International Dairy Industry Farm Performance Report: Australia vs New Zealand vs United States vs Argentina vs Uruguay vs South Africa vs Ireland vs United Kingdom

Four decades of data for some trends: two decades of data for other trends

Background

This report includes high-level comparative data for the period 1979/80 to 2019/20 and an extensive analysis for the period from 2002/03 to 2019/20. Also included within the extensive analysis are estimated data for 2020/21 and forecast data for 2021/22.

Version 2.1

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List of contents

The table of **Contents** on page 3 outlines the sections related to each ratio and includes a hyperlink to the page related to that ratio.

Sources of data

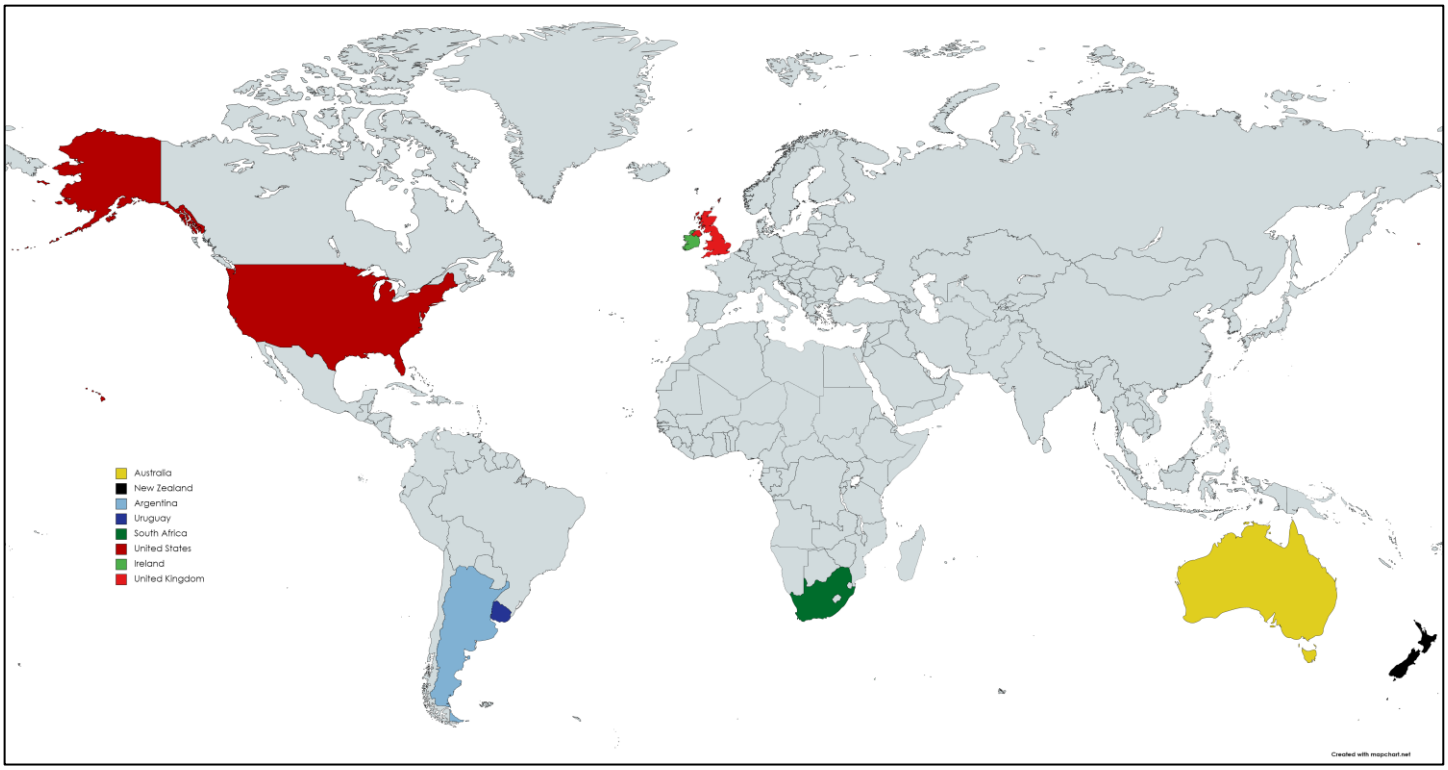
Primary data sources are listed in the table below.

DATA SOURCES						
Country	Abbreviation	Industry Statistics	Farm Performance Analysis	AUS State/Region	Abbreviation	Farm Performance Analysis
Argentina	ARG	MAGYP	AACREA	New South Wales	NSW	DFMP
Australia	AUS	Dairy Australia	DFMP, QDAS, Red Sky	Queensland	QLD	QDAS
Ireland	IRE	CSO	Teagasc	South Australia	SA	DFMP, Red Sky
New Zealand	NZ	DairyNZ	DairyBase, Red Sky	Tasmania	TAS	DFMP, Red Sky
South Africa	RSA	MPO	Red Sky	Victoria	VIC	DFMP, Red Sky
United Kingdom	UK	DEFRA	AHDB	Gippsland	GipViv	DFMP, Red Sky
United States	USA	USDA	Genske Mulder	South-West Victoria	SWVic	DFMP, Red Sky
Uruguay	URU	INALE	FUCREA	Northern Victoria	Nvic	DFMP, Red Sky
				Western Australia	WA	DFMP, Red Sky

Appendix A provides more information on the data sources and describes the methodology for standardising the different data sources so that relevant comparisons could be undertaken. Data that is based on estimates are denoted as a dashed line in the international comparisons or denoted with an asterisk (*) in the regional comparisons.

New to Version 2: all graphs now include actual or estimated results for 2020/21, and forecast results for 2021/22. Also, all farm performance graphs include data for Ireland and United Kingdom. The Irish data is based on Teagasc National Farm Survey reports. The United Kingdom data is developed from limited benchmark data provided by AHDB and from converting data in refereed and non-refereed publications into a farm performance model to represent average benchmark data. Benchmark data for United Kingdom should be interpreted as estimates only.

Countries included in this report: identified in map below.



Categorisation of countries (Beca 2020a)

The following table broadly categorises the countries for milk market focus, climate and the level of government support or subsidies.

MILK MARKET		
Primary export focus	**Combined export and domestic focus**	**Primary domestic focus**
New Zealand, Uruguay	Australia, Argentina, United States, Ireland	South Africa, United Kingdom
Tasmania	Victoria, South Australia	New South Wales, Queensland, Western Australia

CLIMATE		
"Cool" temperate	**"Moderate-Hot" temperate (some areas subtropical)**	
New Zealand, Ireland, United Kingdom	Australia, Argentina, Uruguay, South Africa, United States	
"Cool" temperate	**"Hot" temperate**	**Subtropical**
Tasmania	Victoria, New South Wales, South Australia, Western Australia	Queensland

GOVERNMENT SUPPORT / SUBSIDIES	
Some / Significant	**Very little to none**
Argentina, United States, Ireland, United Kingdom	Australia, New Zealand, Uruguay, South Africa

Graph format

Graphs marked '**a**' (on left) are actual lines and graphs marked '**b**' (on right) are fitted trendlines.

Graphs in US cents are notated as '**USDc**'.

Calculations and definitions

Appendix B outlines the methodology utilised for calculating or defining each of the ratios referenced in this document.

Energy Corrected Milk (**ECM**) is utilised extensively in this report, with this corrected to 4.0% fat and 3.3% protein using the formula: ECM = milk production x ((0.383 x fat% + 0.242 x protein% + 0.7832) / 3.1138).

International comparisons are in **USD**, with the average foreign exchange rate for each year applied to that year.

References

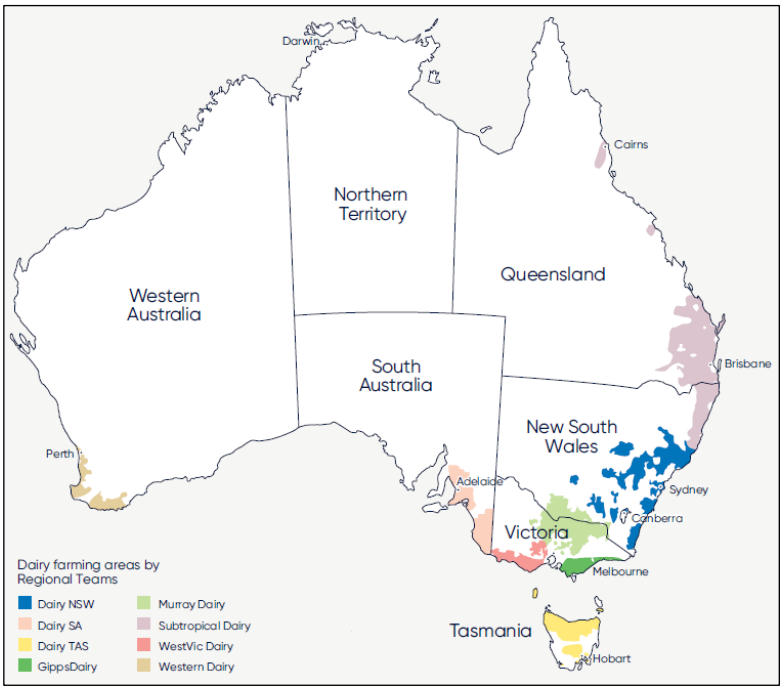
The following two references significantly inform the data in this report:

Beca, D. (2020a), '**Evaluating the Loss of Profitability and Declining Milk Production in the Australian Dairy Industry'**, *Australasian Agribusiness Perspectives* 23, Paper 9, 136-164.

Beca, D. (2020b), '**Key Determinants of Profit for Pasture-based Dairy Farms**', *Australasian Agribusiness Perspectives* 23, Paper 16, 247-274.

Dairy farming regions in Australia

Source: Dairy Australia



Contents

1. Introduction

Dairy farming industries in all countries, and farmers within these countries, need to continuously review their business performance and production systems to ensure they retain a sound level of profitability. This is important if these industries, and the farmers within these industries, are to maintain a comparative advantage to other farming enterprises within their region as well as to maintain international competitiveness with dairy industries in other countries.

Comparative dairy industry farm performance data can be an important source of information for identifying trends in countrywide and regional business performance. If the ratios utilised for these comparisons are relevant to changes in profitability (Beca 2020b), then these can be used to identify both positive and negative trends that improve or reduce a country or region's competitiveness (Beca 2020a).

There is a full suite of farm performance ratios for the eight countries included in the comparisons in this report. These countries include Australia, New Zealand, United States, Argentina, Uruguay, South Africa, Ireland, and United Kingdom. The intention is that further countries may be added to these datasets if robust sets of farm performance data can be accessed.

Where industry performance is assessed on its success in maintaining or increasing farm profitability over time, maintaining or limiting increases in cost of production, and delivering consistent growth in national milk production, then the dairy industry performance trends in this report suggest that New Zealand has the highest level of performance overall, and that Australia has the lowest level of performance. Ireland, United States and South Africa would appear to be the countries that along with New Zealand comprise the top 50 percentile of performance in this sample, with Argentina, Uruguay and United Kingdom along with Australia comprising the bottom 50 percentile. However, all countries except Australia have been growing national milk production in recent years, so it would only be Australia that could be assessed as being relatively unprofitable and likely to be in the bottom 50 percentile of countries if a wider group were to be included in the analysis.

There is a small number of farm performance ratios included for all six States of Australia, including Victoria, Tasmania, New South Wales, Queensland, South Australia and Western Australia. These can potentially provide further insight into the variations in performance between countries. Where Australian state performance is assessed on the same basis as for the countries, then Tasmania has the highest level of performance, and by a wide margin, with New South Wales and Queensland having the lowest level of performance. The three other states of Victoria, South Australia and Western Australia comprise a group somewhere between the highest and lowest performing states. A full suite of farm performance ratios for the Australian states are included in a lengthier report that can be downloaded from: Red Sky Report webpage.

Graphs and tables that outline changes in total milk production, total farm numbers, total cow numbers, and number of cows per farm, highlight where trends over the last two and four decades have been similar and where they have been different. These comparisons can help identify where longer-term trends are consistent across all countries and regions, as opposed to trends that are more specific to a country or region and so potentially worthy of even closer scrutiny.

Graphs that outline changes in milk price highlight how variations between countries, irrespective of their focus on domestic or export markets, have been narrowing over the last two decades. For those countries that have been performing poorly, milk price does not appear to have been a factor in their comparatively poor performance.

Graphs that outline changes in profitability and cost of production confirm how all the countries, and the Australian states, have evolved over recent years. To identify what factors have been creating changes in performance, there is a full suite of ratios that outline how farm performance has changed in all areas of the business. This includes a range of financial ratios, with these split between supplement and feed costs, labour costs, cow costs and hectare costs, as well as a range of physical ratios. These physical ratios include milk production per cow and per hectare, stocking rate (cows per hectare), pasture harvest, pasture as a per cent of the cows' diet (production system), and labour efficiency.

There are a number of graphs that help describe farm and business conditions. These graphs include milksolids (fat and protein) percentages, USD exchange rates, inflation rates, minimum hourly salary rates, total value of farm assets per cow, opportunity cost of capital, risk free interest rates and long-term land lease rates.

Most milk related ratios are calculated on Energy Corrected Milk (ECM) with milk corrected to 4.0% fat and 3.3% protein. This has been completed for most litre and milksolid ratios.

This report has been produced so that the data, and its associated trends, might be used by any interested party to inform discussions and create debate on how dairy industries can develop and improve their level of performance and profitability. Please contact the author (details on page 1) if there are queries or requests for further analysis.

This report can also be downloaded from: Red Sky Report webpage.

2. Total milk production (industry averages)

Figure 1. National milk production 2003-2022 (b litres ECM)

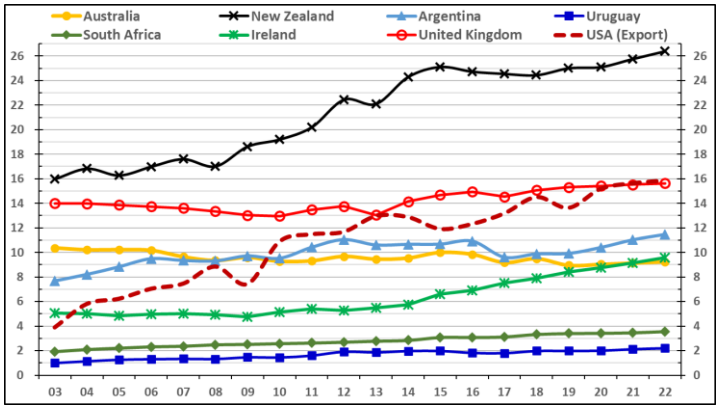
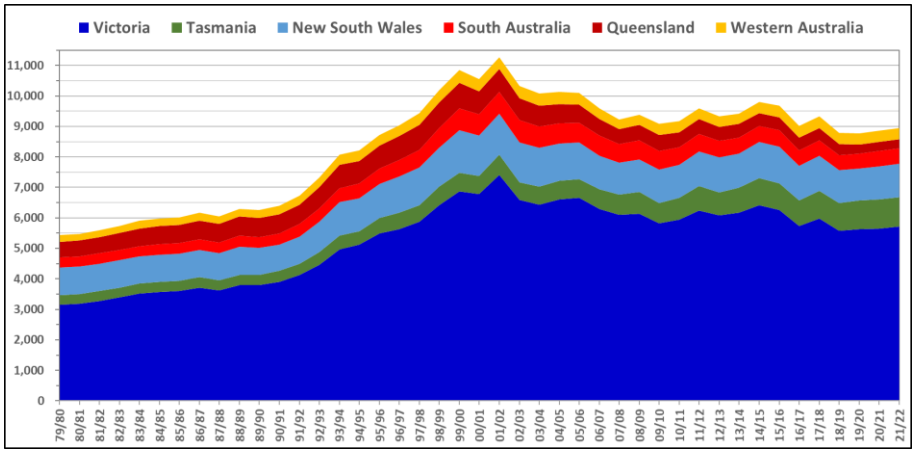


Figure 2: National milk production 1980-2020 (billion litres)

MILK (b litres)	1980	1990	2000	2010	2020
Australia	5.43	6.26	10.85	9.08	8.78
New Zealand	6.00	7.08	11.63	16.48	21.15
United States	55.48	63.85	73.00	83.72	97.07
Argentina	5.15	6.09	9.79	10.31	11.11
Uruguay*	0.63	0.78	1.24	1.50	2.01
South Africa*	0.96	1.23	1.75	2.60	3.32
Ireland	4.42	5.12	5.01	5.17	8.29
United Kingdom*	11.98	13.87	13.77	12.90	14.94

Figure 3. Australian milk production by state 1980-2022 (million litres)



