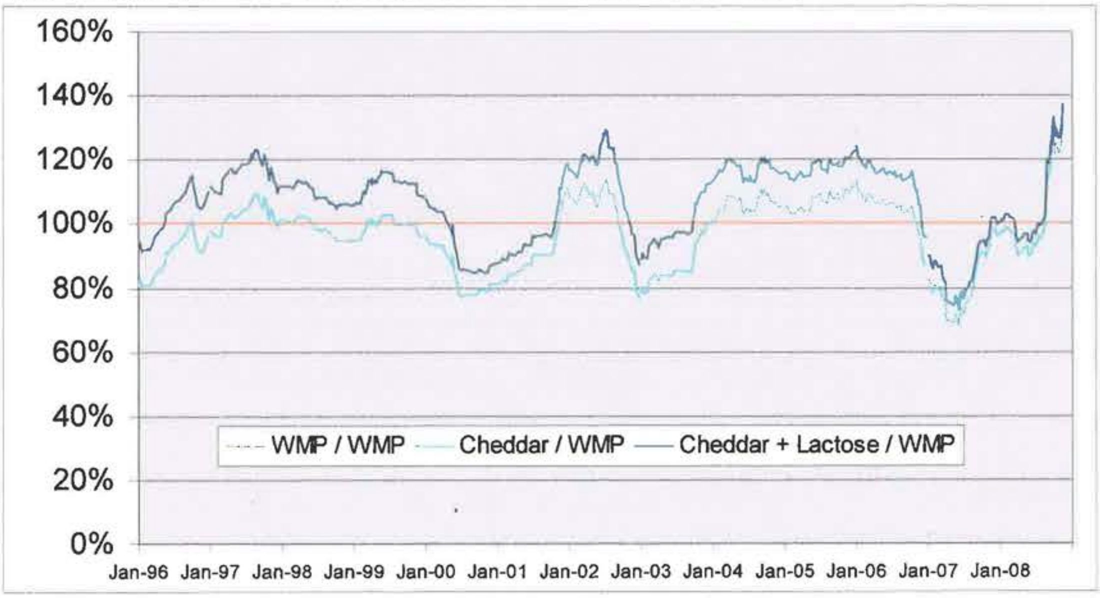
Cheese and Whole Milk Powder are alternative uses of milk. In the same way we have deconstructed other product mixes we can achieve a similar outcome with Cheese and WMP. Unlike other product options CODEX WMP inherently is Fat deficient for making standard Cheddar cheese and requires a small Fat top up which will come from Fat used for Butter making. Based on 100 kg WMP we can make 82.0 kg standard Cheddar cheese and 48.1 kg Whey Powder. Casein Protein is assumed to be 80% of WMP crude protein and basis for the yield cheese.

Table 4.2: WMP and Butter convert ed to Cheese and Whey Powder

	WMP	+ Butter	Cheese	Yield Cheese	Whey Powder
Fat	26.50		35.00	26.50	
+ Fat		2.67		2.19	
Protein	25.10		24.50	20.08	5.02
Milksolids	51.60	2.67	59.50	48.77	5.02
Lactose	39.80		1.39	1.14	38.66
Minerals	5.90		3.85	3.16	2.74
Moisture	2.70		35.26	28.90	1.62
	100.00		100.00	81.96	48.05

Whey Powder is generally regarded as a low value product frequently used as the base for low cost Calf Milk Replacer formulations. It also has an alternative use in the manufacture of high value infant formula. The alternative use of Whey Powder as an ingredient for a high value Infant Formula is regarded as a Value Add activity. The following chart shows the Raw WMP + Butter revenue and Cheese revenue ratio, where Whey powder has no value and when Whey Powder has a nominal value of $1.00 kg. [There are no readily available data sets for Lactose and whey powder prices to incorporate into this comparison]

Chart 4.4: Cheese, Cheese + Whey Powder and WMP + Butter revenue ratio.



The average revenue ratio of Cheese and WMP + Butter for the data set is 92.5%
The average revenue ratio of Cheese + Whey Powder [$480] and WMP + Butter for the data set is 106.4%

Whey powder comprises has 11-14% crude protein and 63-75% lactose. It is important that Lactose value is included into the Cheese process stream. In the absence of Whey or Lactose Powder, as a co-product, suggests that making Cheese is a less preferable option to making WMP.

Alternative uses of whey include Whey Protein Concentrates, Lactose powder or Ethanol. These options need to yield more profit than Whey Powder. There will be an increase in capital investments and will require more energy to process to finished powders.

Producing Ethanol is the exception; in that Ethanol is evaporated from whey permeate rather than water from Lactose making this process less energy demanding than powder manufacture.

One of the difficulties for Fonterra is that unlike new comers, like Synlait, it has a source of Lactose as a by-product of cheese manufacture. To be able to transfer Lactose into CODEX milk powders is a huge Value Add activity, to be distributed via Milksolids payment. Synlait needs to buy Lactose for Milk Powder manufacture and is a legitimate manufacturing cost. Having Lactose already present in milk is a valuable resource which Synlait recognises by way of a Lactose payment.

5. Milk Payment Models

Since 1985, dairy companies state they are using the A+B-C [Fat + Protein – Volume] milk payment formula. Despite the apparent simplicity of the formula, only Westland continues to pays its suppliers that way and in a convoluted way so is Tatua.

Table 5.1: Milk Payout Values 2001-2006 seasons

Tatua	2006/7	2005/6	2004/5	2003/4	2002/3	2001/2
Fat	196.6878	254.2410	252.8271	256.6510	353.5496	414.4466
Protein	702.4546	687.1379	682.5146	692.8373	840.3818	985.1330
Milksolids	4.1000	4.3500	4.3200	4.3900	5.6000	6.7280
VCR	0.280	0.370	0.370	0.370	0.421	0.421

Westland	2006/7	2005/6	2004/5	2003/4	2002/3	2001/2
Fat	306.1900	273.8600	332.8400	299.8800	293.0900	398.4500
Protein	665.6300	595.3500	723.5600	651.9100	637.1600	866.1900
Milksolids	4.6600	4.1500	4.5300	4.1300	3.9710	5.4310
VCR	0.460	0.460	0.460	0.460	0.460	0.460

Fonterra	2006/7	2005/6	2004/5	2003/4	2002/3	2001/2
Fat	266.5663	244.8919	260.5794	236.1211	205.1814	332.4400
Protein	683.5066	628.3356	723.8430	674.6204	569.9507	791.5300
Milksolids	4.4600	4.1000	4.5900	4.2500	3.6300	5.3000
VCR	0.390	0.390	0.360	0.350	0.360	0.420

Source: Company Annual reports and private communications

The payout values shown are inclusive of Volume related costs. In reality, for the A + B – C formula to work the Volume cost needs to be included into the Milksolids [Fat + Protein] portion of the payment and then deducted. Here is where the various implementation of the basic formula differ.

Westland:

Payout = (Payout + Volume) Protein$ + (Payout + Volume) Fat$ - Volume$

Tatua:

Payout = Payout Protein$ + Payout Fat$ - Volume$ + (Volume Protein$ + Volume Fat$)

Fonterra:

Payout = Payout Protein$ + Payout Fat$ - Volume$ + MS Volume$

At the average [neutral] position each model will deliver the same payout. It is only at the extreme variations of milk composition does the implementation method create an effect. Mathematically Tatua and Westland are equivalent and both correctly implement the A + B – C formula. Fonterra's implementation appears similar but does not correctly value the MS redistribution.

Fonterra's volume charge comprises two components, the Excess Volume Charge [EVC] and a component embedded in the Capacity Entitlement [CE] charge. The total charge during 06/07 season was 3.79c/l.

The Excess Volume Charge for 06/07 season was set at 2.70c/l.
The volume component of Capacity Entitlement is about 1.09c / l.

Volume component of Capacity Entitlement

100 kg MS = 5.8545 Capacity Entitlement litres * $5.40 * 0.4 volume ratio / (100 kg MS / 8.61%)
= 1.09c / l

Using a hypothetical payout of $5.00 and a Volume charge of 4.0c/l we can construct payment simulations for each company.