3. Growth in milk production (industry averages)

Figure 5. Change in national milk production 1980-2022 (milksolids)

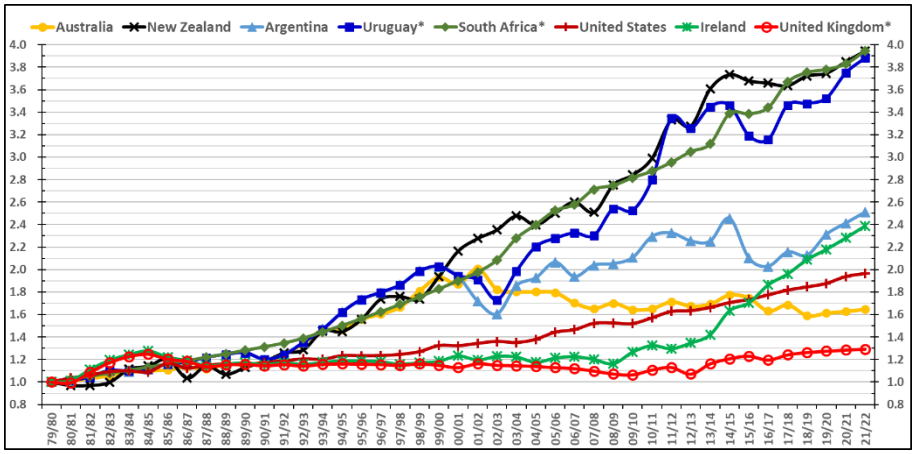
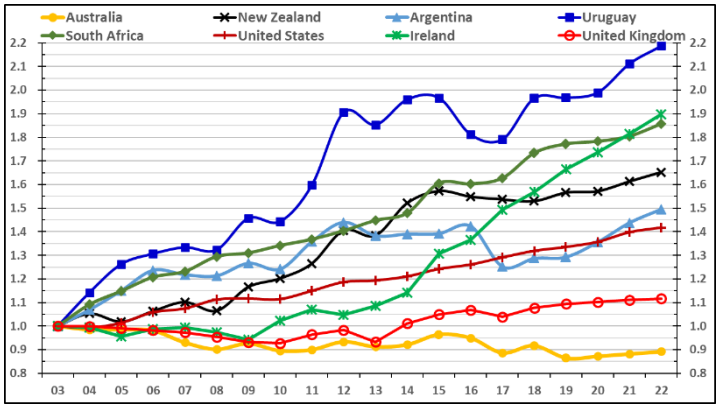
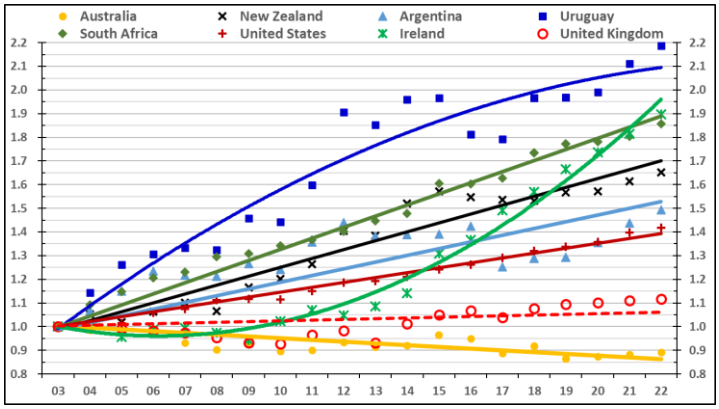


Figure 6. Compound annual growth rate (CAGR) of national milk production 1980-2020 (milksolids)

CAGR-MILK (milksolids)	1980-2020	1980-2000	2000-2020	1980-1990	1990-2000	2000-2010	2010-2020	2015-2020
Australia	1.20%	3.35%	-0.90%	1.43%	5.30%	-1.60%	-0.20%	-1.89%
New Zealand	3.36%	3.37%	3.35%	1.23%	5.54%	3.90%	2.80%	0.06%
United States	1.59%	1.41%	1.76%	1.43%	1.40%	1.39%	2.14%	1.93%
Argentina	2.12%	3.59%	0.67%	2.31%	4.88%	0.40%	0.94%	-1.20%
Uruguay*	3.20%	3.60%	2.80%	2.34%	4.88%	2.21%	3.39%	0.36%
South Africa*	3.38%	3.06%	3.70%	2.50%	3.62%	4.43%	2.98%	2.22%
Ireland	1.97%	0.86%	3.09%	1.60%	0.12%	0.66%	5.58%	5.93%
United Kingdom*	0.61%	0.70%	0.52%	1.48%	*-0.08%*	-0.76%	1.82%	1.09%

Figures 7a & 7b. Change in national milk production 2003-2022 (milksolids ECM)





4. Number of farms (industry averages)

Figure 8. Change in number of farms 1980-2022

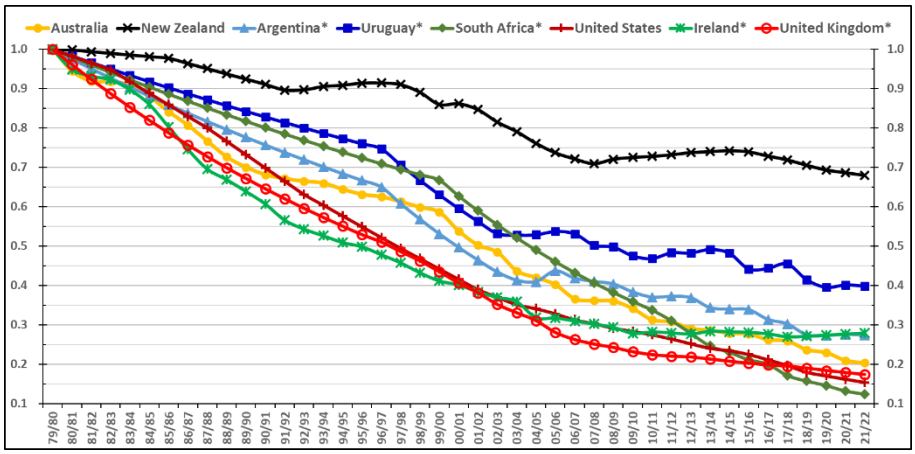


Figure 9. Change in number of farms 2000-2022

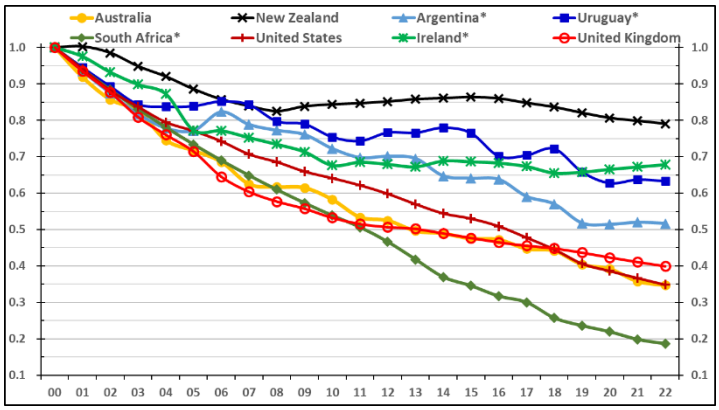


Figure 10: Number of farms 1980-2020

FARM NUMBERS	1980	1990	2000	2010	2020
Australia	21,994	15,396	12,888	7,511	5,055
New Zealand	16,123	14,899	13,861	11,691	11,179
United States	190,000	139,200	84,050	53,900	32,478
Argentina*	36,122	28,043	19,199	13,862	9,867
Uruguay*	5,157	4,344	3,251	2,452	2,041
South Africa*	7,947	6,493	5,305	2,857	1,164
Ireland*	64,559	41,254	26,583	17,988	17,698
United Kingdom*	65,332	43,889	28,422	15,139	12,044

Figure 11. Compound annual growth rate (CAGR) of number of farms 1980-2020

CAGR-FARM NUMBERS	1980-2020	1980-2000	2000-2020	1980-1990	1990-2000	2000-2010	2010-2020	2015-2020
Australia	-3.61%	-2.64%	-4.57%	-3.50%	-1.76%	-5.26%	-3.88%	-3.78%
New Zealand	-0.91%	-0.75%	-1.07%	-0.79%	-0.72%	-1.69%	-0.45%	-1.36%
United States	-4.32%	-4.00%	-4.64%	-3.06%	-4.92%	-4.35%	-4.94%	-6.14%
Argentina*	-3.19%	-3.11%	-3.27%	-2.50%	-3.72%	-3.20%	-3.34%	-4.31%
Uruguay*	-2.29%	-2.28%	-2.30%	-1.70%	-2.86%	-2.78%	-1.82%	-3.89%
South Africa*	-4.69%	-2.00%	-7.30%	-2.00%	-2.00%	-6.00%	-8.59%	-8.69%
Ireland*	-3.18%	-4.34%	-2.01%	-4.38%	-4.30%	-3.83%	-0.16%	-0.61%
United Kingdom*	-4.14%	-4.08%	-4.20%	-3.90%	-4.25%	-6.10%	-2.26%	-2.36%

5. Number of cows (industry averages)

Figure 12. Change in national number of cows 1980-2022

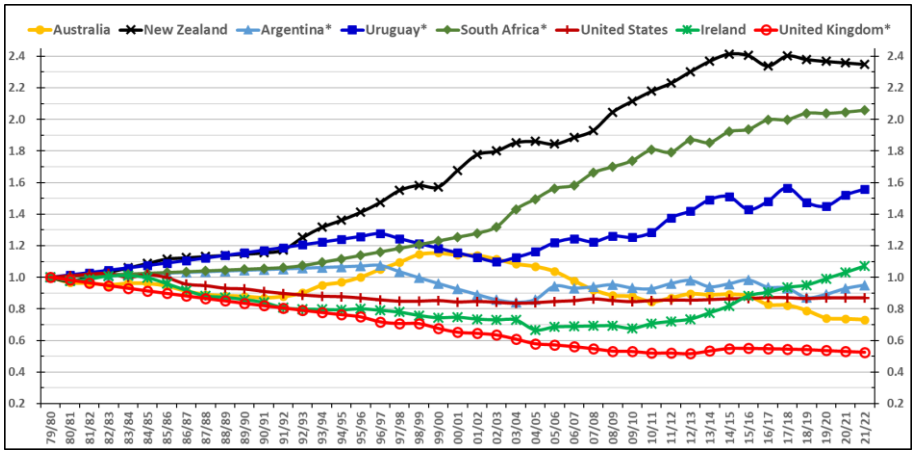


Figure 13. Change in national number of cows 2000-2022

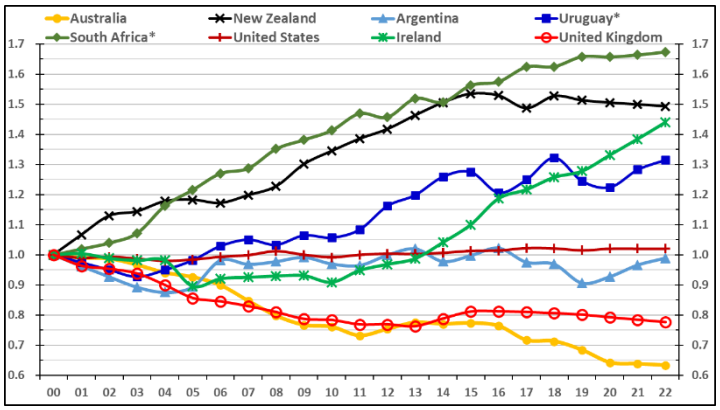


Figure 14: National number of cows 1980-2020 (thousands)

COW NUMBERS ('000)	1980	1990	2000	2010	2020
Australia	1,880	1,652	2,170	1,651	1,394
New Zealand	2,079	2,386	3,269	4,397	4,922
United States	10,799	9,993	9,199	9,123	9,388
Argentina*	1,880	1,961	1,804	1,751	1,675
Uruguay*	234	270	277	293	339
South Africa*	291	306	358	506	594
Ireland	1,583	1,360	1,178	1,071	1,568
United Kingdom*	3,452	2,883	2,336	1,830	1,850

Figure 15. Compound annual growth rate (CAGR) of national number of cows 1980-2020

CAGR-COW NUMBERS	1980-2020	1980-2000	2000-2020	1980-1990	1990-2000	2000-2010	2010-2020	2015-2020
Australia	-0.75%	0.72%	-2.19%	-1.28%	2.76%	-2.70%	-1.68%	-3.65%
New Zealand	2.18%	2.29%	2.07%	1.39%	3.20%	3.01%	1.13%	-0.39%
United States	-0.35%	-0.80%	0.10%	-0.77%	-0.82%	-0.08%	0.29%	0.15%
Argentina*	*-0.29%*	*-0.20%*	-0.37%	0.43%	*-0.83%*	*-0.30%*	-0.44%	-1.44%
Uruguay*	0.93%	0.85%	1.02%	1.45%	0.25%	0.56%	1.48%	-0.81%
South Africa*	1.79%	1.04%	2.56%	0.49%	1.59%	3.52%	1.60%	1.18%
Ireland	-0.02%	-1.47%	1.44%	-1.51%	-1.43%	-0.95%	3.89%	3.88%
United Kingdom*	*-1.55%*	*-1.93%*	-1.16%	*-1.79%*	*-2.08%*	-2.41%	0.11%	-0.48%

6. Number of cows per farm (industry averages)

Figure 16. Change in number of cows per farm 1980-2022

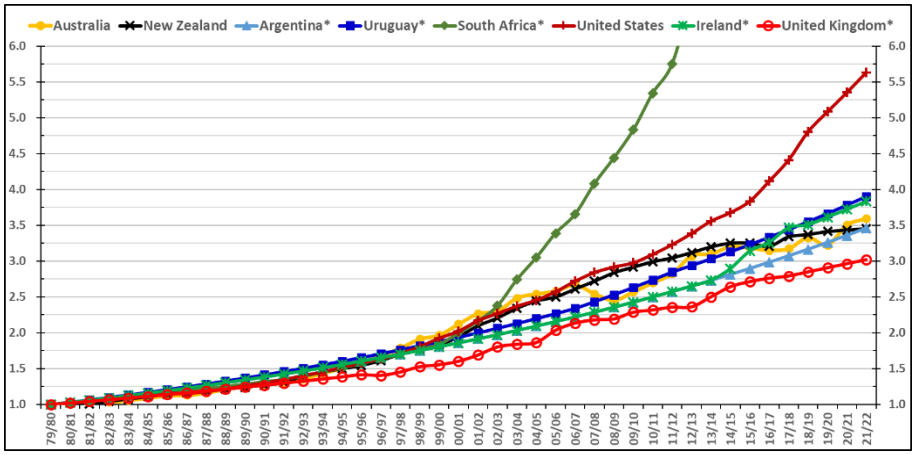


Figure 17. Change in number of cows per farm 2000-2022

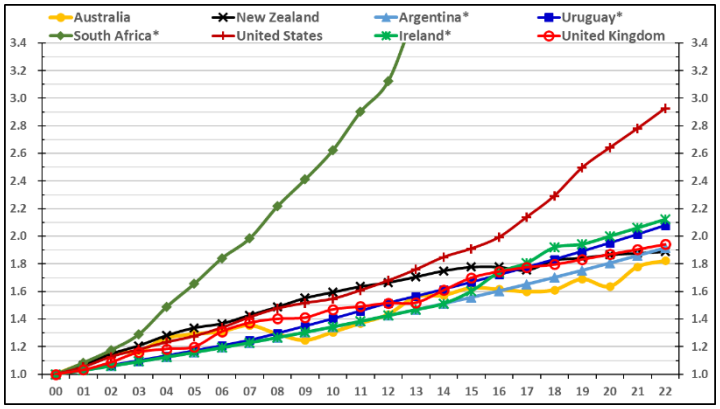


Figure 18: Number of cows per farm 1980-2020

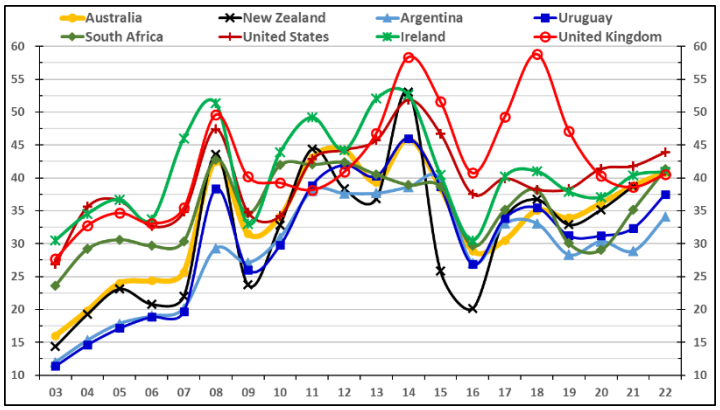
COWS per FARM	1980	1990	2000	2010	2020
Australia	85	107	168	220	276
New Zealand	129	160	236	376	440
United States	57	72	109	169	289
Argentina*	52	70	94	126	170
Uruguay*	45	62	85	119	166
South Africa*	37	47	68	177	510
Ireland*	25	33	44	60	89
United Kingdom*	53	66	82	121	154