Table 5.2: Milk payment model Comparisons [Average Milksolids Milk]

	Base Values	Tatua Value$	Tatua Payout$	Westland Value$	Westland Payout$	Fonterra Value$	Fonterra Payout$
Fat kg	57,013	2.7803	158,514	3.0387	173,243	2.7803	158,514
Protein kg	42,987	7.9438	341,485	8.6819	373,215	7.9438	341,485
Gross Payout	100,000	5.00	500,000	5.46	546,458	5.00	500,000
Protein : Fat Ratio	0.754						
MS%	8.61%						
Volume	1,161,440	-0.040	-46,458	-0.040	-46,458	-0.040	-46,458
Volume Fat $		0.26	14,728				
Volume Protein $		0.74	31,729				
Volume Redistribution	1,161,440					0.040	46,458
Net Volume Charge			-		-46,458		-
Net Payout			500,000		500,000		500,000

To see how the implementation changes payout value for High Milksolids % [Jersey average for 2006/7]

Table 5.3: Milk payment model Comparisons [High Milksolids Milk]

Jersey	Base Values	Tatua Value$	Tatua Payout$	Westland Value$	Westland Payout$	Fonterra Value$	Fonterra Payout$
Fat kg	58,235	2.7803	161,912	3.0387	176,957	2.7803	161,912
Protein kg	41,765	7.9438	331,777	8.6819	362,604	7.9438	331,777
Gross Payout	100,000	4.94	493,689	5.40	539,561	4.94	493,689
Protein : Fat Ratio	0.717						
MS%	9.82%						
Volume	1,018,330	-0.040	-40,733	-0.040	-40,733	-0.040	-40,733
Volume Fat $		0.26	15,044				
Volume Protein $		0.74	30,827				
Volume Redistribution	1,161,440					0.040	46,458
			5,138		-40,733		5,724
Net Payout			498,827		498,827		499,414

To see how the implementation changes payout value for Low Milksolids % [Holstein average for 2006/7]

Table 5.4: Milk payment model Comparisons [Low Milksolids Milk]

Holstein	Base Values	Tatua Value$	Tatua Payout$	Westland Value$	Westland Payout$	Fonterra Value$	Fonterra Payout$
Fat kg	55,085	2.7803	153,155	3.0387	167,386	2.7803	153,155
Protein kg	44,915	7.9438	356,798	8.6819	389,950	7.9438	356,798
Gross Payout	100,000	5.10	509,953	5.57	557,335	5.10	509,953
Protein :Fat Ratio	0.815						
MS%	7.91%						
Volume	1,264,223	-0.040	-50,569	-0.040	-50,569	-0.040	-50,569
Volume Fat$		0.26	14,230				
Volume Protein$		0.74	33,152				
Volume Redistribution	1,161,440					0.040	46,458
Net Volume charge			-3,187		-50,569		-4,111
Net Payout			506,766		506,766		505,842

Westland has the Volume Charge built into their initial component payouts. Fonterra and Tatua component payouts are net of the volume charge.

The sensitivity table below shows the payment difference between High and Low Milksolids milks and the differences between Tatua/Westland and Fonterra.

Table 5.5: Sensitivity analysis of VCR and Volume Charges on Payment Differences between High and Low Milksolids Value

Payout $5.00 / kg MS 100,000 kg MS supplied	Volume Charge c/litre	VCR 0.30	0.35	0.40	0.45
Tatua / Westland	3.5	11,231	8,979	6,923	5,038
Fonterra	3.5	9,739	7,657	5,756	4,012
Payment difference	3.5	1,492	1,322	1,167	1,026
Tatua / Westland	4.0	10,214	7,939	5,861	3,955
Fonterra	4.0	8,510	6,428	4,526	2,783
Payment difference	4.0	1,705	1,511	1,334	1,172
Tatua / Westland	4.5	9,198	6,898	4,798	2,872
Fonterra	4.5	7,280	5,198	3,297	1,553
Payment difference	4.5	1,918	1,700	1,501	1,319

The subtle differences between the Tatua/Westland and Fonterra payout models show that Fonterra typically pays more for High Milksolids milks and less for Low Milksolids than its competitors. Just the implementation of the payment model has a modest influence on the value of milk at the farm gate.

Increasing VCR

As VCR increases the value difference between Fat and Protein declines and the value difference between High and Low Milksolids milk closes.

Increasing Volume Charge

As the Volume charge increases it erodes the value of Low Milksolids milks. The redistribution of Volume charges using VCR will transfer more value to High Protein / Low Milksolids milks.

Volume Charge Redistribution mechanism

Fonterra bases its redistribution mechanism on a flat Milksolids basis applying the volume redistribution equally between Fat and Protein. This mechanism takes value from High Protein / Low Milksolids and transfers it to Low Protein / High Milksolids milk. The redistribution mechanism used by Tatua and Westland uses the VCR to redistribute Volume charges. The later more closely conforms to the A + B – C formula.

Tatua has an economic advantage of having a compact milk collection area and the lowest volume charge of 3.5c/l and the lowest current VCR at 0.28 and pays the most for Low Milksolids / High Protein milks and the least for High Milksolids / Low Protein milk.

Westland on the other hand has the highest volume charge at 4.5c/l and the highest VCR at 0.46. It pays the least for Low Milksolids / High Protein milks and the most for High Milksolids / Low Protein milk.

Fonterra has an intermediate position with a.3.79c/l Volume charge and a VCR of 0.36. Fonterra consistently pay less for Low Milksolids / High Protein and more for High Milksolids / Low Protein milks than their competitors.

Fonterra commands 95% of the New Zealand milk market and dominates the AEU interpretation of payout.

6. Manufacturing / Revenue Models

In the previous sections we have shown that:

- The AEU uses VCR in setting the long term value of milk
- Breeding trends in New Zealand are moving to higher Milksolids milks with less Lactose
- Fat is less efficient in converting feed energy to milk profit
- A Lactose payment would close the BW gap currently between major New Zealand breeds
- The New Zealand average VCR is trending downward but is significantly higher than its true value
- The VCR used by Fonterra is too high for the New Zealand milk market
- World commodity prices sets VCR and is naturally close to 0.35
- That true VCR would be lower once Lactose value is recognised
- Whole Milk Powder should be the bench mark from which other product values are compared
- WMP typically generates more revenue than SMP + Butter made from the same quantity of milk
- Casein seldom yields more revenue than SMP and requires Whey Powder and Lactose revenue to improve revenue ratios
- Cheese seldom yields more revenue than WMP and requires Whey Powder and Lactose revenue to improve revenue ratios
- Payment models change milk value at the farm gate

6.1 Manufacturing Models

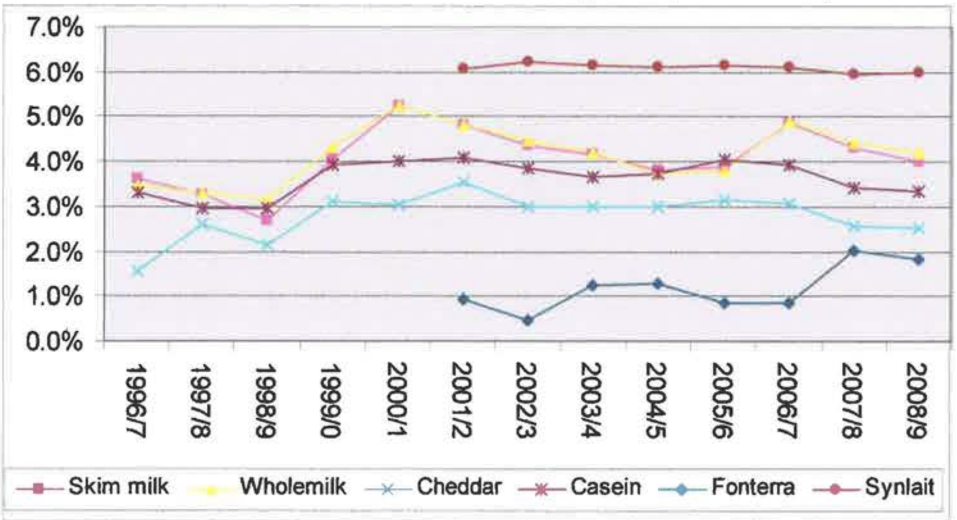
In this final section we will study the 4 main commodity product streams. Appendix B has a detail explanation on the construction of the Skim Milk Powder + Butter model. Appendix C discusses Massey University's work. Appendix D shows print outs of the manufacturing models using 2006/7 average commodity prices.

The models show that gross income is very dependant on yield. That gross yields for Milk Powder, Cheese and Casein are dependant on Protein. The higher Protein content of Low Milksolids milks typically produces a 7% yield advantage over High Milksolids milks. This typically translates to a 7-9% gross revenue advantage for Milk powder and a 3-5% revenue advantage for Cheese and Casein. The lower revenue yield for Cheese and Casein is due to the low value assigned to their by-products Whey Powders and Lactose.

The gross yield advantage of Low Milksolids milk is reduced when CODEX standardising is permitted. Standardising of Lactose content in CODEX milk powders masks a significant manufacturing cost that is missed in the current payout models.

Throughout the study period the final net milk value difference between Holstein and Jersey is consistently higher that what Fonterra has distributed to members. [For simplicity 2006/7 milk compositions have been held constant, Whey and lactose powder value has been held at $1,000 / t]

Chart 6.1: Relative value difference between Holstein and Jersey milks [Fonterra costs].