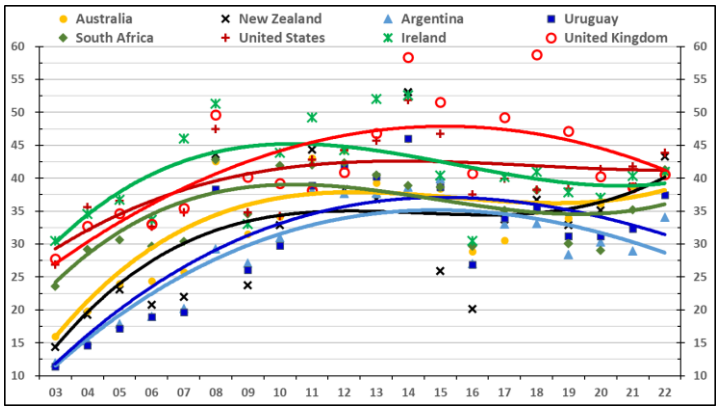
Figure 19. Compound annual growth rate (CAGR) of number of cows per farm 1980-2020

CAGR-COWS per FARM	1980-2020	1980-2000	2000-2020	1980-1990	1990-2000	2000-2010	2010-2020	2015-2020
Australia	2.97%	3.45%	2.50%	2.30%	4.61%	2.70%	2.29%	0.13%
New Zealand	3.12%	3.07%	3.17%	2.19%	3.95%	4.78%	1.59%	0.98%
United States	4.15%	3.33%	4.98%	2.36%	4.31%	4.46%	5.50%	6.70%
Argentina*	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Uruguay*	3.30%	3.20%	3.40%	3.20%	3.20%	3.44%	3.36%	3.20%
South Africa*	6.80%	3.10%	10.64%	2.54%	3.66%	10.13%	11.15%	10.81%
Ireland*	3.26%	3.00%	3.53%	3.00%	3.00%	3.00%	4.05%	4.52%
United Kingdom*	2.70%	2.23%	3.18%	2.20%	2.27%	3.93%	2.43%	1.92%

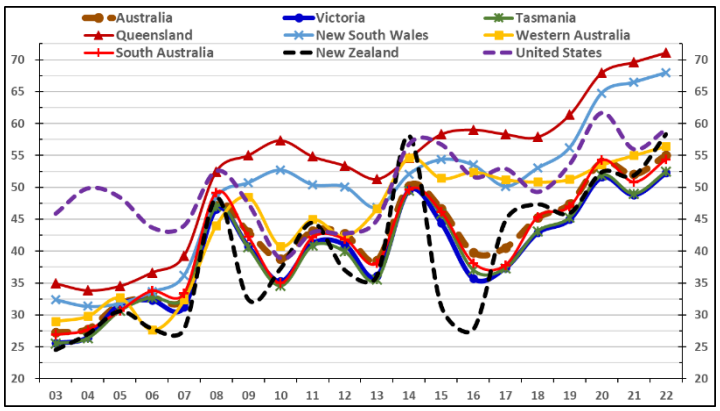
7. Milk price per litre (industry averages)

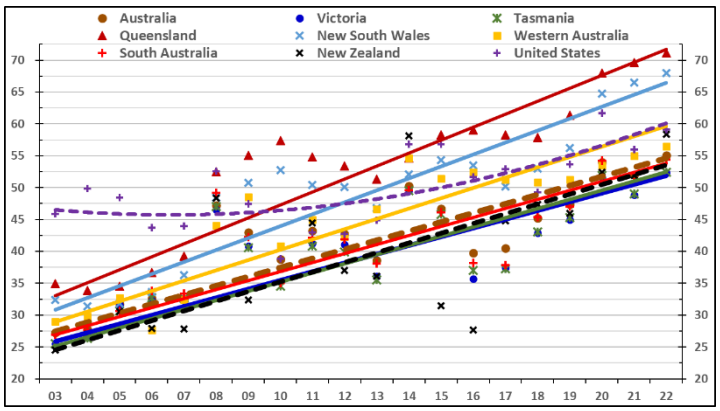
Figures 20a & 20b. Milk price per litre 2003-2022 (USDc ECM)





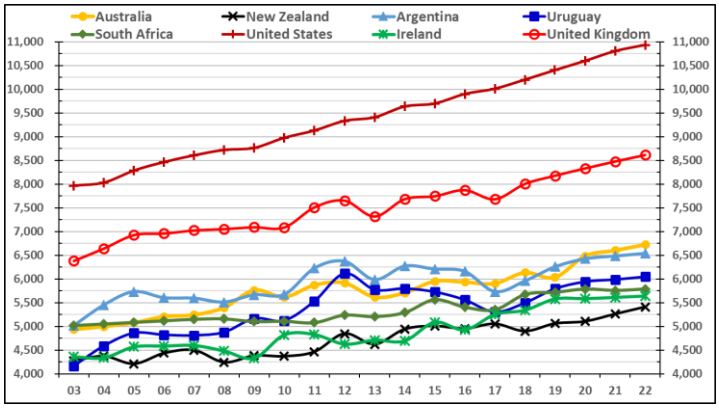
Figures 21a & 21b. Australian national and state milk price per litre (plus NZ, USA) 2003-2022 (AUDc ECM)

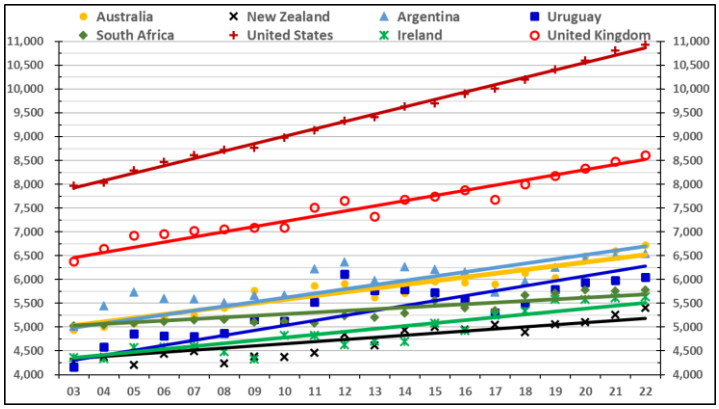




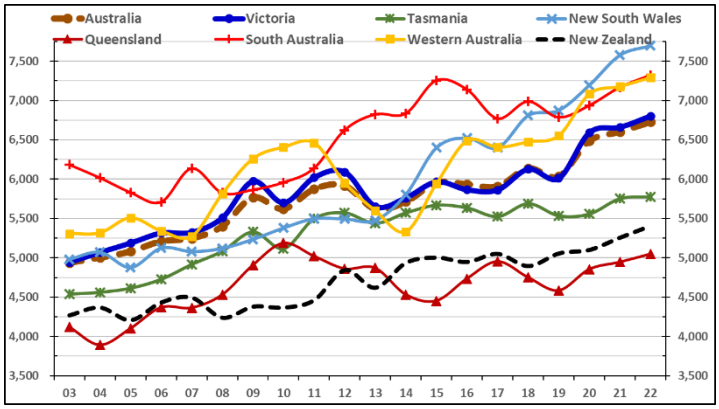
8. Milk Production per cow per year (industry averages)

Figures 22a & 22b. Milk production per cow 2003-2022 (litres ECM)





Figures 23a & 23b. Australian national and state milk production per cow (plus NZ) 2003-2022 (litres ECM)



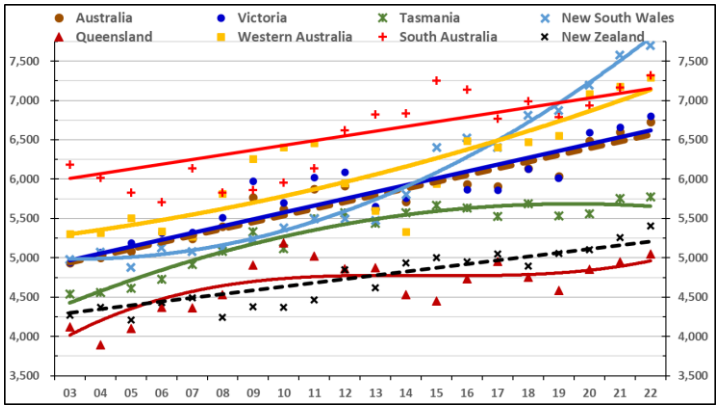


Figure 24. Change in milk production per cow 1980-2022 (milksolids)

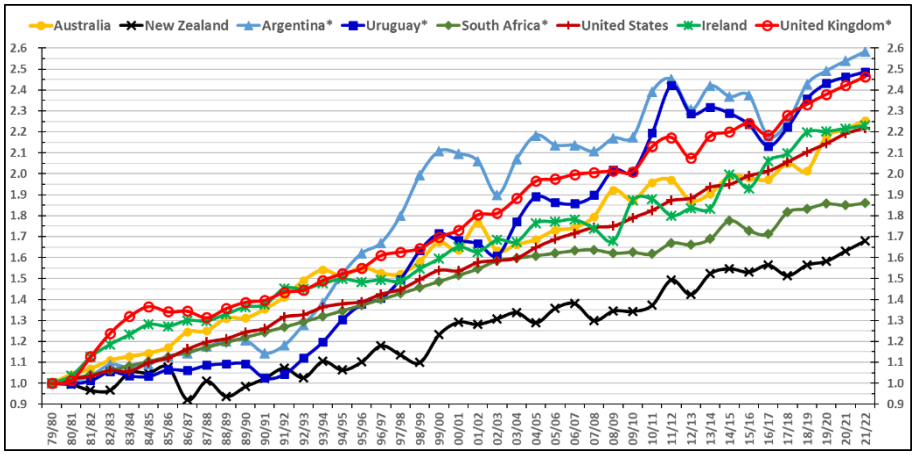


Figure 25. Change in milk production per cow 2000-2022 (milksolids)

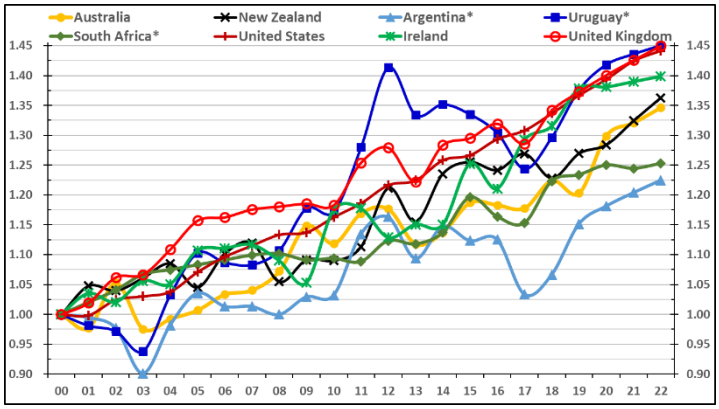


Figure 26: Milk production per cow 1980-2020 (milksolids)

MILK per COW (kgMS)	1980	1990	2000	2010	2020
Australia	220	289	368	412	479
New Zealand	243	240	300	327	385
United States	363	452	559	650	779
Argentina*	180	216	379	391	448
Uruguay*	177	194	304	356	431
South Africa*	227	277	337	369	422
Ireland	186	254	297	349	410
United Kingdom*	254	353	432	511	605

Figure 27. Compound annual growth rate (CAGR) of milk production per cow 1980-2020 (milksolids)

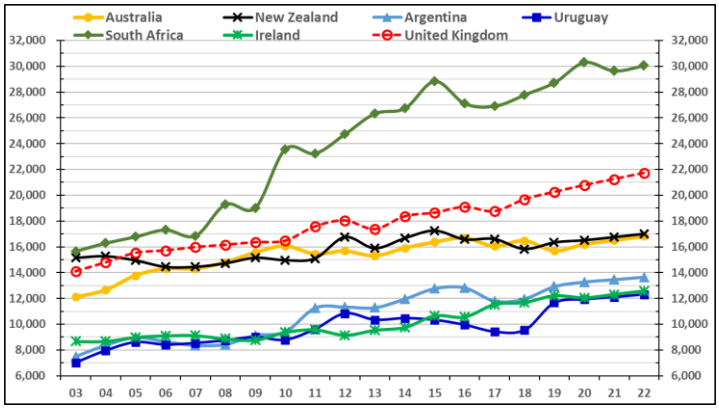
CAGR - MILK per COW	1980-2020	1980-2000	2000-2020	1980-1990	1990-2000	2000-2010	2010-2020	2015-2020
Australia	1.96%	2.61%	1.32%	2.75%	2.47%	1.13%	1.51%	1.82%
New Zealand	1.15%	1.05%	1.26%	-0.15%	2.27%	0.87%	1.65%	0.45%
United States	1.93%	2.18%	1.67%	2.21%	2.15%	1.52%	1.83%	1.93%
Argentina*	2.31%	3.80%	0.84%	1.88%	5.76%	0.32%	1.36%	*1.01%*
Uruguay*	2.25%	2.73%	1.76%	0.89%	4.61%	1.60%	1.92%	*1.22%*
South Africa*	1.56%	2.00%	1.12%	2.00%	2.00%	0.90%	1.34%	0.89%
Ireland	1.99%	2.36%	1.63%	3.15%	1.57%	1.62%	1.63%	1.97%
United Kingdom*	2.19%	2.68%	1.70%	3.32%	2.05%	1.70%	1.70%	1.58%

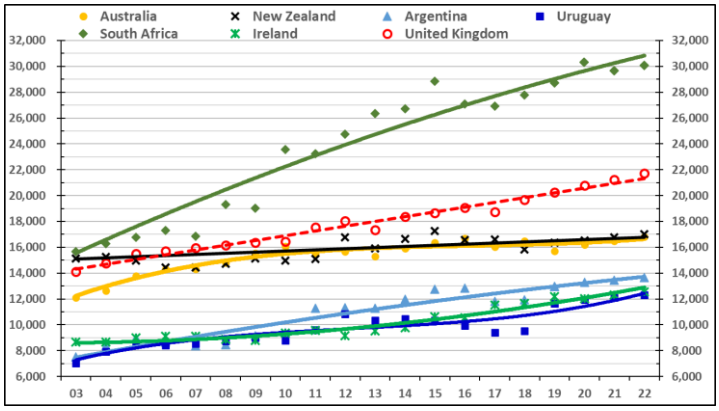
Figure 28. Impact of increasing milk production per cow on profit for pasture-based farms (Beca 2020b)

As milk production per cow INCREASES	Change	R^2	P
Return on Capital (PROFIT)	**No change**	**0.05**	**0.0049**
Cost of production per litre	**No change**	*0.02*	*0.213*
Core per cow cost	Increases	0.28	<= 0.001
Supplement cost per litre	Increases	0.26	<= 0.001
Total feed cost per litre	Increases	0.22	<= 0.001
Labour cost per cow	Increases	0.19	<= 0.001
Pasture cost per tonne dry matter	Increases	0.12	<= 0.001
Core per hectare cost per tDM of pasture harvest	Increases	0.09	<= 0.001

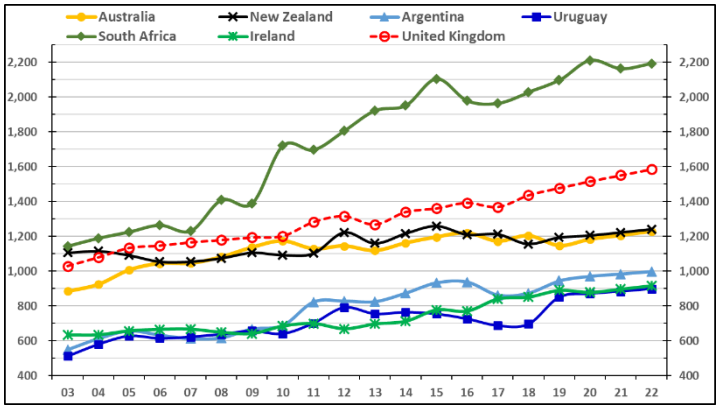
9. Milk production per effective milking hectare (benchmark averages)

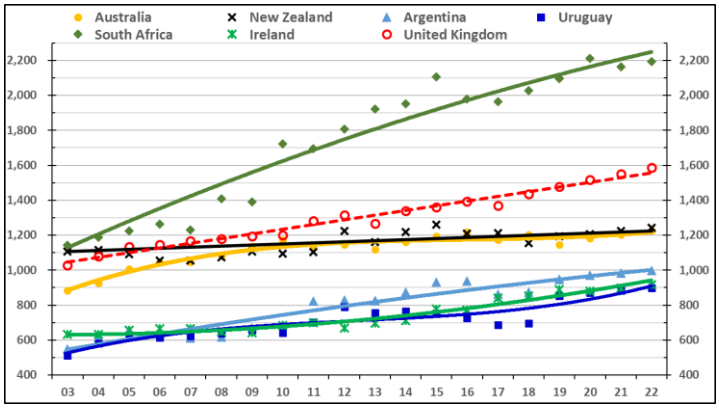
Figures 29a & 29b. Milk production per hectare 2003-2022 (litres ECM)





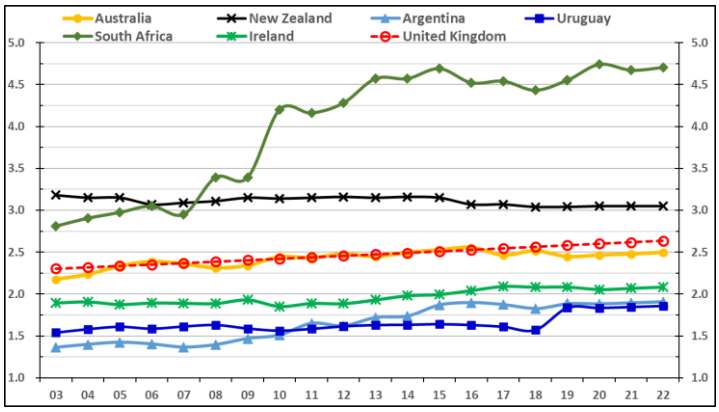
Figures 30a & 30b. Milk production per hectare 2003-2022 (kg milksolids ECM)

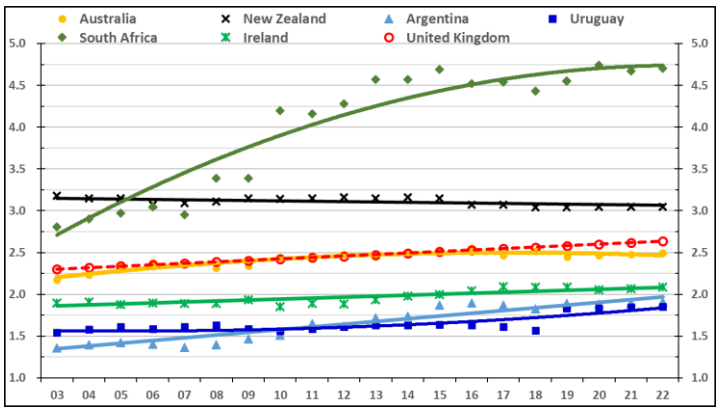




10. Stocking rate (benchmark averages)

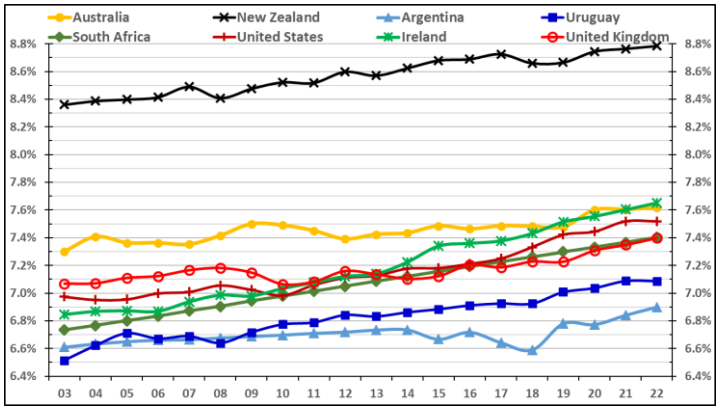
Figures 31a & 31b. Stocking rate 2003-2022 (cows per effective milking hectare)

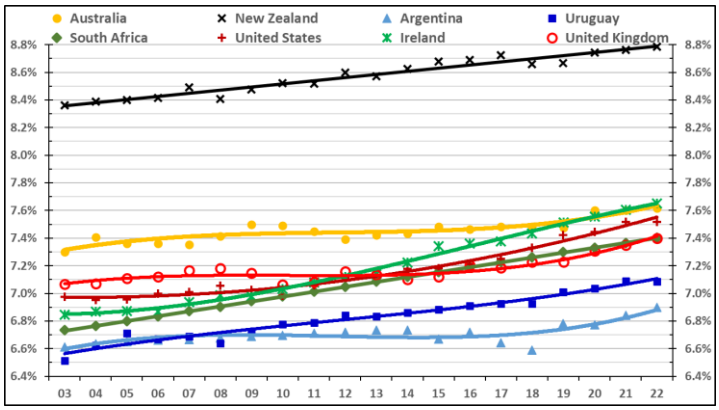




11. Milksolids (fat and protein) percentage (industry averages)

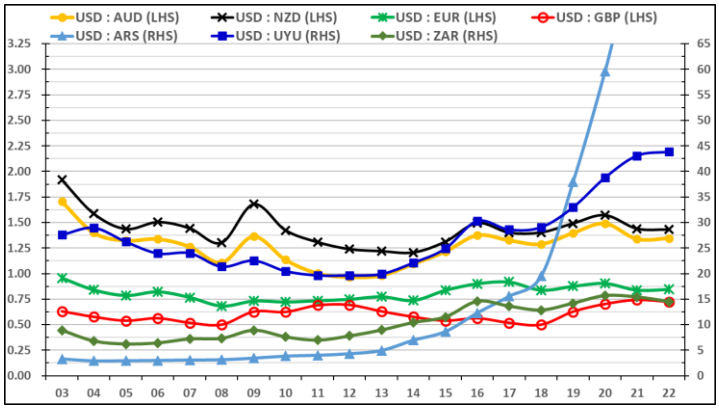
Figures 32a & 32b. Milksolids (fat + protein) percentage 2003-2022





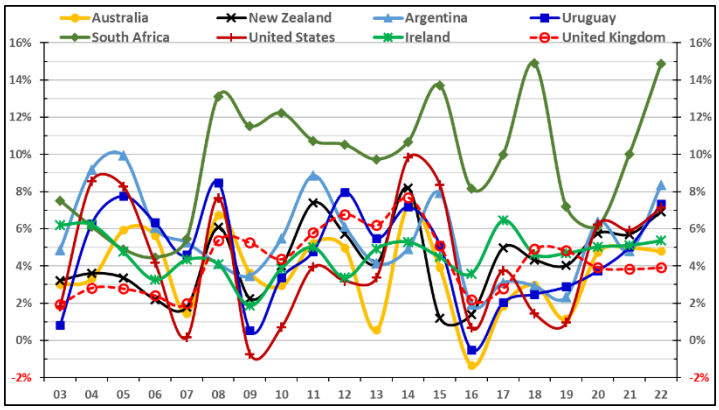
12. USD exchange rate

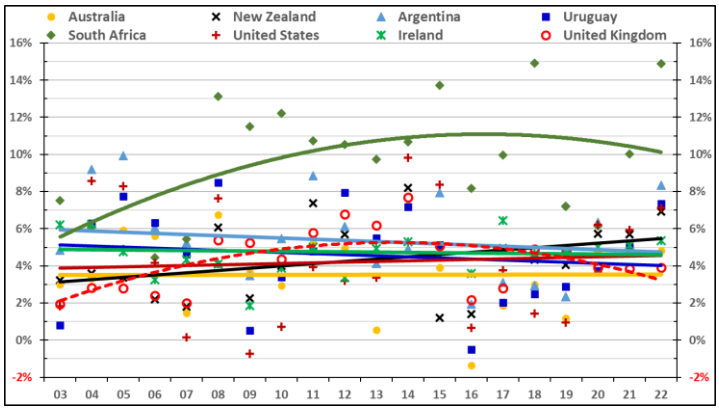
Figure 33. USD exchange rate 2003-2022



13. Return on capital (benchmark averages)

Figures 34a & 34b. Return on capital 2003-2022 (%)





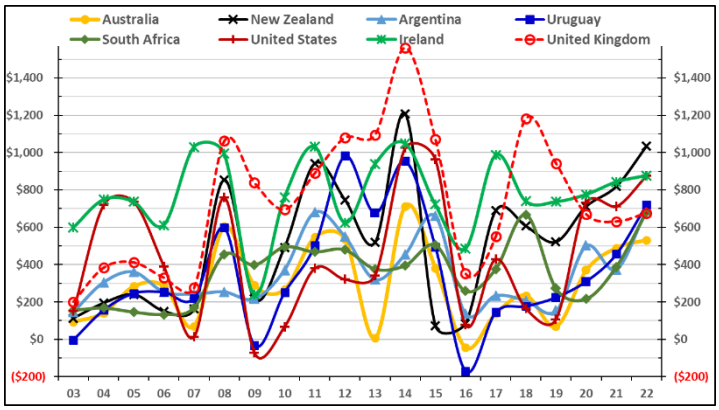
14. Ratios that correlate with return on capital (Beca 2020b)

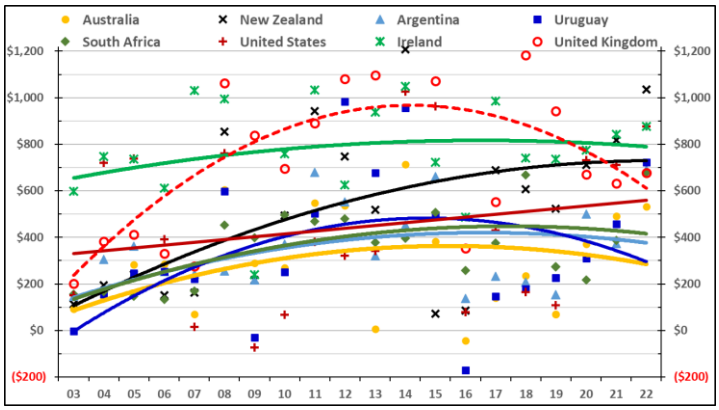
Figure 35. Ratios that correlate with return on capital (Beca 2020b)

Primary ratio	R^2	P	Secondary ratio or proxy	R^2	P
Return on total capital (ROC) [defines profit]	**Comparator for other ratios**		Profit per hectare	0.79	<= 0.001
			Profit per cow	0.73	<= 0.001
Operating profit margin	0.75	<= 0.001	Profit per litre	0.76	<= 0.001
Cost of production per litre	0.44	<= 0.001	Total expenses per litre	0.51	<= 0.001
Pasture harvest	0.41	<= 0.001			
Pasture cost per tonne dry matter	0.23	<= 0.001			
Milk price	0.20	<= 0.001			
Milk production per hectare	0.20	<= 0.001	Stocking rate	0.25	<= 0.001
Supplement cost per litre	0.20	<= 0.001	Total feed cost per litre	0.21	<= 0.001
Core per cow cost	0.20	<= 0.001			
Labour cost per cow	0.18	<= 0.001	Cows per full-time staff equivalent	0.13	<= 0.001
			Labour cost per litre	0.17	<= 0.001
			Litres per full-time staff equivalent	0.11	<= 0.001
Core per hectare cost per tonne dry matter of pasture harvest	0.17	<= 0.001			
Pasture as per cent of diet	0.08	<= 0.001	Pasture consumed per cow	0.07	0.001
Ratios of low utility	R^2	P	**(some impractical to apply)**		
Milk production per cow	0.05	0.0049	Little to no positive or negative correlation with ROC		
Income over feed costs per litre	0.28	<= 0.001	Correlation calculated on annual basis (for practical use,		
Income over feed costs per cow	0.25	<= 0.001	would need to be calculated on monthly or weekly basis)		
Grams concentrate per litre	0.10	<= 0.001	Correlation calculated on annual basis (for practical use,		
Grams supplement per litre	0.08	<= 0.001	would need to be calculated on monthly or weekly basis)		

15. Profit per cow (benchmark averages)

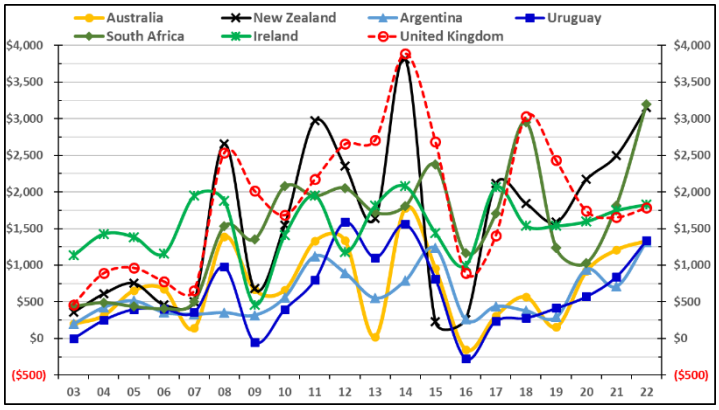
Figures 36a & 36b. Profit per cow 2003-2022 (USD)

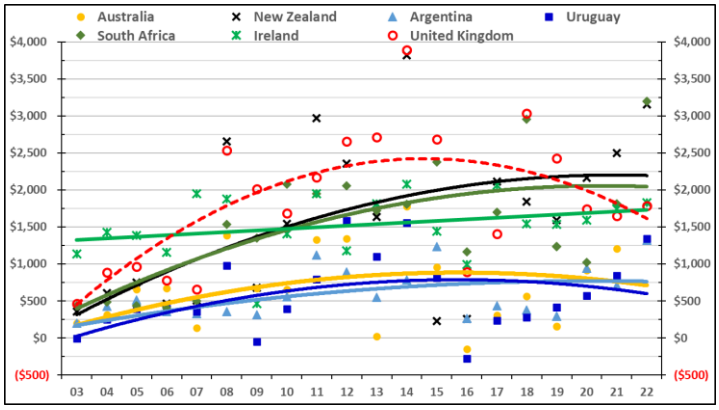




16. Profit per effective milking hectare (benchmark averages)

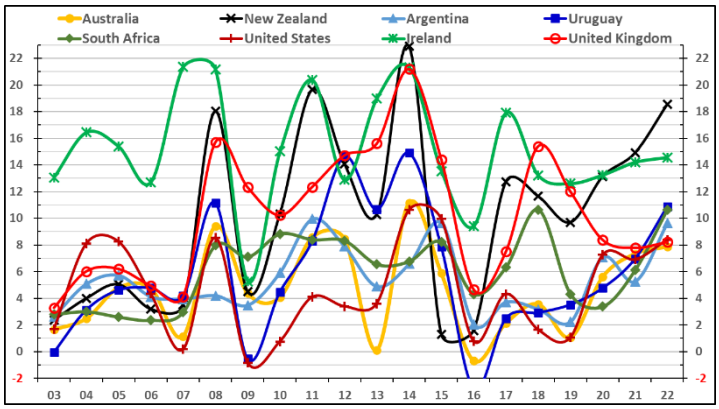
Figures 37a & 37b. Profit per effective milking hectare 2003-2022 (USD)

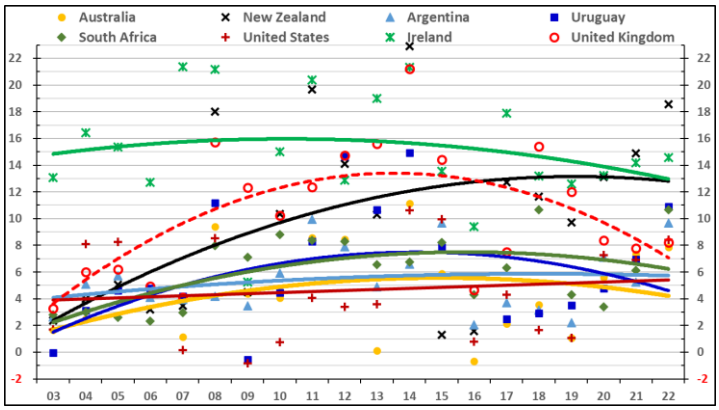




17. Profit margin per litre (benchmark averages)

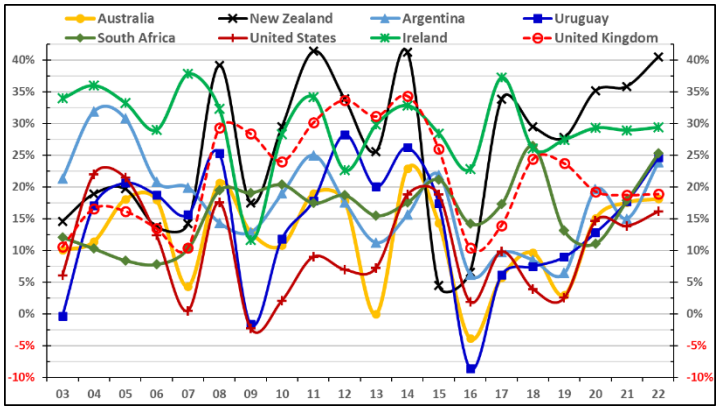
Figures 38a & 38b. Profit margin per litre 2003-2022 (USDc ECM)