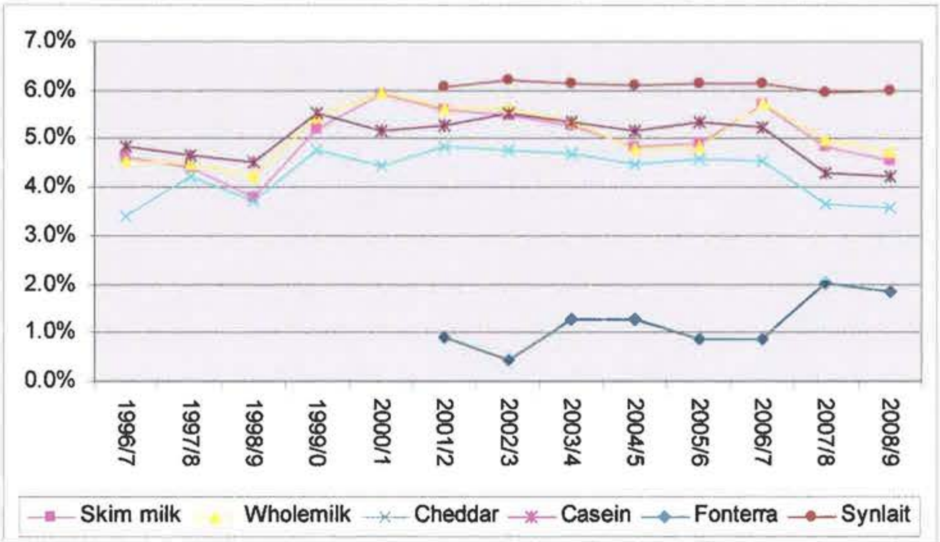


Using a conservative value of $1,000 / t Lactose the models estimate that Low Milksolids / High Protein milks should have received between 1.5 -4.0% more economic benefit than High Milksolids / Low Protein milks. Fonterra payment differences for the same period are considerably less.

With the New Zealand Dairy industry becoming more focused on Milk powders production it can be seen that the current payment models are under paying Holstein Friesian type milk. The upward lift in the Fonterra payment ratio between Holstein and Jersey milk in 2007 and 2008 is due to the much higher lift in value for commodity products had relative to the fixed volume related costs of manufacturing.

Without a payout history Synlait's payment ratios have been based on the Fonterra payout for each season. [A sensitivity check shows no significant change at Fonterra payout – 0.25c] and their volume charge of 3.31c/litre. The much higher payment differential is due to their lower Volume Charge and a higher value they place on Lactose.

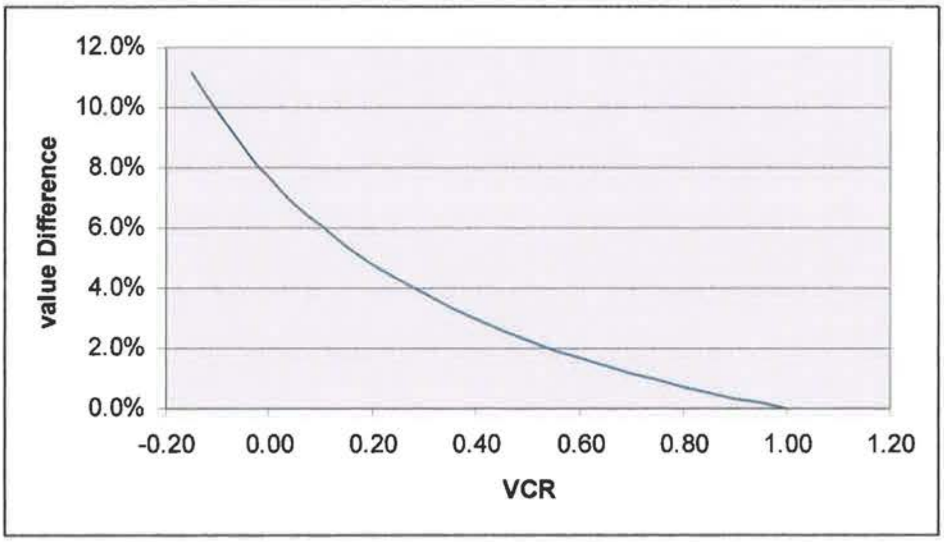
Chart 6.2: Relative value difference between Holstein and Jersey milks [Synlait costs].



6.2 Can the Current Payment models correctly reflect milk Value?

In the models the Low Milksolids milks are consistently more valuable than High Milksolids milks in all the product processes. Using the limited tools available in the current model it is possible to achieve the value differences identified. The following graph shows that the VCR can be used to manipulate value difference between Low and High Milksolids % milks.

Chart 6.3: VCR Impact on Value difference between Low and High MS% milks



In a milk powders environment the value difference [before volume and standardizing costs] is about 8%. To achieve that scale of value difference a VCR of 0.0 is required. Should such a value be introduced into the Evaluation model Fat, like Lactose, would have no economic value at the farm gate and Protein would carry all the economic weight.

Current shareholders would see this as irrational and inconsistent with the positive economic value Fat has making Butter. This logic should be extended to Lactose.

7. Regional Variation in Milk Production and Composition

Throughout New Zealand there is significant variation in milk production outputs per Ha. Along with the significant increase in output there is an increase in Lactose output.

Chart 7.1 Milk Component Production per Ha

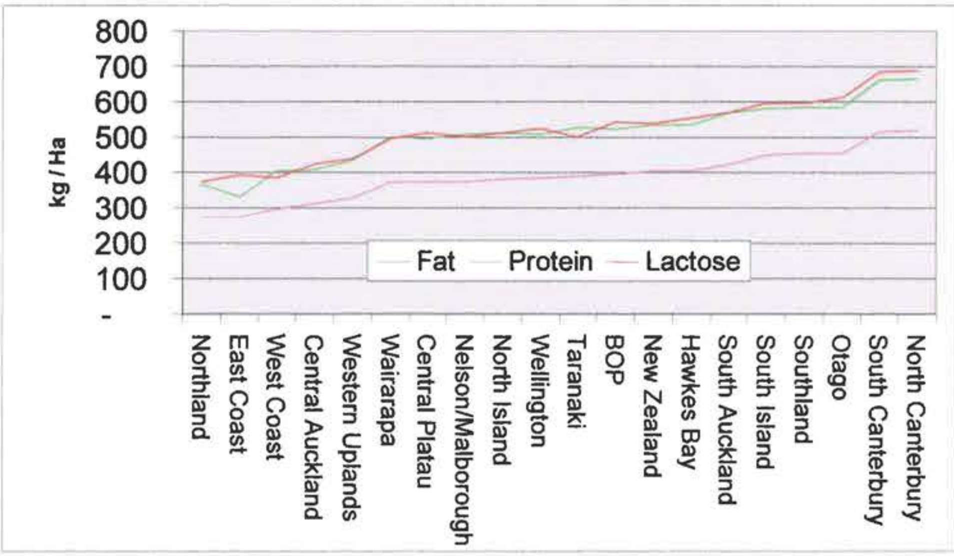
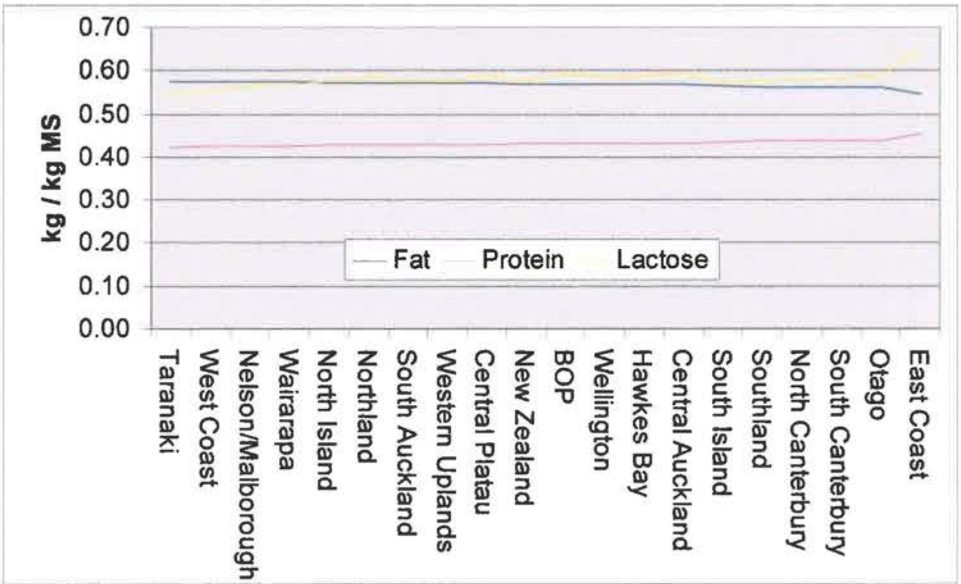


Chart 7.2 Milk Component Compositions as a Ratio to Milksolids.