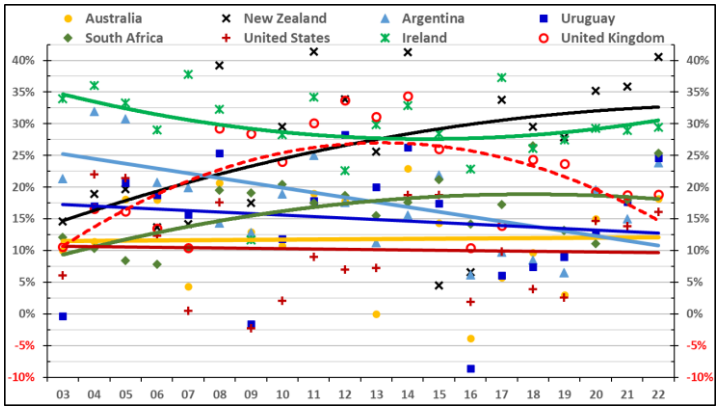




18. Operating profit margin (benchmark averages)

Figures 39a & 39b. Operating profit margin 2003-2022 (%)

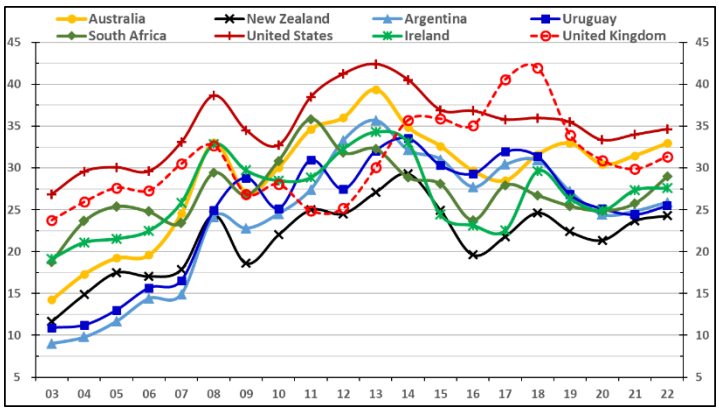


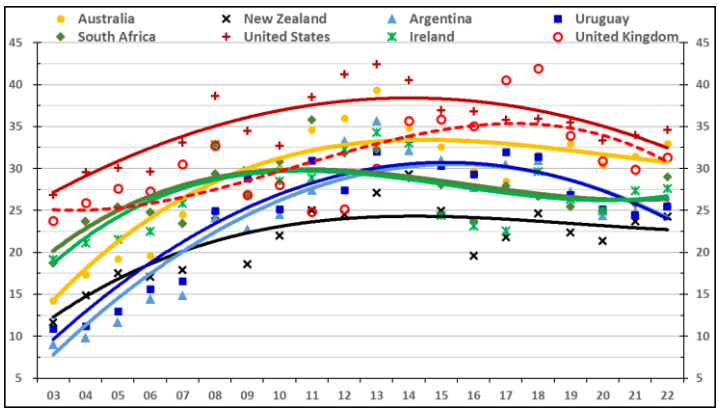


19. 'Operating' cost of production per litre (benchmark averages)

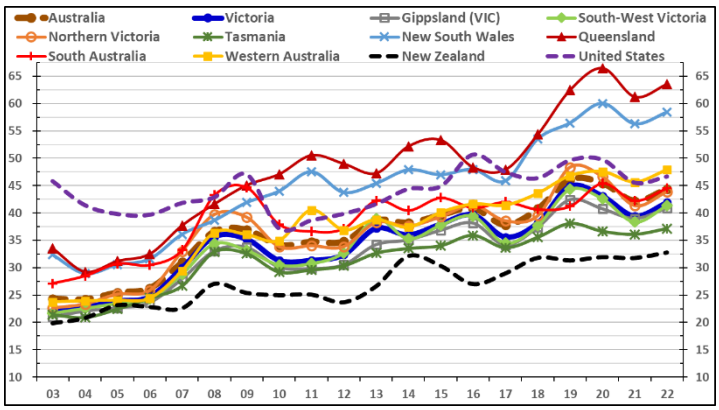
Operating (accounting) cost of production = operating expenses minus livestock revenue minus other non-milk revenue

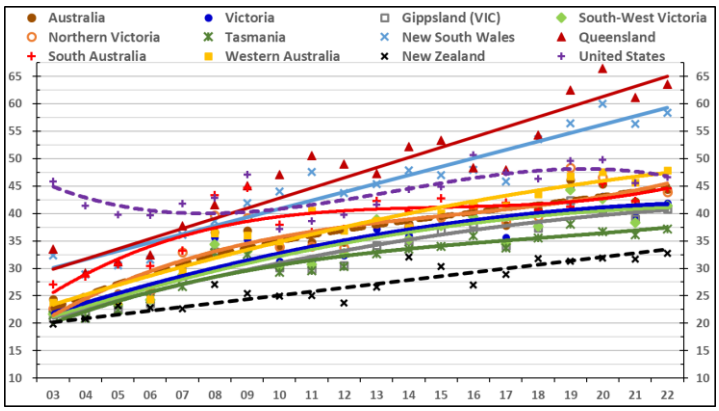
Figures 40a & 40b. Operating cost of production per litre 2003-2022 (USDc ECM)





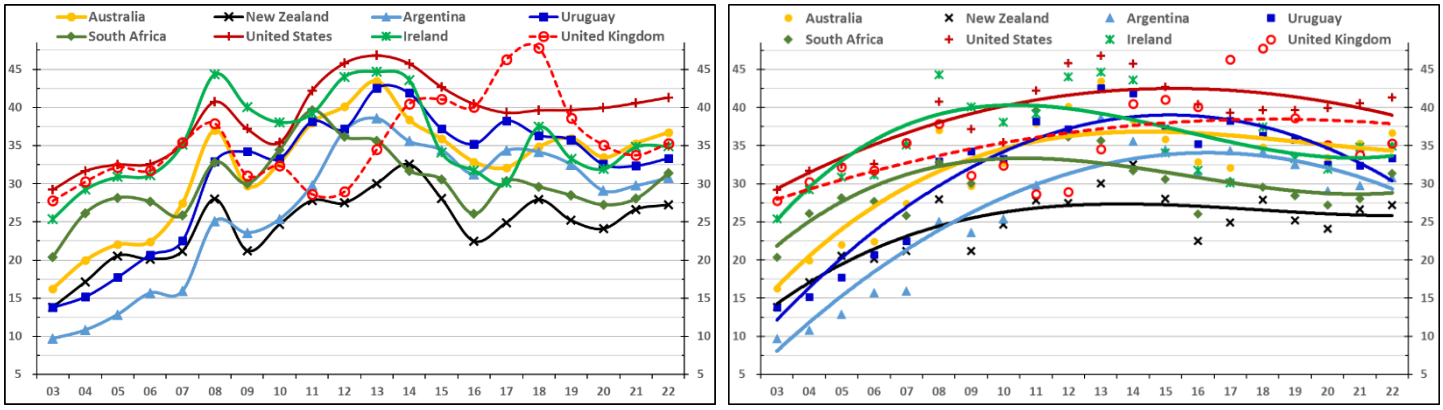
Figures 41a & 41b. Australian national, state and Vic regions cost of production per litre (plus NZ, USA) 2003-2022 (AUDc ECM)





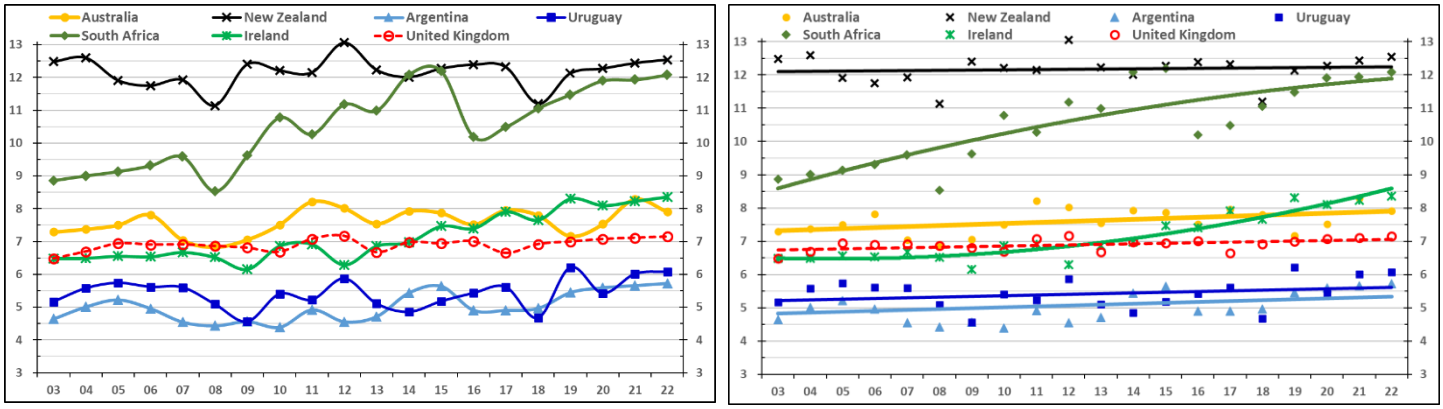
20. Total operating expenses per litre (benchmark averages)

Figures 42a & 42b. Total operating expenses per litre 2003-2022 (USDc ECM)



21. Pasture harvest (benchmark averages)

Figures 43a & 43b. Pasture harvest per year 2003-2022 (tonne DM/ha)



Figures 44a & 44b. Australian national, state and Vic regions pasture harvest per year (plus NZ, ARG) 2003-2022 (tonne DM/ha)

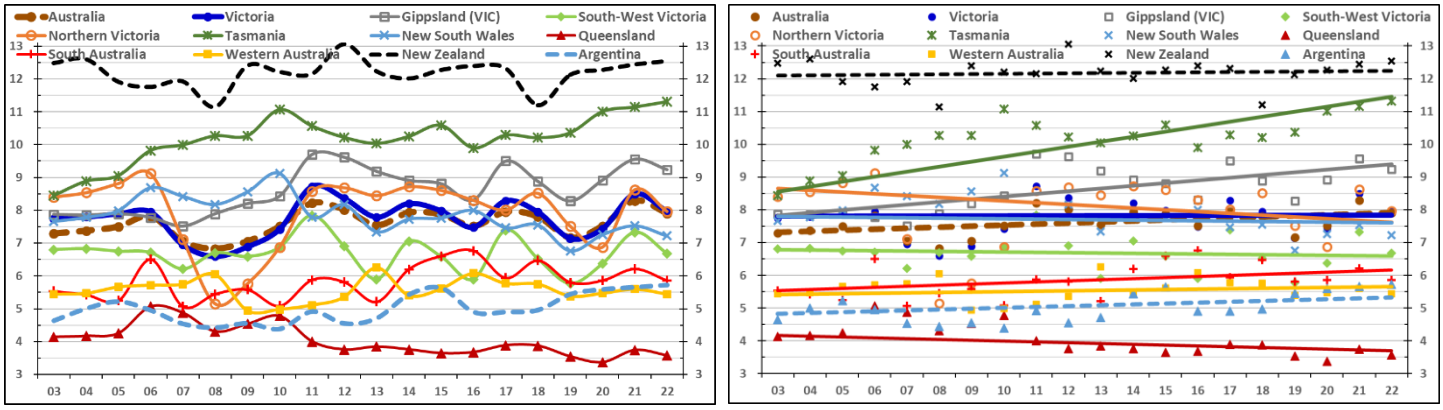
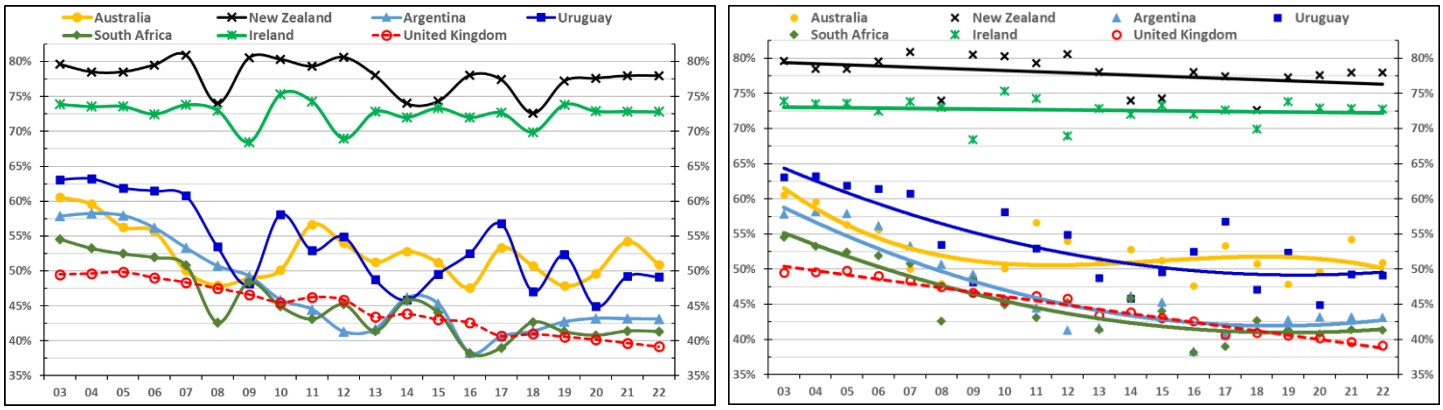


Figure 45. Impact of increasing pasture harvest on profit for pasture-based farms (Beca 2020b)

As pasture harvest INCREASES	Change	R^2	P
Return on Capital (PROFIT)	**Increases**	**0.41**	**<= 0.001**
Cost of production per litre	**Decreases**	**0.14**	**<= 0.001**
Core per hectare cost per tDM of pasture harvest	Decreases	0.31	<= 0.001
Pasture cost per tonne dry matter	Decreases	0.23	<= 0.001
Supplement cost per litre	Decreases	0.12	<= 0.001
Labour cost per cow	Decreases	0.09	<= 0.001
Core per cow cost	Decreases	0.08	<= 0.001
Other factors			
Stocking rate impact on pasture harvest	Increases	0.63	<= 0.001
Pasture consumed/cow impact on pasture harvest	Increases	0.07	<= 0.001

22. Pasture as per cent of cows' diet (benchmark averages)

Figures 46a & 46b. Pasture as per cent of cows' diet 2003-2022 (%)



Figures 47a & 47b. Australian national, state and Vic regions pasture as per cent of cows' diet (plus NZ) 2003-2022 (%)