With the exception of the South Island regions dominate milk production per Ha, highest Protein: Fat Ratio, lowest Milksolids concentration and Lactose output.

The west coast regions, Westland, Taranaki have the highest Milksolids concentration etc. This has a genetic/breed component but may reflect environmental circumstances.

8. Conclusion

The current milk payment model used by most New Zealand Dairy companies does not reflect market prices correctly to the farm gate. This flawed signal has been used to estimate the most profitable for the industry.

The current Animal Evaluation model, developed in 1996, compares the opportunity feed costs of producing various milk components. It incorrectly places high value on Protein and falsely penalizes Lactose because it is not in the farm gate price. With its high weighting [66%] for milk revenue, this model is selecting High Milksolids milks and driving Lactose out of the milk supply. With gene knowledge, breeding companies are pre-selecting sires that meet these apparent breeding objectives.

Other farming practices, such as "Once a Day" milking, is driving Milksolids concentration up and decreasing Lactose output.

Decreasing Lactose output automatically improves the efficiency of producing Milksolids in the Breeding worth model because there is no farm gate revenue signal for Lactose. Over 75% of milk in New Zealand is processed into Milk Powders where Lactose comprises between 40% and 53% of product tonnages. The declining Lactose content in milk supply is reducing powder yields or increasing the cost of standardizing Lactose. Costs that are not reflected in the farm gate price because Lactose value is blended into the current Protein payment.

In developing the models used in this report the farm gate price has been ignored and only the relative value differences of different milk types are studied. It shows Lactose plays an important role in developing milk value. Increasing Lactose content may increase manufacturing costs but the increase in milk value is significantly more.

The use of "value ratios" is independent of actual payout magnitude. A 1% value shift represent 4c / kg MS at a $4.00 payout. A value difference of 5% at a $7.60 payout represents a 38c / kg MS difference. Historically the highest difference between milk type paid by Fonterra has been 2% and is consistently 1-4% lower than the value estimates derived from the models.

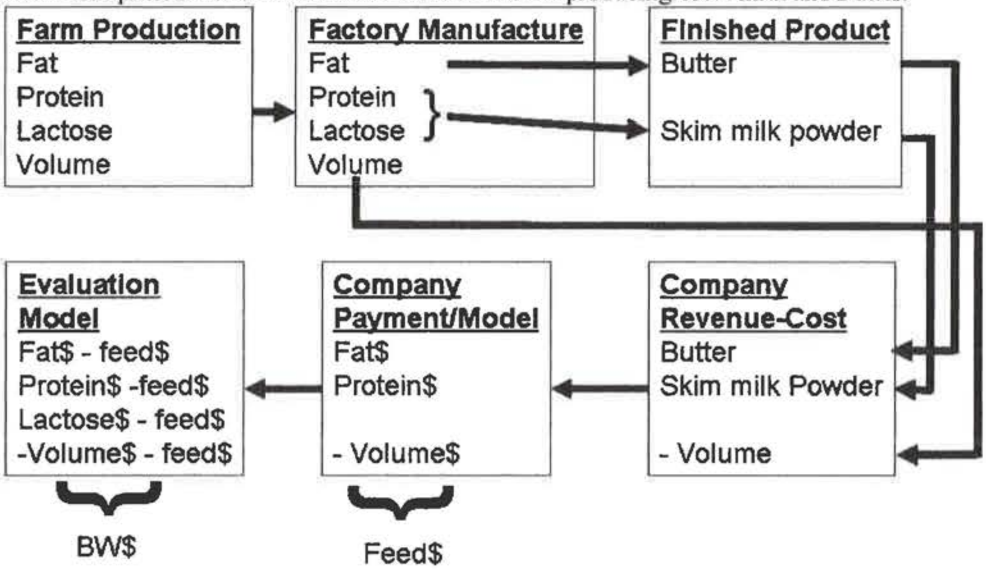
As Lactose content increases the energy cost to produce milk goes down. On a feed energy basis Fat is grossly less efficient in creating product revenue. In a Whole Milk Powder environment Fat and Solids Not Fat generate the same revenue. The energy cost of Fat [56 MJME / kg] is 66% higher than the energy cost of Solids Not Fat [30 MJME / kg]. The long term value of Fat [as Butter] is 96.6% that of Solids Not Fat [as Skim Milk Powder] during the study period. The drive for more Fat has not been recognised as being less efficient than producing more Solids Not Fat.

Correcting the marketing signal at the farm gate can be accomplished easily by introducing a Lactose component into the Milk Payment models. It is also possible to achieve the same outcome in a two component model, by lowering the VCR to around 0.15 or lower. At this value the Evaluation model would determine that Fat is produced at a loss.

Synlait has to be commended for their forward thinking in this arena.

Appendix A: Simplified Partial Implementation of the AEU Animal Evaluation.

Figure A.1: Simplified model for Animal Evaluation when producing Skim milk and Butter.



Description:
A Farmer uses feed to produce milk containing Fat, Protein, Lactose, Volume and Live Weight [partially excluded from this discussion for simplicity]. Milk is manufactured in to product, here Skim milk powder and Butter. The finished product is sold and manufacturing costs are deducted forming the farm gate milk price, while keeping separate volume costs. The net farm gate milk revenue determines the opportunity cost of feed. Revenue from salvage [cull] cows, calves and related feed inputs refine the opportunity cost of feed.

There is no Lactose component in the farm gate payment. The Lactose value is blended into the Protein payment.

The total farm gate revenue is divided by the total energy input to determine the proxy [opportunity] cost of feed. In the Evaluation Model the proxy feed$ value is deducted from the Farm gate payment determining the Economic Value of each component. Each milk component has a different energy requirement and feed$ cost, offering different profit opportunities.

Table A.1: Simplified Economic Evaluation of Milk Components [Fonterra $5.10 / kg MS].

Fonterra	Output	MJME	Energy cost MJ	Payout $5.10	Feed Cost $	Profit $	Economic Value $
Fat	200	56	11,200	580	424	156	0.78
Protein	151	32	4,832	1208	183	1025	6.79
Lactose	203	25	5,075	0	192	-192	-0.95
Volume	4,070	0.61	2,483	-158	94	-94	*-0.06
Total		67.2	23,590	1,788	894	894	

* The Economic Value$ of Volume includes both the Volume charge and Energy charge.
The Volume charge is neutral in payment model for average milk.

Roughly 50% of feed energy is applied to Live Weight with the remainder used to produce milk. In the example $1,788 revenue requires (23,590 * 2) MJME energy to produce. The derived feed opportunity cost becomes 3.8c / MJME. The energy requirement can also be viewed as 4,493 kg DM @ 10.5 MJ and is close to the 4.5 t DM base described in the AEU model.

Fat is energy dense and requires 56 MJME / kg to produce. Deducting the feed$ cost leaves profit of $0.78c per kg Fat produced. Protein requires less apparent energy than Fat but has a high Payout value. The Protein profit after feed cost is very high suggesting that farmers should pursue Protein production. The manufacturing diagram shows that Lactose value forms part of the Protein payment and Lactose energy should form part of the energy cost, but is not. The pragmatic approach used by the AEU excludes this energy cost. In doing so, they falsely promote Protein production and falsely penalise Lactose production.

The absence of a Lactose payment at the farm gate leads to the false conclusion by the AEU that any energy applied to Lactose production is wasted [zero value]. Yet at the factory Lactose forms an important ingredient in the manufacture of milk powders and especially CODEX milk powders, along with other "Value Add" activities such as "Pharmaceutical Grade Lactose Powders".

Like the dairy companies the AEU seeks to smooth Economic Values by applying running averages and smoothed projections in determining the future values.

The Lactose needs to be separated from the Protein payment. Its inclusion within the Protein payment is misleading and needs to be corrected.

Contrast the evaluation outcome using Synlait's proposed payment model. For consistency of comparison Fonterra's Volume charge is used.

Table A.2: Simplified Economic Evaluation of Milk Components [Synlait $5.10 / kg MS].

Synlait	Output	MJME	Energy cost MJ	Payout $5.10	Feed Cost $	Profit $	Economic Value $
Fat	200	56	11,200	490	424	66	0.33
Protein	151	32	4,832	1072	183	889	5.89
Lactose	203	25	5,075	227	192	35	0.17
Volume	4,070	0.61	2,483	-158	94	-94	*-0.06
Total		67.2	23,590	1,789	894	895	

* The Economic Value$ of Volume includes both the Volume charge and an Energy charge.
The Volume charge is neutral in payment model for average milk.

With a lower economic value for Fat and a positive value for Lactose, Synlait will encourage more Protein production. Energy estimates show that this approach will lower the energy [feed] requirements to produce more milk. For a fixed Protein output, lowering Fat production will increase Lactose output. The energy saved by substituting of 1 kg Fat with Lactose will save 19 MJME [Fat -56 MJME / kg + Lactose 25 MJME / kg + Volume 18 MJME] of energy that is available for extra milk production.