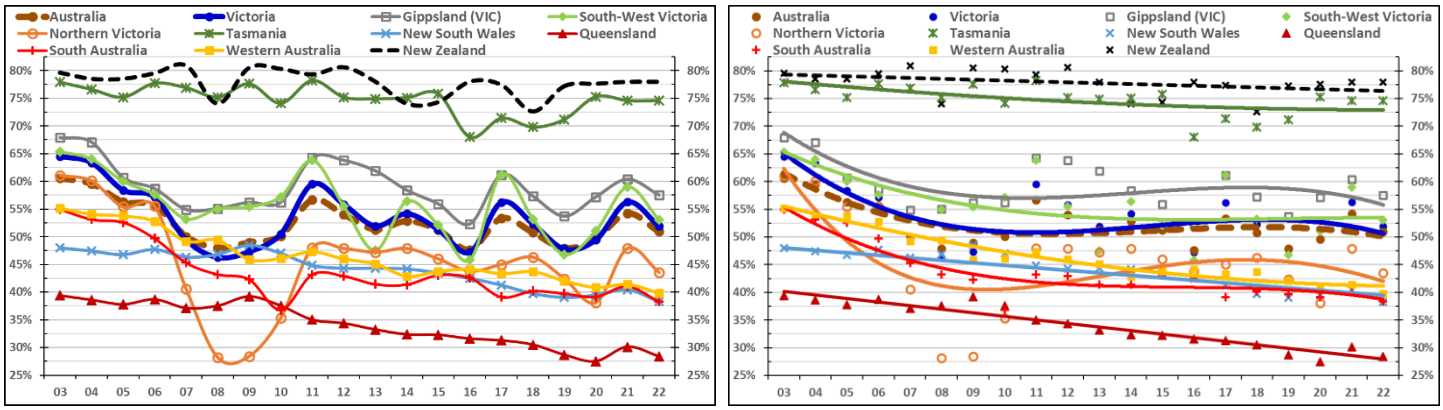
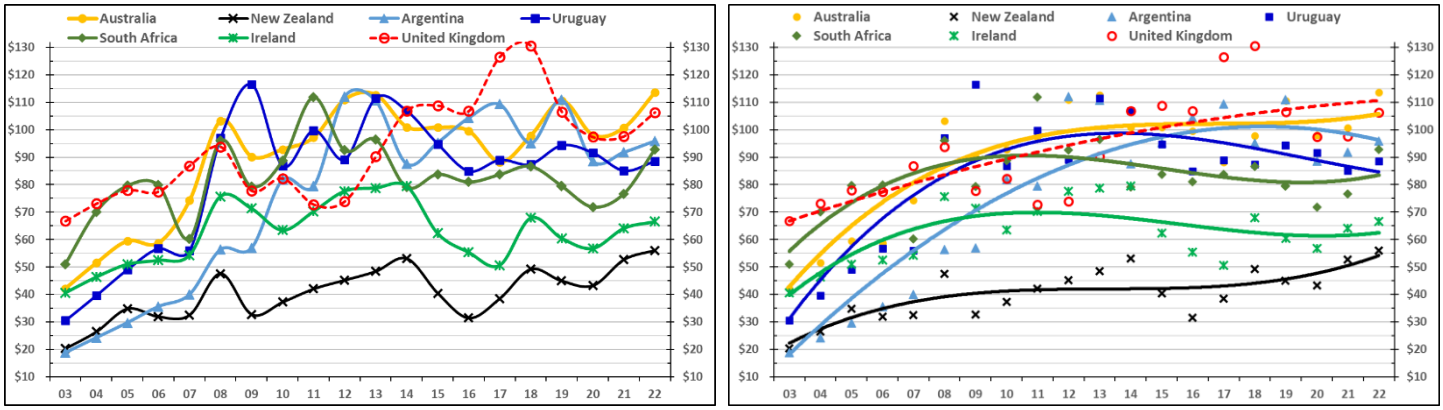


Figure 48. Impact of decreasing pasture as per cent of cows' diet on profit for pasture-based farms (Beca 2020b)

As pasture as per cent of cows' diet DECREASES	Change	R^2	P
Return on Capital (PROFIT)	**Decreases**	**0.08**	**<= 0.001**
Cost of production per litre	**Increases**	**0.16**	**<= 0.001**
Pasture consumed per cow	Decreases	0.68	<= 0.001
Supplement cost per litre	Increases	0.58	<= 0.001
Total feed cost per litre	Increases	0.50	<= 0.001
Core per hectare cost per tDM of pasture harvest	Increases	0.49	<= 0.001
Pasture cost per tonne dry matter	Increases	0.26	<= 0.001
Core per cow cost	Increases	0.09	<= 0.001
Labour cost per cow	Increases	0.08	<= 0.001
Pasture harvest	**Decreases**	**0.10**	**<= 0.001**
Total consumed per cow	Increases	0.31	<= 0.001
Milk production per cow	Increases	0.32	<= 0.001

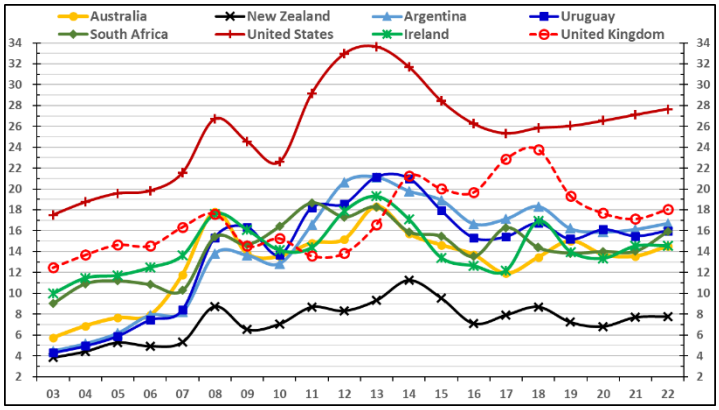
23. Pasture cost per tonne dry matter (benchmark averages)

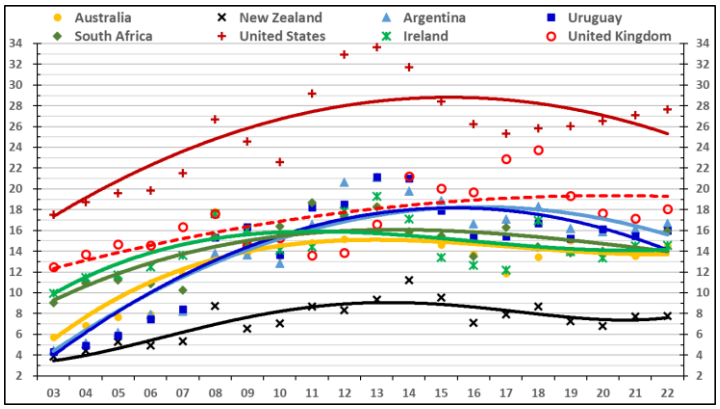
Figures 49a & 49b. Pasture cost per tonne dry matter 2003-2022 (USD)



24. Supplement cost per litre (benchmark averages)

Figures 50a & 50b. Supplement cost per litre 2003-2022 (USDc ECM)

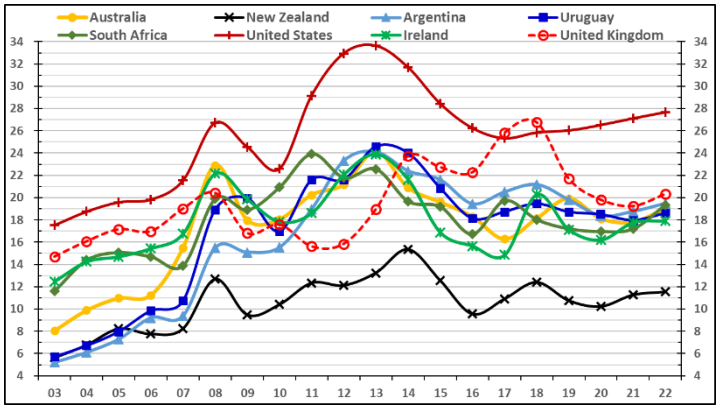


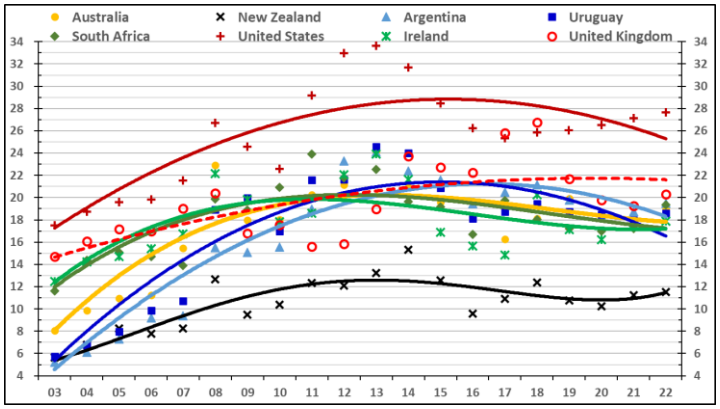


25. Total feed cost per litre (benchmark averages)

Total feed cost = supplement cost plus pasture cost

Figures 51a & 51b. Total feed cost per litre 2003-2022 (USDc ECM)

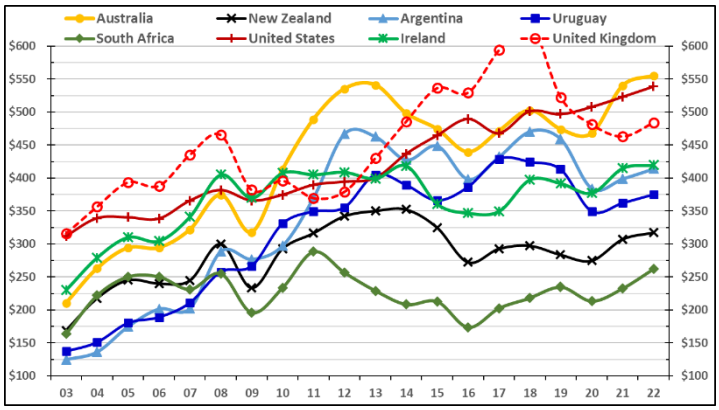


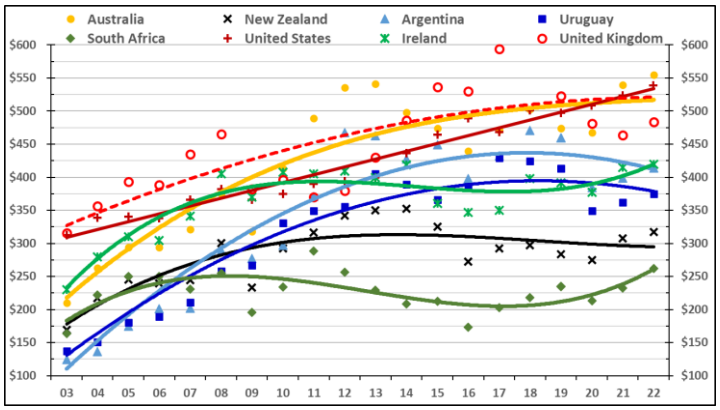


26. Labour cost per cow (benchmark averages)

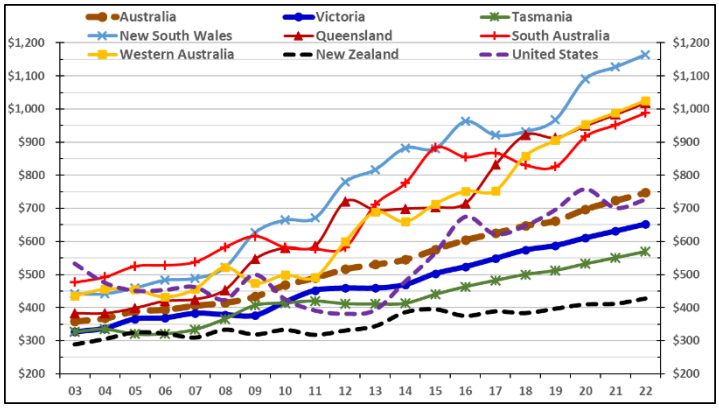
Labour cost includes full cost of management (including imputed owner salary)

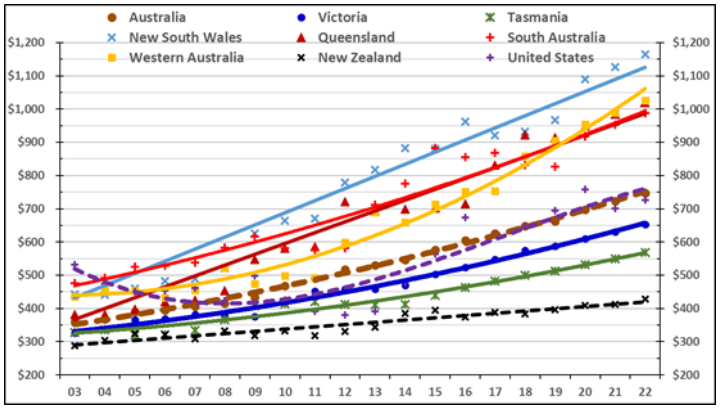
Figures 52a & 52b. Labour cost per cow 2003-2022 (USD)





Figures 53a & 53b. Australian national and state labour cost per cow (plus NZ, USA) 2003-2022 (AUD)

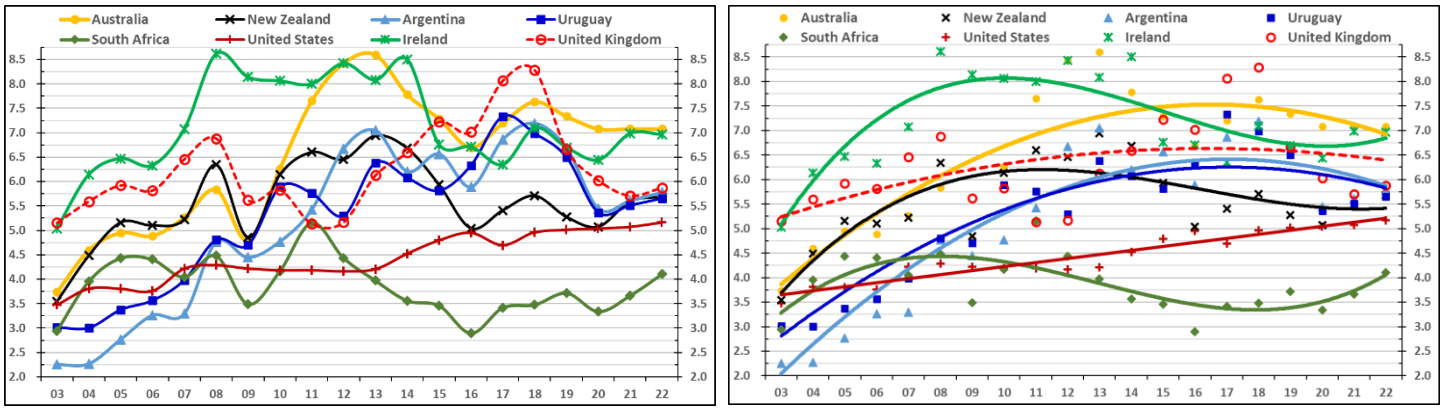




27. Labour cost per litre (benchmark averages)

Labour cost includes full cost of management (including imputed owner salary)

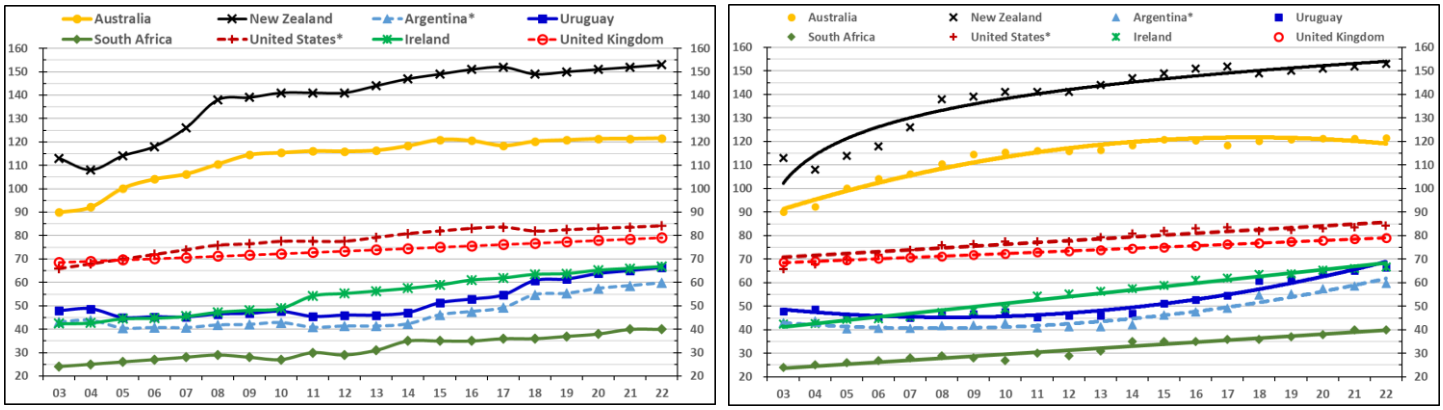
Figures 54a & 54b. Labour cost per litre 2003-2022 (USDc ECM)



28. Labour efficiency = Cows per 50-hour full-time equivalent (benchmark averages)

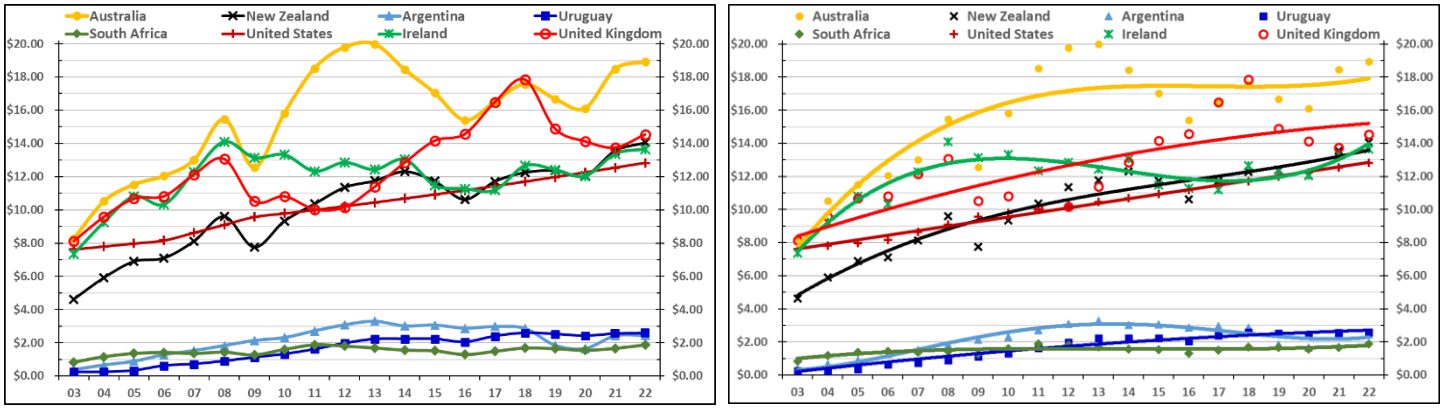
Cows = cows in herd. Full management time included. 50-hour full-time equivalent = 'FTE'.