Three Component Payment Model

Elsewhere in this report it has been shown that the revenue potential of Butter + SMP is lower than WMP. If we assume that WMP is the preferred [and only] product, the revenue generated by milk is dependant on all the components used.

The conversion of the two component Milksolids [Fat + Protein] payout to a three component Total Milk Solids [TMS: Fat, Protein and Lactose] payout requires the redistribution of value:

Distributing MS value equally over TMS:

TMS payout = $5.10 * 351 kg MS / 553 kg TMS = $3.23 for Fat, Protein and Lactose.

Table A.3: Simplified Economic Evaluation of Milk Components [WMP production. $5.10 / kg MS].

Whole Milk Powder	Output	MJME	Energy cost MJ	Payout $5.10	Feed Cost $	Profit $	Economic Value $
Fat	200	56	11,200	645	424	221	1.11
Protein	151	32	4,832	487	183	304	2.01
Lactose	203	25	5,075	655	192	463	2.28
Volume	4,070	0.61	2,483	-158	94	-94	*-0.06
Total		67.2	23,590	1,788	894	894	

* The Economic Value$ of Volume includes both the Volume charge and Energy charge.
The Volume charge is neutral in payment model for average milk.

In a milk powders only manufacturing environment, the economic value of different milk components changes considerably. Each component generates identical revenue and incurs identical manufacturing costs. Once the feed energy costs are applied to each of the components it shows that high MJME Fat is less profitable than Protein or Lactose.

From a purist point of view, this evaluation is most correct.

Re Cutting the Payout Pie

In reality manufacturers place more value on Protein because it determines the yield characteristics of many of the products. Lactose on the other hand is a by product of Cheeses and Casein manufacture and is produced in excess by the industry and trends to be disposed off at cost. It is sold into the carbohydrate/sugar market or converted to ethanol. Its marketability is restricted by; the low cost of sucrose [table sugar], Lactose intolerance in consumers, its low sweetness measure [1 sixth of sucrose] and its low value as ethanol. The long term value of Lactose is between $NZ 1.00 and $NZ 2.00 kg. If Lactose is deemed to be an ingredient for milk powders then it intrinsically holds $1.00 as a minimum value in any product that uses it.

Payout available for distribution is fixed. How it is distributed is a matter of balancing payout values between components [cutting the pie]. Protein is considered as the main value component of milk followed by Fat. Currently Lactose is assigned no value by companies, with the exception of Synlait.

We can simplify average milk composition to simple ratios, Protein is 1.00, Fat become 1.33 and Lactose becomes 1.35. Using these ratios we can re formulate payout in terms of those ratios. The following table shows that payout cannot be destroyed or created but only distributed in another way.

Starting with a payout of $5.10 / kg MS, composing of a Protein component of $8.03 and Fat component of $2.90 [ratio 0.36]. Distributing that evenly over a Total Milk Solids [TMS] payment model becomes $3.23 / kg TMS.

The ingredient Lactose holds an intrinsic value of $1.00. This value needs to be deduced from the average TMS price paid to Lactose and allocated to another component, Protein. Lactose value lost becomes ($3.23 - $1.00) * 1.35 or $3.01 to be added to Protein.

Table A.4: Payout Redistribution from example

	Protein	Fat	Lactose	Total	Average Payout	Total Payout	Payout Ratios P : F :L
Average Milk percentages	3.70	4.91	5.00	8.61			
Average Ratios in milk	1.00	1.33	1.35	3.68			
Average Milk Solids	1.00	1.33		2.33			
Component Payout	8.03	2.90			5.10	11.88	1.00 :0.36 :0.00
TMS Average Value	3.23	3.23	3.23		3.23	11.88	1.00 :1.00 :1.00
Lactose redistribution	3.01		-2.23				
Interim values	6.24	3.23	1.00		3.23	11.88	1.00 :0.52 :0.16
Assumption Butter =$2.90	0.44	0.33					
Final Payout	6.68	2.90	1.00		3.23	11.88	1.00: 0.43: 0.15

To complete the example we can reallocate some Fat value to Protein. To get the residual of $2.90, 0.33c of Fat value is to be added to Protein. The Fat to Protein ratio is 1.33. Fat value added to Protein = 0.33 * 1.33 = 0.44c. These ratios will be used to demonstrate how milk value changes and which most closely true milk value.

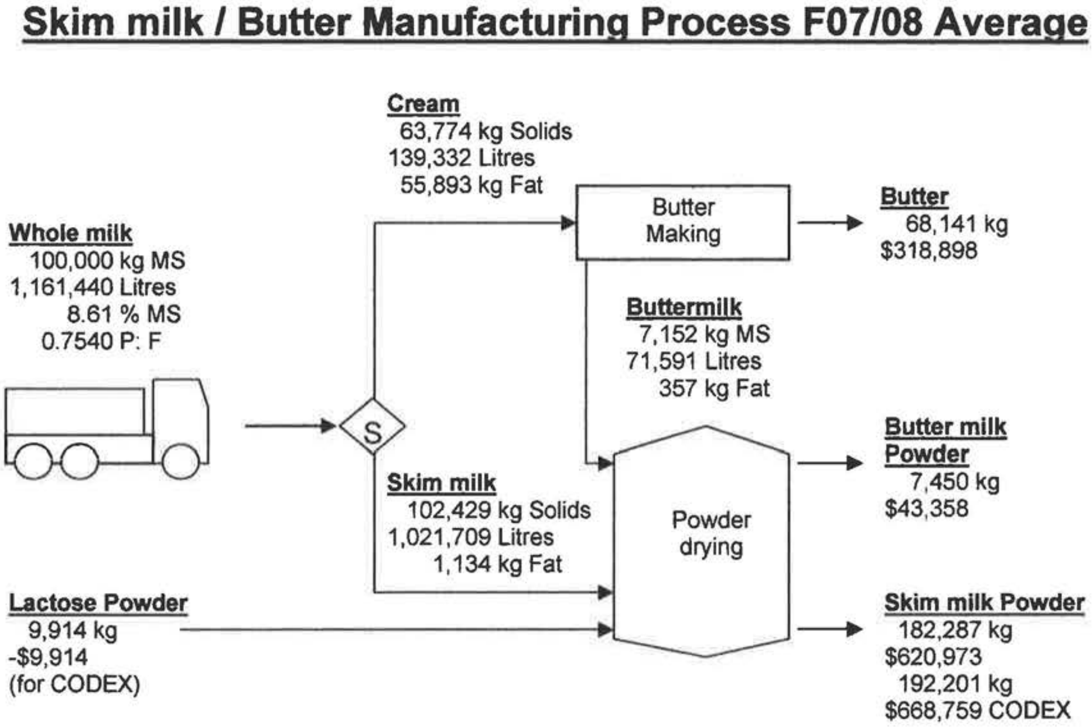
For comparison the value ratios for Synlait are P 1.00, F 0.34, L 0.16.

Appendix B: The Factory model; Skim milk Powder / Butter

Four manufacturing models have been developed for this paper. They portray a simplified analysis of the five main commodity products produced in New Zealand [Butter is a common co-product]. Each model has been based on the average milk composition of Fonterra and then expanded to compare the yield outcomes for Holstein Friesian [Low Milksolids %] and Jersey [High Milksolids %] milks.

In developing the models, the Pearson Square calculation has been used to refine the partitioning of milk components through various process steps. This calculation compensates for leakage of components that do not follow the main process stream. Also perfect yields occur with no adjustments for losses.

The following diagram portrays the basic Skim milk/Butter process and incorporating the F 07/8 average commodity product prices [$NZ]. The model is based on a fixed 100k kg Milksolids.
Fig B.1. Skim milk powder / Butter Process.



The yield elements remain constant within the process and are independent of product prices. The model uses the basic characteristics of the milk being processed. The table below identifies the remaining detail for Lactose, Minerals and Solids not Fat and extends the comparison to High and Low Milksolids milks..

The model uses average Jersey milk composition as typical High Milksolids milk and average Holstein Friesian as typical Low Milksolids milks. Other compositional variations can be modelled, such as Once A Day vs. Twice A Day or early season vs. late season milk.

Again, the yield characteristics do not change for each milk type, but the revenue may vary significantly.

New Zealand's Fat and Protein based payment model ignores Lactose and Minerals. These milk components have a significant impact on raw yield, manufacturing costs and ultimately profit.

The model shows that the raw product yield. Low MS% milks out performs High MS% milk by 7.4%. When the manufacturer is not making CODEX milk powder Low MS% milk after manufacturing costs is far more valuable than High MS% milk [7.9%].

CODEX rules now allow the Lactose standardisation of powder. The quantity of Lactose needed to optimise the yield differs between High and Low MS% milks. Low MS% milk requires less standardisation Lactose because of the high Lactose content naturally present in milk. After standardisation the yield of milk powder becomes much closer [4.4%] between High and Low MS% milks.

The higher Protein content of Low MS% milk leads to an overall raw yield advantage [8.5%] over High MS% milk. To appreciate why this is so, consider the substitution of 1 kg Protein with 1 kg Fat. This will cause 1.22 kg increase in Butter output with a corresponding 2.82 kg drop in SMP yield. Unless the price of Butter is more than three times that of SMP, the total amount of revenue will fall.

Lactose is associated with Volume and an increase in manufacturing costs [16.9%].

Fig B.3 Skim Milk Powder / Butter model

Skim milk Powder Manufacture F 2007/8 Season

Skim milk		Fat	High MS%	Average	Low MS%	
Fat			58,248	57,027	55,247	
Protein			41,752	42,973	44,753	
MS %			100,000	100,000	100,000	
Lactose			50,916	58,072	63,211	
Minerals			7,128	8,130	8,850	
Total Milk Solids			158,045	166,202	172,061	
Raw WM Volume			1,018,330	1,161,440	1,264,223	
Cream (40%)			142,929	139,732	135,119	
Std WM			875,401	1,021,709	1,129,104	
Fat:Prot Ratio		0.0300	0.12%	0.11%	0.11%	
Raw Product Yield			High MS%	Average	Low MS%	
Butter			69,700	68,141	65,891	
BMP			8,192	7,450	7,069	
Skim milk			96,322	106,696	115,127	
Raw Total			174,214	182,287	188,087	
			-4.4%	0.0%	3.2%	[illegible]
Added Lactose			14,548	9,914	7,856	
Net yield			188,762	192,201	195,943	
			-1.8%	0.0%	1.9%	[illegible]
Skim milk						
Raw Revenue			High MS%	Average	Low MS%	
Butter	$	4.68	326,190	318,892	308,364	
BMP	$	5.83	47,718	43,396	41,176	
Skim milk	$	5.83	561,074	621,507	670,617	
Raw Revenue Total			934,982	983,795	1,020,157	85,175
			-5.0%	0.0%	3.7%	[illegible]
Manufacturing Costs						
EVC	-$	0.0270	- 27,495	- 31,359	- 34,134	
CE (Volume)	-$	0.0109	- 11,088	- 12,646	- 13,765	
CE (Total Solids kg)	-$	0.1141	- 18,038	- 18,969	- 19,637	
Total Costs			- 56,620	- 62,973	- 67,536	- 10,916
			-10.1%	0.0%	7.2%	17.3%
Net Income (before standardizing)			878,362	920,821	952,621	74,259
			-4.6%	0.0%	3.5%	[illegible]
Lactose Cost	$	1.00	- 14,548	- 9,914	- 7,856	
Lactose added Value	$	5.83	84,743	57,749	45,762	
Net Income (After standardizing)			948,567	968,656	990,527	41,970
			-2.1%	0.0%	2.3%	[illegible]

Volume costs are Fonterra's, comprising 2.70c/l from the Excess Volume Charge and 1.11c / litre being the Capital component embedded in their Capacity Entitlement Charge.

In the model the balance of the Capacity Entitlement Charge has been allocated using Total Milk Solids rather than Milksolids. This allocation method is places a manufacturing cost on Lactose and is fairer than the current Milksolids only basis.

The gross revenue advantage before standardisation to Low MS% milk is 7.9%. However if CODEX product is being made the Protein to Lactose ratio can be adjusted. The addition of Lactose to milk powders incurs a Lactose cost to get the yield gain. The revenue gains justify the cost. High MS% milk has the greatest Lactose deficit and obtains the biggest revenue boost. When milk powders are manufactured to CODEX standards the revenue/profit margin of Low MS% milk drops to 4.4%.

Having High MS% milk with a low Lactose content is advantageous if there is a supply of surplus Lactose. Generally, the value of Lactose powder closely resembles its cost of production of Lactose and is much greater than the cost of processing Volume.

The yield of Lactose powder, using current crystallisation technology, typically recovers about 50% of the Lactose that enters the process. There are more than twice the volume costs associated with recovering Lactose than if it were in the milk with Protein at the start of the Milk Powder manufacture.

This is not reflected in New Zealand payment models.

Appendix C: Massey University Milk Valuation Model.

Reference: Milk Production from Pasture, 2002, C. W. Holmes [et. el] Ch 24.

Massey researcher Nick Lopez-Lillalobos developed a manufacturing simulation model based on data obtained from NZDG, Kiwi Co-operative Dairy Co and New Zealand Dairy Board. The model was based on manufacturing processes, their yields and costs. His approach differs from that used in this paper but draws similar outcomes. The following tables are derived from the publication

Table: C.1: Milk solids concentration [g / 100g] (from Table 24.1)

Milk	Average	Holstein	Holstein Friesian	Jersey	Ayrshire	Cross Breed F*J
Fat	4.68	3.50	4.39	5.77	4.36	4.79
Protein	3.53	3.20	3.41	4.01	3.50	3.59
Milksolids	8.21	6.70	7.80	9.78	7.86	8.38

In the publication they discusses milk value in terms of mass (g / kg milk) not volume. Applying milk with the above compositions to the main commodity channels they have estimated the True Value of milk.

Table C.2: True Milk value [$ / kg Milk] (From Table 24.5c)

Milk Channel	Average	Holstein	Holstein Friesian	Jersey	Ayrshire	Cross Breed F*J
Whole Milk Powder	0.284	0.238	0.278	0.334	0.274	0.289
Skim milk Powder	0.269	0.223	0.255	0.319	0.260	0.274
Cheese	0.335	0.283	0.320	0.394	0.326	0.342
Casein/Butter	0.311	0.265	0.297	0.362	0.302	0.316

On the milk mass basis reported, Jersey High MS% milk is the most valuable on a milk mass basis and [US] Holstein the lowest. This interpretation reinforces the view that High MS% milk is the more valuable than Low MS% milk. This methodology masks a different outcome when the data is converted to a kg MS basis.

To convert from g / kg milk to $ / kg Milksolids:

Estimate milk mass needed for 1 kg Milksolids and multiply by milk value.

WMP Average value = 1 / 8.21% * $0.284 = $3.459 / kg Milksolids

Table C.3: Milksolids payout value ($ / kg Milksolids)

Milk Channel	Average	Holstein	Holstein Friesian	Jersey	Ayrshire	Cross Breed F*J
Whole Milk Powder	3.459	3.552	3.564	3.415	3.499	3.449
Skim milk Powder	3.276	3.328	3.269	3.262	3.308	3.270
Cheese	4.080	4.224	4.103	4.029	4.148	4.081
Casein/Butter	3.788	3.955	3.808	3.701	3.842	3.771
Average	3.651	3.765	3.686	3.602	3.699	3.643

The US style Holstein milk has the highest Milksolids value reflecting its high Protein: Fat ratio and high Lactose content. Despite its impressive Milksolids value this type of animal has been quickly out breed from the national herd. Its high milk volume trait is not rewarded in New Zealand. They also exhibit low fertility when farmed on New Zealand's pasture based systems.

Ayrshire milk ranks highly. This reflects their high Protein: Fat ratio and a high Milksolids: Lactose ratio. Unfortunately Ayrshire animals form a small percentage [1.0%] of the national herd. With such a small genetic pool, selection of best animals is restricted. Genetically they are considered to be Red Holsteins but differ genetically from their Black and White cousins in having a higher prevalence of the Optimum T [high test] allele and Quantum P [more Protein] allele.

Jersey has the lowest Milksolids value. By having a low apparent energy requirement for Milksolids, low milk volume and low live weight characteristics promotes Jersey as the most valuable breed in New Zealand.

Changing the reporting units significantly alters the conclusions that might be drawn. Using Milk [mass/volume] Jersey milk appears to have the highest value. Using Milksolids Holstein milk is most valuable. Depending on which breed you wish to promote will determine which units will be used to compare breeds.

The methodology described by Massey has formed part of their curriculum since 2001. To date there does not appear to be any universal appreciation of what their work represents.

Appendix D: Manufacturing and revenue models

The following spreadsheet pages have been taken from the models developed for this project. They simulate a simplified manufacturing model for the main 5 commodity products. They simulate the flow of milk through various processing stages for each of the manufacturing steps. Each model is divided into 3 streams, High Milksolids, Average Milksolids and Low Milksolids. The impact on changing the composition of milk can be studied and the effect that has on product yield and product revenue yield.

The least complicated processes are those of Skim milk and Whole milk powder manufacture which differ only in the amount of Fat incorporated into the primary product and Butter as a by product.

The model examines the composition of milk and how those changes translate into different quantities of Milk, Cream, Skim milk [or standardised whole milk] and other by-products such as Butter Milk. The use of the "Pearson Square Calculation" allows tracking of the leakage of value components into the various milk streams. The changes in Fat and Protein concentration mean that different amounts of milk components end up in each milk stream and changes product yields.