Figures 55a & 55b. Labour efficiency 2003-2022 (cows per FTE)

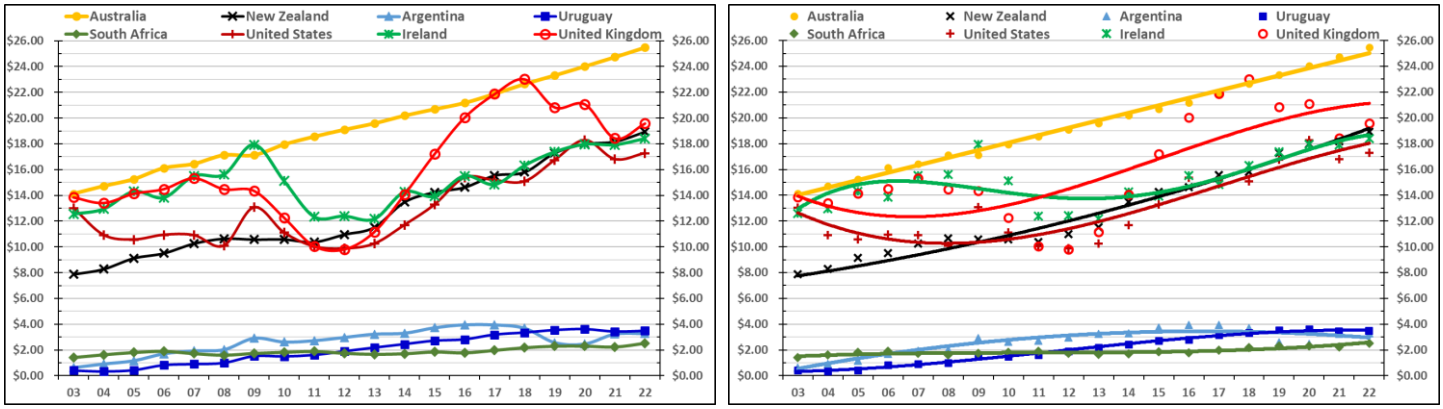


29. Minimum hourly salary including taxes/superannuation/levies

Figures 56a & 56b. Minimum hourly salary 2003-2022 (USD per hour)



Figures 57a & 57b. Minimum hourly salary 2003-2022 (AUD per hour)

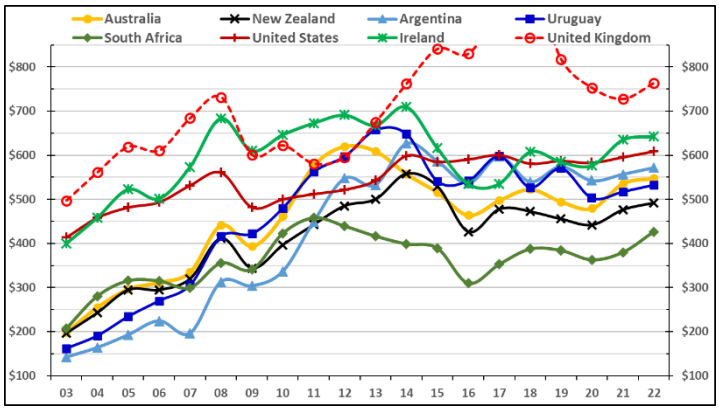


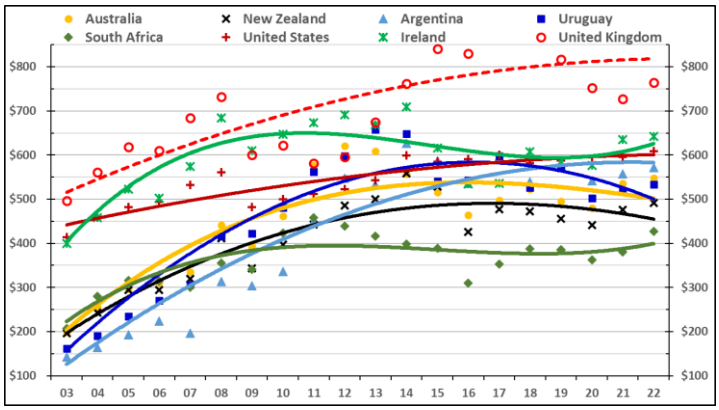
30. Core per cow cost (benchmark averages)

Figure 58. Costs included in 'Core per cow cost' calculation (Beca 2020b)

Costs included in Core per Cow Costs	Percent
Animal Health	100%
Breeding	100%
Dairy Shed Expenses	100%
Electricity / Energy	100%
Freight on Livestock	100%
Support / Youngstock	100%
Repairs & Maintenance	50%
Vehicle Expenses incl. fuel & oil	70%
Industry Levies	100%
Depreciation	50%

Figures 59a & 59b. Core per cow cost 2003-2022 (USD/cow)



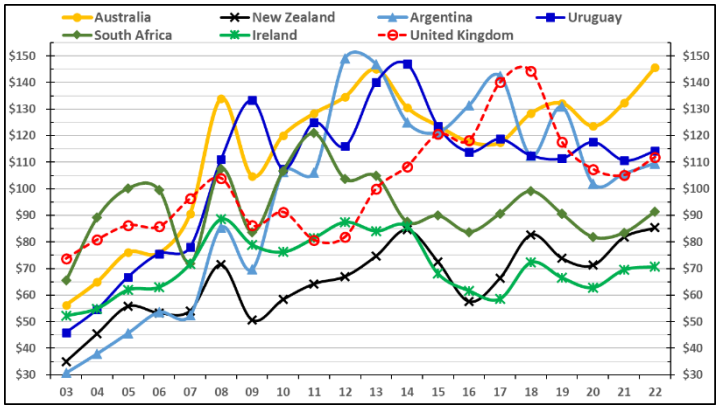


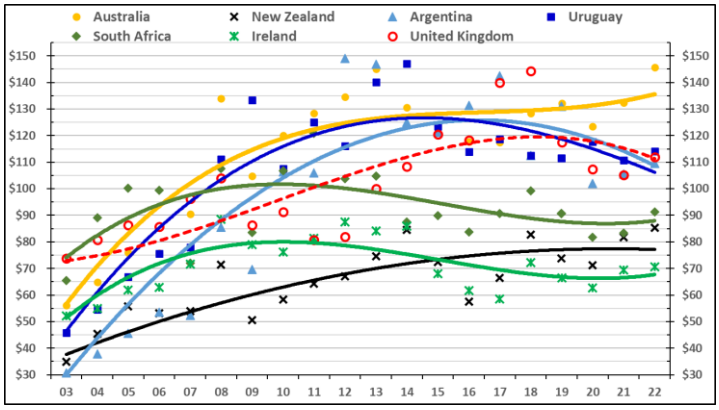
31. Core per hectare cost per tonne dry matter of pasture (benchmark averages)

Figure 60. Costs included in 'Core per hectare cost per tonne dry matter of pasture' calculation (Beca 2020b)

Costs included in Core per Hectare Costs	Percent
Cropping (greenfeed)	100%
Fertiliser excl. Nitrogen	100%
Pasture Maintenance & Renewal	100%
Repairs & Maintenance	50%
Vehicle Expenses incl. fuel & oil	30%
Administration	100%
Insurance, Land Taxes, Licenses	100%
Professional fees	100%
Depreciation	50%

Figures 61a & 61b. Core per hectare cost 2003-2022 (USD/ha/tDM)

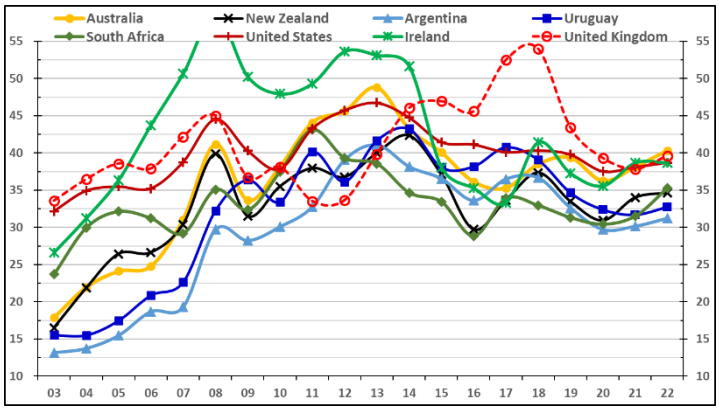


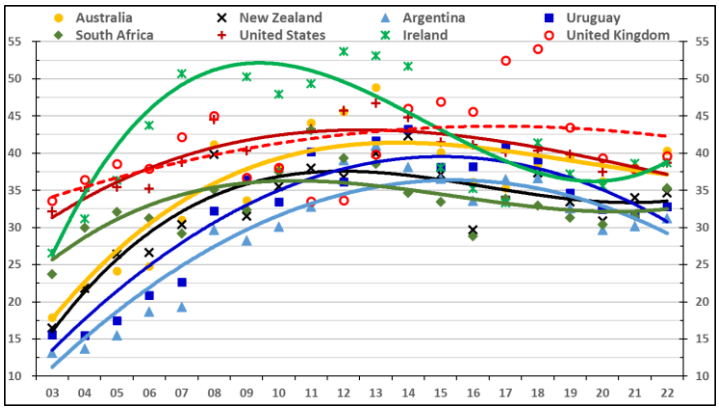


32. 'Economic' cost of production per litre (benchmark averages)

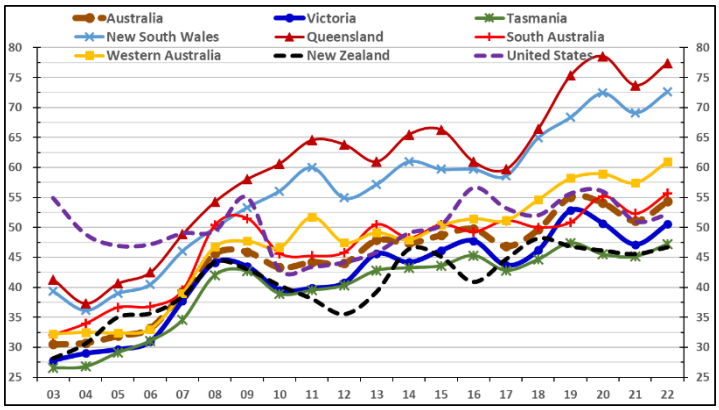
Economic cost of production = operating cost of production plus opportunity cost of capital

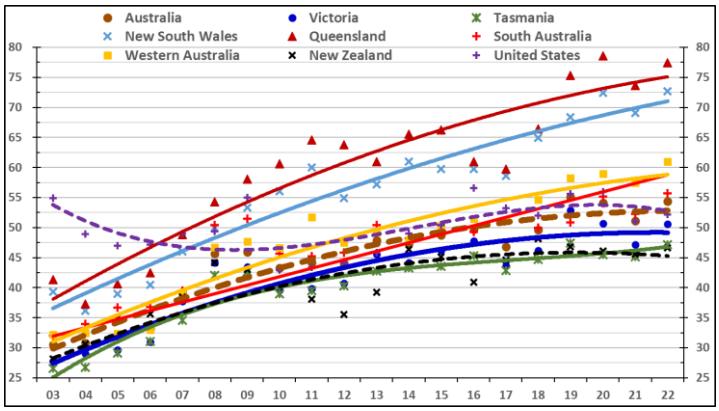
Figures 62a & 62b. Economic cost of production per litre 2003-2022 (USDc ECM)





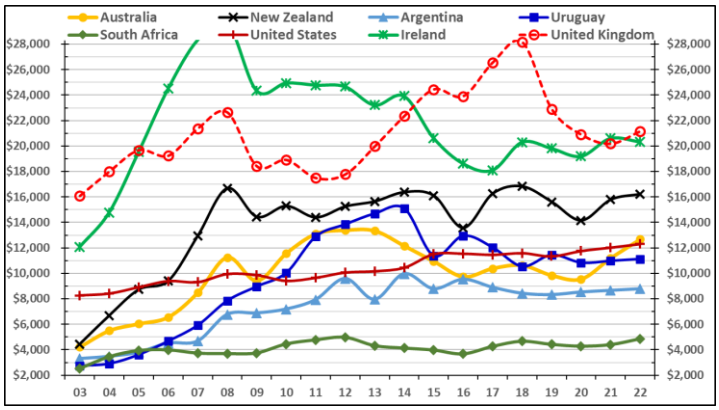
Figures 63a & 63b. Australian national and state economic cost of production per litre (plus NZ, USA) 2003-2022 (AUDc ECM)

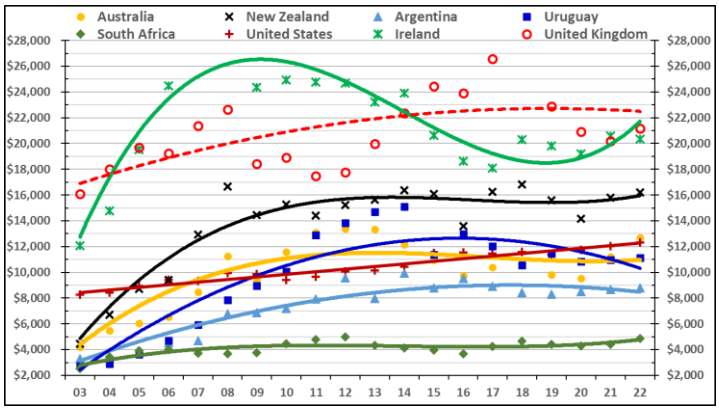




33. Value of total dairy farm assets per cow (benchmark averages)

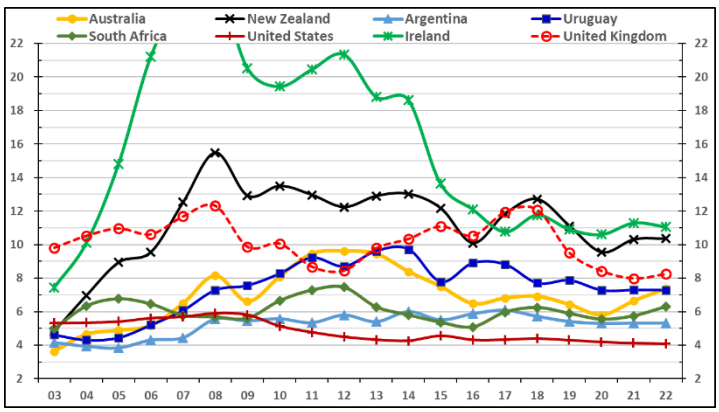
Figures 64a & 64b. Value of dairy farm assets per cow 2003-2022 (USD)

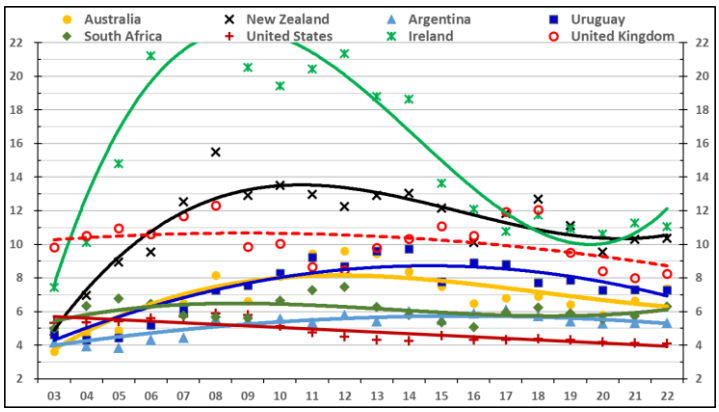




34. Opportunity cost of capital per litre (benchmark averages)

Figures 65a & 65b. Opportunity cost of capital per litre 2003-2022 (USDc ECM)