From the Skim Milk and Whole Milk Manufacturing sheets we find that High Milksolids/Fat milk yields more cream and less Skim milk than average or Low Milksolids/Fat milk. This translates into a higher Butter and Butter Milk powder yield but a much lower yield of Skim milk powder. The total raw yield of product is 4.4% lower than average and 7.6% lower than the Low MS milk.

If CODEX milk powders are being manufactured then additional Lactose can be added. This reduces the yield difference for High MS milks to 3.7%. The current payment models recognise this by way of Value Add and not a change in manufacturing costs.

The raw revenue yield closely follows the raw product yield difference; that is yield is more significant than product value. Changing the value of Butter or SMP using annual average prices does little to change the ratio of raw revenue yields. Sensitivity studies show that Butter needs to trade at a 3 times the value of SMP [or 2 times that of WMP] before the profit balance between the milk types becomes neutral.

An area where High Milksolids milks have had significant leverage over Low MS milk has been in the area of manufacturing costs. Using Fonterra's Excess Volume charges and Capacity Charges Low MS% milk attract $10,990 more cost. Compared to high MS milk this represents 17.3% advantage. Here perception provokes an illogical conclusion. For the same Milksolids processed Low MS% milk generated between $85k [SMP] and $93k [WMP] more revenue than High MS% milks. Viewing Volume related costs in isolation is misleading.

We cannot ignore CODEX manufacture where Lactose is added to improve yields. Adding Lactose closes the yield gap from 7.6% to 3.7%. Being able to source Lactose at about $1.00 / kg and adding it to milk powder where it can be sold at milk powder prices. This yield gain is naturally present in Low MS% milk but is ignored in the current payment model. The gain from average milk to CODEX standard is regarded as a "Value Add" activity and the benefit is either distributed through the Protein payment or added to Milksolids. If the cost of Lactose is applied to each milk type we find that the revenue advantage declines to around 4%. This gap is slightly higher than the yield advantage because the cost of Lactose powder [or liquid permeate] is greater than the cost to process Volume.

The same principles have been applied to Cheese and Casein processes. Of interest when making cheese, it does not matter [significantly] what type of cheese is being made. Simple cheddar requires about 1.48 kg Fat per kg Casein Protein and a low Fat Cheese [Edam] requires 1.036 kg Fat. Shifting production from one cheese type to another increases or decreases the amount of Fat available for Butter. With more Protein available in Low MS% milks the shift from Cheddar to Edam would release more Fat than High MS% milk to Butter and therefore more value is likely to be lost because Butter generally trades at a lower value than Cheese.

Skim milk Powder Manufacture F 2007/8 Season

Skim milk		Fat	High MS%	Average	Low MS%	
Fat			58,248	57,027	55,247	
Protein			41,752	42,973	44,753	
MS %			100,000	100,000	100,000	
Lactose			50,916	58,072	63,211	
Minerals			7,128	8,130	8,850	
Total Milk Solids			158,045	166,202	172,061	
Raw WM Volume			1,018,330	1,161,440	1,264,223	
Cream (40%)			142,929	139,732	135,119	
Std WM			875,401	1,021,709	1,129,104	
Fat: Prot Ratio		0.0300	0.12%	0.11%	0.11%	
Raw Product Yield			High MS%	Average	Low MS%	
Butter			69,700	68,141	65,891	
BMP			8,192	7,450	7,069	
Skim milk			96,322	106,696	115,127	
Raw Total			174,214	182,287	188,087	
			-4.4%	0.0%	3.2%	7.6%
Added Lactose			14,548	9,914	7,856	
Net yield			188,762	192,201	195,943	
			-1.8%	0.0%	1.9%	3.7%
Skim milk						
Raw Revenue			High MS%	Average	Low MS%	
Butter	$	4.68	326,190	318,892	308,364	
BMP	$	5.83	47,718	43,396	41,176	
Skim milk	$	5.83	561,074	621,507	670,617	
Raw Revenue Total			934,982	983,795	1,020,157	85,175
			-5.0%	0.0%	3.7%	
Manufacturing Costs						
EVC	-$	0.0270	- 27,495	- 31,359	- 34,134	
CE (Volume)	-$	0.0109	- 11,088	- 12,646	- 13,765	
CE (Total Solids kg)	-$	0.1141	- 18,038	- 18,969	- 19,637	
Total Costs			- 56,620	- 62,973	- 67,536	- 10,916
			-10.1%	0.0%	7.2%	17.3%
Net Income (before standardizing)			878,362	920,821	952,621	74,259
			-4.6%	0.0%	3.5%	8.1%
Lactose Cost	$	1.00	- 14,548	- 9,914	- 7,856	
Lactose added Value	$	5.83	84,743	57,749	45,762	
Net Income (After standardizing)			948,557	968,656	990,527	41,970
			-2.1%	0.0%	2.3%	

Whole milk		High MS%	Average	Low MS%
Protein: Fat		0.717	0.754	0.810
Fat		5.72%	4.91%	4.37%
Protein		4.10%	3.70%	3.54%
MS %		9.82%	8.61%	7.91%
Lactose		5.00%	5.00%	5.00%
Minerals		0.70%	0.70%	0.70%
Total Milk Solids		15.52%	14.31%	13.61%
Cream				
Fat	40.0%	57,172	55,893	54,047
Protein		3,516	3,102	2,870
Lactose		4,288	4,192	4,054
Minerals		600	587	567
SNF		8,404	7,881	7,491
Butter				
Fat	81.5%	56,806	55,535	53,701
Protein	0.6%	349	418	404
Lactose	1.0%	558	669	647
SNF	1.6%	906	886	857
Total solids		57,712	56,622	54,752
Butter milk				
Litres		73,229	71,591	69,227
Fat	0.5%	366	358	346
Protein		3,168	2,684	2,466
Lactose		3,730	3,523	3,407
Minerals		600	587	567
Total solids		7,864	7,152	6,786
Skim milk Powder				
Fat		1,077	1,134	1,199
Protein		38,235	39,871	41,884
Raw Lactose		46,629	53,880	59,158
Minerals		6,528	7,543	8,282
Total solids		92,469	102,429	110,522
Add Lactose	1.6	14,548	9,914	7,856

Whole milk Powder Manufacture F 2007/8 Season

Whole milk		Fat	High MS%	Average	Low MS%	Low vs. High
Fat			58,248	57,027	55,247	
Protein			41,752	42,973	44,753	
MS %			100,000	100,000	100,000	
Lactose			50,916	58,072	63,211	
Minerals			7,128	8,130	8,850	
Total Milk Solids			158,045	166,202	172,061	
Raw WM Volume			1,018,330	1,161,440	1,264,223	
Cream (40%)			39,719	32,295	22,053	
Std WM			978,611	1,129,145	1,242,170	
Fat: Prot Ratio		1.0558	4.33%	3.91%	3.74%	
Raw Product Yield			High MS%	Average	Low MS%	
Butter			19,369	15,749	10,754	
BMP			2,276	1,722	1,154	
Whole milk			145,648	157,773	168,768	
Raw Total			167,293	175,244	180,676	
			-4.5%	0.0%	3.1%	7.6%
Added Lactose			16,161	10,945	8,653	
Net yield			183,454	186,189	189,328	
			-1.5%	0.0%	1.7%	
Whole milk		1				
Raw Revenue			High MS%	Average	Low MS%	
Butter	$	4.68	90,645	73,703	50,328	
BMP	$	5.83	13,260	10,030	6,720	
Whole milk	$	6.06	883,186	956,714	1,023,382	
Raw Revenue Total			987,091	1,040,447	1,080,430	93,339
			-5.1%	0.0%	3.8%	9.0%
Manufacturing Costs						
EVC	-$	0.0270	- 27,495	- 31,359	- 34,134	
CE (Volume)	-$	0.0109	- 11,088	- 12,646	- 13,765	
CE (Total Solids kg)	-$	0.1141	- 18,038	- 18,969	- 19,637	
Total Costs			- 56,620	- 62,973	- 67,536	- 10,916
			-10.1%	0.0%	7.2%	17.3%
Net Income (before standardizing)			930,471	977,474	1,012,894	82,423
			-4.8%	0.0%	3.6%	8.4%
Lactose Cost	$	1.00	- 15,514	- 10,507	- 8,307	
Lactose added Value	$	6.06	94,076	63,713	50,370	
Net Income (After standardizing)			1,009,033	1,030,680	1,054,957	45,925
			-2.1%	0.0%	2.4%	4.5%

Whole milk		High MS%	Average	Low MS%
Protein: Fat		0.717	0.754	0.810
Fat		5.72%	4.91%	4.37%
Protein		4.10%	3.70%	3.54%
MS %		9.82%	8.61%	7.91%
Lactose		5.00%	5.00%	5.00%
Minerals		0.70%	0.70%	0.70%
Total Milk Solids		15.52%	14.31%	13.61%
Cream				
Fat	40.0%	15,887	12,918	8,821
Protein		977	717	468
Lactose		1,192	969	662
Minerals		167	136	93
SNF		2,335	1,821	1,223
Butter				
Fat	81.5%	15,786	12,835	8,765
Protein	0.6%	97	97	66
Lactose	1.0%	155	155	106
SNF	1.6%	252	205	140
Total solids		16,038	13,087	8,936
Butter milk				
Litres		20,350	16,546	11,299
Fat	0.5%	102	83	56
Protein		880	620	402
Lactose		1,037	814	556
Minerals		167	136	93
Total solids		2,185	1,653	1,108
Whole milk Powder				
Fat		42,361	44,109	46,425
Protein		40,774	42,256	44,285
Raw Lactose		49,725	57,103	62,550
Minerals		6,961	7,994	8,757
Total solids		139,822	151,463	162,017
Add Lactose	1.6	15,514	10,507	8,307

Cheese Manufacture F 2007/8 Season

Cheese		Fat	High MS%	Average	Low MS%	Low vs. High
Fat			58,248	57,027	55,247	
Protein			41,752	42,973	44,753	
MS %			100,000	100,000	100,000	
Lactose			50,916	58,072	63,211	
Minerals			7,128	8,130	8,850	
Total Milk Solids			158,045	166,202	172,061	
Raw WM Volume			1,018,330	1,161,440	1,264,223	
Cream (40%)			25,266	17,446	6,506	
STD Whole Milk			993,064	1,143,994	1,257,717	
Fat: 80% Prot Ratio		1.4780	4.85%	4.37%	4.19%	
Raw Product Yield			High MS%	Average	Low MS%	
Butter			12,321	8,508	3,173	
BMP			1,448	930	340	
Cheese			135,289	140,079	146,754	
Whey Powder			51,258	58,781	64,470	
Raw Total			200,317	208,297	214,737	
			-3.8%	0.0%	3.1%	6.9%
Added Lactose			-	-	-	
Net yield			200,317	208,297	214,737	
			-3.8%	0.0%	3.1%	6.9%
Cheese						
Raw Revenue			High MS%	Average	Low MS%	
Butter	$	4.68	57,661	39,814	14,847	
BMP	$	5.83	8,435	5,418	1,983	
Cheese	$	6.46	874,048	904,989	948,114	
Whey Powder	$	1.00	51,258	58,781	64,470	
Raw Revenue Total			991,403	1,009,003	1,029,414	38,011
			-1.7%	0.0%	2.0%	3.8%
Manufacturing Costs						
EVC	-$	0.0270	- 27,495	- 31,359	- 34,134	
CE (Volume)	-$	0.0109	- 11,088	- 12,646	- 13,765	
CE (Total Solids kg)	-$	0.1141	- 18,038	- 18,969	- 19,637	
Whey disposal	$	-	-	-	-	
Total Costs			- 56,620	- 62,973	- 67,536	- 10,916
			-10.1%	0.0%	7.2%	17.3%
Net Income (before standardizing)			934,783	946,029	961,878	27,095
			-1.2%	0.0%	1.7%	2.9%
Lactose Cost	$	1.00	-	-	-	
Lactose added Value	$	1.00	-	-	-	
Net Income (After standardizing)			934,783	946,029	961,878	27,095
			-1.2%	0.0%	1.7%	2.9%

Whole milk		High MS%	Average	Low MS%
Protein: Fat		0.717	0.754	0.810
Fat		5.72%	4.91%	4.37%
Protein		4.10%	3.70%	3.54%
MS %		9.82%	8.61%	7.91%
Lactose		5.00%	5.00%	5.00%
Minerals		0.70%	0.70%	0.70%
Total Milk Solids		15.52%	14.31%	13.61%
Cream				
Fat	40.0%	10,106	6,978	2,602
Protein		622	387	138
Lactose		758	523	195
Minerals		106	73	27
SNF		1,486	984	361
Butter				
Fat	81.5%	10,042	6,934	2,586
Protein	0.6%	62	52	19
Lactose	1.0%	99	84	31
SNF	1.6%	160	111	41
Total solids		10,202	7,069	2,636
Butter milk				
Litres		12,945	8,938	3,333
Fat	0.5%	65	45	17
Protein		560	335	119
Lactose		659	440	164
Minerals		106	73	27
Total solids		1,390	893	327
Cheese	Ratio: Prot			
Fat	1.448	47,645	49,332	51,682
Protein	0.800	32,904	34,069	35,692
Lactose	0.057	1,867	1,933	2,025
Minerals	0.157	5,171	5,354	5,609
Total solids		87,586	90,687	95,008
Whey				
Fat	1.3%	497	717	962
Protein	15.1%	8,226	8,517	8,923
Lactose	78.8%	38,633	44,493	48,793
Minerals	4.8%	1,852	2,703	3,213
Total solids		49,208	56,430	61,891

Casein Manufacture F 2007/8 Season

Casein		Fat	High MS%	Average	Low MS%	Low vs. High
Fat			58,248	57,027	55,247	
Protein			41,752	42,973	44,753	
MS %			100,000	100,000	100,000	
Lactose			50,916	58,072	63,211	
Minerals			7,128	8,130	8,850	
Total Milk Solids			158,045	166,202	172,061	
Raw WM Volume			1,018,330	1,161,440	1,264,223	
Cream (40%)			142,929	139,732	135,119	
Skim milk			875,401	1,021,709	1,129,104	
Fat:Prot Ratio		0.0300	0.12%	0.11%	0.11%	
Raw Product Yield			High MS%	Average	Low MS%	
Butter			69,700	68,141	65,891	
BMP			8,192	7,450	7,069	
Casein			34,369	35,839	37,648	
Whey Powder			64,459	73,470	80,224	
Raw Total			176,720	184,900	190,833	
			-4.4%	0.0%	3.2%	
Added Lactose			-	-	-	
Net yield			176,720	184,900	190,833	
			-4.4%	0.0%	3.2%	7.6%
Casein						
Raw Revenue			High MS%	Average	Low MS%	
Butter	$	4.68	326,190	318,892	308,364	
BMP	$	5.83	47,718	43,396	41,176	
Casein	$	15.76	541,655	564,828	593,335	
Whey Powder	$	1.00	64,459	73,470	80,224	
Raw Revenue Total			980,022	1,000,586	1,023,099	43,078
			-2.1%	0.0%	2.3%	4.3%
Manufacturing Costs						
EVC	-$	0.0270	- 27,495	- 31,359	- 34,134	
CE (Volume)	-$	0.0109	- 11,088	- 12,646	- 13,765	
CE (Total Solids kg)	-$	0.1141	- 18,038	- 18,969	- 19,637	
Whey disposal	$	-	-	-	-	
Total Costs			- 56,620	- 62,973	- 67,536	- 10,916
			-10.1%	0.0%	7.2%	17.3%
Net Income (before standardizing)			923,402	937,613	955,563	32,162
			-1.5%	0.0%	1.9%	3.4%
Lactose Cost	$	1.00	-	-	-	
Lactose added Value	$	15.76	-	-	-	
Net Income (After standardizing)			923,402	937,613	955,563	32,162
			-1.5%	0.0%	1.9%	3.4%

Whole milk		High MS%	Average	Low MS%
Protein: Fat		0.717	0.754	0.810
Fat		5.72%	4.91%	4.37%
Protein		4.10%	3.70%	3.54%
MS %		9.82%	8.61%	7.91%
Lactose		5.00%	5.00%	5.00%
Minerals		0.70%	0.70%	0.70%
Total Milk Solids		15.52%	14.31%	13.61%
Cream				
Fat	40.0%	57,172	55,893	54,047
Protein		3,516	3,102	2,870
Lactose		4,288	4,192	4,054
Minerals		600	587	567
SNF		8,404	7,881	7,491
Butter				
Fat	81.5%	56,806	55,535	53,701
Protein	0.6%	349	418	404
Lactose	1.0%	558	669	647
SNF	1.6%	906	886	857
Total solids		57,712	56,622	54,752
Butter milk				
Litres		73,229	71,591	69,227
Fat	0.5%	366	358	346
Protein		3,168	2,684	2,466
Lactose		3,730	3,523	3,407
Minerals		600	587	567
Total solids		7,864	7,152	6,786
Skim milk				
Fat		1,077	1,134	1,199
Protein		38,235	39,871	41,884
Lactose		46,629	53,880	59,158
Minerals		6,528	7,543	8,282
Total solids		92,469	102,429	110,522
Whey				
Fat		1,077	1,134	1,199
Protein	20.0%	7,647	7,974	8,377
Lactose		46,629	53,880	59,158
Minerals		6,528	7,543	8,282
Total solids		61,880	70,532	77,015

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