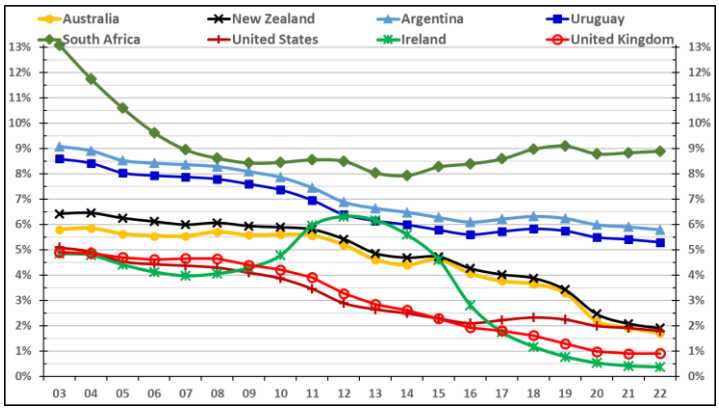




35. Risk free interest rate

Risk free interest rate (for opportunity cost of capital excluding land) = rolling 5-year average of 10-year bond rate

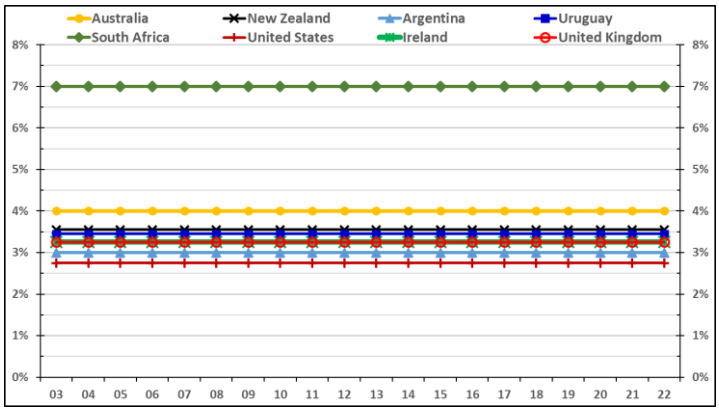
Figure 66. Risk free interest rate 2003-2022 (%)



36. Land lease rate

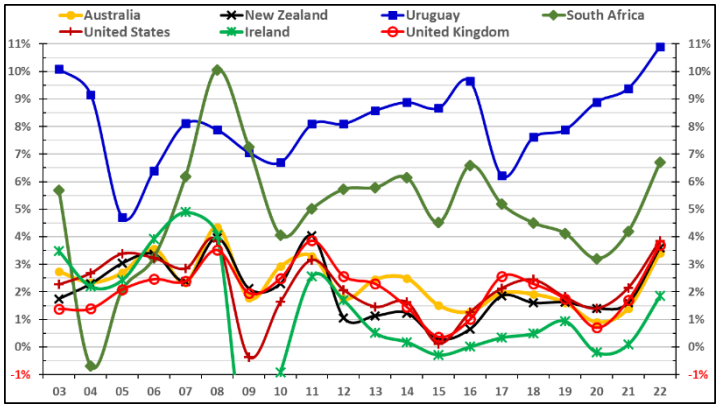
Land lease rate (for opportunity cost of capital) = average long-term lease rates for agricultural (dairy) land

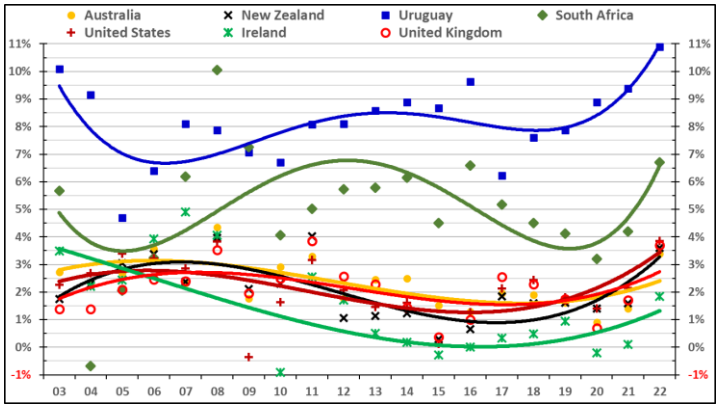
Figure 67. Land lease rate 2003-2022 (%)



37. Inflation rate

Figures 68a & 68b. Inflation rate 2003-2022 (%)





APPENDIX A – Data sources and methodology for standardising data

Sources of data

DATA SOURCES						
Country	Abbreviation	Industry Statistics	Farm Performance Analysis	AUS State/Region	Abbreviation	Farm Performance Analysis
Argentina	ARG	MAGYP	AACREA	New South Wales	NSW	DFMP
Australia	AUS	Dairy Australia	DFMP, QDAS, Red Sky	Queensland	QLD	QDAS
Ireland	IRE	CSO	Teagasc	South Australia	SA	DFMP, Red Sky
New Zealand	NZ	DairyNZ	DairyBase, Red Sky	Tasmania	TAS	DFMP, Red Sky
South Africa	RSA	MPO	Red Sky	Victoria	VIC	DFMP, Red Sky
United Kingdom	UK	DEFRA	AHDB	Gippsland	GipViv	DFMP, Red Sky
United States	USA	USDA	Genske Mulder	South-West Victoria	SWVic	DFMP, Red Sky
Uruguay	URU	INALE	FUCREA	Northern Victoria	Nvic	DFMP, Red Sky
				Western Australia	WA	DFMP, Red Sky

AACREA (Asociación Argentina de Consorcios Regionales de Experimentación Agrícola) www.crea.org.ar; producer-owned organisation in Argentina that has as its main purpose to help producers improve the economic and financial results of their farm business. AACREA has the largest dataset of dairy farm performance in Argentina.

AHDB (Agriculture and Horticulture Development Board, United Kingdom) www.ahdb.org.uk.

CSO (Ireland's Central Statistics Office) www.cso.ie/en.

Dairy Australia www.dairyaustralia.com.au.

DFMP (Dairy Farm Monitor Project, Australia) www.dairyaustralia.com.au/farm/farm-business-management/dairy-farm-monitor-project.

DairyBase (New Zealand) www.dairynz.co.nz/business/dairybase.

DairyNZ www.dairynz.co.nz.

DEFRA (United Kingdom's Department for Environment Food & Rural Affairs) www.gov.uk/government/organisations/department-for-environment-food-rural-affairs.

FUCREA (Federación Uruguaya de Grupos CREA) www.fucrea.org; producer-owned organisation in Uruguay that has as its main purpose to help producers improve the economic and financial results of their farm business. FUCREA has the largest dataset of dairy farm performance in Uruguay.

Genske Mulder (United States) www.genskemulder.com; the largest dairy farm accountancy practice in United States. Genske Mulder produce benchmark data for dairies in Arizona, California, Colorado, Idaho, New Mexico, Texas and Washington and in the regions of the Upper Midwest and Lower Midwest.

INALE (Instituto Nacional de la Leche) www.inale.org; the Uruguayan National Milk Institute is a non-state public entity with its main task being to advise the government on dairy policy. The aim is to contribute to a joint public-private partnership aimed at the development of the Uruguayan dairy industry.

MAGYP (Ministerio de Agricultura, Ganadería y Pesca) www.argentina.gob.ar/agricultura-ganaderia-y-pesca; the Argentinian government's Ministry of Agriculture, Livestock and Fishing.

MPO (South Africa's Milk Producers Organisation) www.mpo.co.za.

QDAS (Queensland Dairy Accounting Scheme); benchmarking analysis undertaken by Queensland Department of Agriculture and Fisheries www.daf.qld.gov.au with funding from Dairy Australia.

Red Sky Agricultural (**'Red Sky'**) www.redskyagri.com; commercial provider of farm business analysis and benchmarking software that is primarily operating in Australia, New Zealand and South Africa. Red Sky's major shareholder is the author of this report.

Teagasc (Ireland's Agriculture and Food Development Authority) www.teagasc.ie.

TheGlobalEconomy.com www.theglobaleconomy.com/rankings/minimum_wage.

USDA (United States Department of Agriculture) www.usda.gov.

Developing consistent calculations for dairy farm performance comparisons

DairyBase (New Zealand) and Red Sky have near identical methodologies for calculating dairy farm business performance and would generally be considered to be utilising best practice.

All New Zealand and South African data, as well as Tasmanian, Victorian and its three regions' data, were processed via Red Sky even when informed partially or significantly from DairyBase (New Zealand) or Dairy Farm Monitor Project (Australia).

South Australian data for the years 2004/05 to 2011/12, and Western Australian data for the years 2005/06 to 2012/13, were processed entirely by Red Sky.

South Australian data for the years 2013/14 to 2019/20, Western Australian data for the years 2015/16 to 2019/20, and New South Wales data for the years 2011/12 to 2019/20, were entirely based on Dairy Farm Monitor Project reports and then converted into a similar format to Red Sky/DairyBase (NZ).

Queensland data for all years was entirely based on QDAS reports and then converted into a similar format to Red Sky/DairyBase (NZ).

All years for which data were not available were developed from other Australian states that as closely as possible resembled the missing data, with the data scaled on a similar basis to how the states compared in years when data was available. The years for which data were not available included 2002/03 and 2003/04 for South Australia (2 years), 2003/04, 2004/05, 2013/14 and 2014/15 for Western Australia (4 years), and 2002/03 to 2010/11 for New South Wales (9 years).

The Australian national data were based on the individual state and Victoria regions with each state and region's contribution being weighted on the basis of the per cent of milksolids contributing to the national total for that year.

Most of the balance of the international data, from Argentina, Uruguay, United States and Ireland, were entirely based on AACREA, FUCREA, Genske Mulder and Teagasc data respectively, and then converted into a similar format to Red Sky/DairyBase (NZ).

The United Kingdom data was based on limited benchmark data provided by AHDB and from converting data in refereed and non-refereed publications into a farm performance model to represent average benchmark data. As a result, this United Kingdom data should be interpreted as estimates only.

APPENDIX B – Definitions and calculations for ratios (Beca 2020b)

Ratios	Calculation / Definition
Core per cow cost	[100% x (Animal health + Breeding & herd testing + Dairy shed expenses + Electricity + Freight + Grazing/Support area expenses + Industry levies) + 70% x Vehicle expenses + 50% x (Depreciation + Repairs & maintenance)] divided by total cows in herd.
Core per hectare cost per tonne dry matter of pasture harvest	[100% x (Administration fees & overheads excl. industry levies + Fertiliser excl. nitrogen + Green feed crops grazed in situ + Pasture maintenance & renovation) + 30% x Vehicle expenses + 50% x (Depreciation + Repairs & maintenance)] divided by effective dairy hectares divided by tonne of dry matter harvested per hectare.
Economic cost of production per litre or per kg milksolids	(Operating cost of production plus Opportunity cost of capital) divided by total litres or total milksolids (ECM) produced.
Farm size (cow numbers)	Total number of cows in herd (milking plus dry cows).
Farm size (hectares)	Effective dairy farm area that is grazed by the cows.
Grams concentrate per litre	Grams of concentrate consumed per annum divided by total litres (ECM) produced.
Grams supplement per litre	Grams of supplement consumed per annum divided by total litres (ECM) produced, where supplement includes concentrates and forages but excludes pasture.
Income over feed costs per cow	(Milk revenue - concentrate costs - forage costs) divided by total cows in herd. This is an annual calculation and not a daily calculation.
Income over feed costs per litre	(Milk revenue - concentrate costs - forage costs) divided by total litres (ECM) produced. This is an annual calculation and not a daily calculation.
Labour cost per cow	Management & staff costs incl. imputed labour costs divided by total cows in herd.
Labour cost per litre or per kg milksolids	Management & staff costs incl. imputed labour costs divided by total litres or total milksolids (ECM) produced.
Labour efficiency - cows per full-time staff equivalent	Total cows in herd divided by number of 50-hour full-time staff equivalents.
Milk price	Milk price per litre or per kg milksolids (ECM).
Milk production per cow	Total litres (ECM) produced divided by total cows in herd.
Milk production per hectare	Total litres (ECM) produced divided by effective dairy hectares.
Operating cost of production per litre or per kg milksolids	(Operating expenses minus livestock revenue minus other non-milk revenue) divided by total litres or total milksolids (ECM) produced.
Operating profit margin	Operating profit divided by operating revenue.
Opportunity cost of capital	Opportunity cost of capital for land based on the long-term lease or rental cost for land. Opportunity cost of capital for all non-land assets based on rolling 5-year average of 10-year bond rate plus 2%.
Pasture as per cent of diet	Percent of energy provided from pasture harvested on the effective dairy area as a percentage of total annual energy requirements of the cows.
Pasture cost per tonne dry matter ('Consumed')	Direct pasture cost divided by tonne of dry matter harvested. Direct pasture cost includes pasture maintenance and renovation (including green feed crops grazed in situ), fertiliser (including nitrogen), all pasture irrigation costs, and the direct silage and hay costs for pasture conserved on the dairy farm.
Pasture harvest	This is the equivalent tonnage of standardised (10.5-11.0 MJ ME/kgDM) energy density pasture consumed per hectare. Any hay and silage conserved on the dairy farm is included in the total pasture yield. This is a back-calculation based on inputs and outputs.
Profit per cow	Operating profit divided by total cows in herd (milking plus dry cows).
Profit per hectare	Operating profit divided by effective dairy hectares (grazed by the cows).
Profit margin per litre or per kg milksolids	Operating profit divided by total litres or total milksolids (ECM) produced.
Return on (total) capital	Operating profit divided by the total value of all assets employed in the business (regardless of ownership/financing structure). Changes in asset values, including appreciation of land values, are not included in this calculation.
Risk free interest rate	Rolling 5-year average of 10-year bond rate or equivalent plus 2% premium.
Stocking rate	Total cows in herd divided by effective dairy hectares.
Supplement cost per litre or per kg milksolids	(Concentrates + Forages + Grazing/Support area expenses) divided by total litres or total milksolids (ECM) produced.
Total consumed per cow (tDM/cow/year)	Total tonnes of dry matter consumed per cow in herd per year, where the energy supplied from pasture is standardised at 10.5-11.0 MJ ME/kg DM, the energy supplied from forages is standardised at 9.5 MJ ME/kg DM, and the energy supplied from concentrates is standardised at 12.5 MJ ME/kg DM.
Total expenses per litre or per kg milksolids	Operating expenses divided by total litres or total milksolids (ECM) produced.
Total feed cost per litre or per kg milksolids	(Concentrates + Forages + Grazing/Support area expenses + Green feed crops grazed in-situ + Fertiliser incl. nitrogen + Irrigation + Pasture maintenance & renovation) divided by total litres or total milksolids (ECM) produced.

Definitions of operating revenue and expenses utilised in calculation of operating profit (Beca 2020a and 2020b)

Operating profit calculation	Definitions
Operating revenue	Milk sales + Livestock revenue[1] + Other non-milk revenue
[1] Livestock revenue	Livestock sales - livestock purchases + (closing numbers - opening numbers) x closing value per head
Operating expenses	Administration fees & overheads[2] + Animal health + Breeding & herd testing + Dairy shed expenses + Depreciation[3] + Electricity + Fertiliser + Freight + Irrigation + Pasture maintenance & renovation + Repairs & maintenance + Total supplement expenses[4] + Vehicle expenses + Management & labour expenses[5]
[2] Administration fees & overheads	Includes all office expenses plus professional fees plus rates, licences, levies and insurance
[3] Depreciation	Based on straight line depreciation over economic life of asset
[4] Total supplement expenses	Includes all concentrate and forage expenses (excluding pasture grown on dairy farm) fed to cows and growing heifers plus green feed crops grazed in-situ plus all expenses for grazing/support area utilised for cows and growing heifers as well as supplement production
[5] Management & labour expenses	Includes all direct labour expenses plus market salary value of any management provided by owner/family plus market hourly rate value of any labour provided by owner/family
Operating profit	Operating revenue - Operating expenses

Energy corrected milk (ECM)

ECM determines the amount of energy in the milk based upon milk, fat and protein and adjusted to 4.0 per cent fat and 3.3 per cent protein. ECM formula = milk production x ((0.383 x fat% + 0.242 x protein% + 0.7832) / 3.1138). Converting all milk ratios to energy corrected milk is required due to the otherwise confounding impact of the wide range in fat and protein per cent as a result of differing cow types, diets and production systems. This formula is used by the Dairy International Farm Comparison Network, as outlined in the following: https://dairymarkets.org/PubPod/Reference/Library/Energy%20Corrected%20Milk.