COHORT ANALYSIS OF THE DAIRY FARM WORK FORCE

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This paper traces variations in the dairy farm work force in Victoria, New South Wales, and Queensland. Although the substantial differences between States in income levels are reflected in differing rates of reduction in the work force, these differences are not also reflected by appreciable differences in mean age and age structure. The cohort analysis explains this observation.

The purpose of this paper is to illustrate that an approximate cohort analysis can be applied to Australian census data, with interesting results. The data used are from the Censuses of 1933, 1947, and 1961, and relate to the male dairy farm work-force in the States of Victoria, New South Wales, and Queensland. These States show substantially different rates of change in the numbers employed in dairying. Attention is directed to the effect of these differences on the mean age and age structure of the work-force and on the underlying demographic changes that are illustrated by the cohort analysis.

The analysis depends on the comparability of data derived from a series of censuses. The Commonwealth Statistician has advised that there have been no major changes in definitions with respect to the dairying industry between the 1933, 1947, 1954 and 1961 Censuses. The Censuses are not completely comparable because of: (a) changes in the treatment of persons of independent means, retired persons and pensioners; (b) a change in the treatment of inadequate and nil replies; and (c) the introduction of a modified classification of industries in 1954. A further limitation is that the figures are based on the self-classification of people as males employed in dairying. This requires an assumption that a constant proportion of the people actually so employed are prepared to classify themselves in this group. Moreover, the work-force is made up of farmers, members of their families, and employed workers, and the proportion of the work-force in these different categories may not be the same in different States.[1]

However, despite these shortcomings and complications, one would appear to learn more by undertaking the type of analysis proposed than by rejecting it as misleading.

Changes in the Male Work Force: 1933 to 1961

For the three States, a comparison of the total number of males employed in dairying, at the census dates from 1933 to 1961, is shown in Table 1. These data show the declining importance of New South Wales

[1] The recent survey of the Australian dairy industry by the Bureau of Agricultural Economics will provide data on this point.

and Queensland as dairying regions, and reflect the higher percentage of low-income dairy farms in these areas.[2]

TABLE 1

Number of Males Employed in Dairying
at Census Dates from 1933 to 1961

Census date	Victoria	New South Wales	Queensland
1933	24,780	34,329	21,508
1947	30,511	27,909	25,993
1954	31,932	27,351	27,543
1961	29,822	22,129	21,756

Source: Commonwealth Statistician.

Trends in the dairy industry's labour force have been discussed earlier by Lloyd[3] who pointed out that between 1933 and the commencement of World War II there were no substantial rises in the number employed in dairying in any State. The industry's work force was substantially contracted in the early war years but recovered markedly in 1944 and 1945 and the early post-war years. Lloyd gave particular attention to the rise, between 1933 and 1954, in the numbers employed in Queensland and Victoria:[4]

"It is rather difficult to explain this particular trend in Queensland and Victorian dairying in the post-war period. In both States, there was an estimated rise in the labour force of close to 30 per cent between the late war years and 1954. Admittedly, cow numbers were rising in Victoria over this period, and more labour was being devoted to growing feed, but one would have expected these changes would have been largely counterbalanced by the rapid adoption of machine milking. In Queensland, cow numbers actually fell over this period, and less labour was devoted to producing pig meats in dairying districts."

Lloyd considered that the demand for better working conditions, and the ability of farmers to afford better conditions, were important factors explaining these trends. However, since the publication of Lloyd's work, the rate of decline in the industry's labour force in Queensland has paralleled the rate of decline in New South Wales.

In other countries, low-income areas are characterized by a high percentage of elderly farmers. In the United States, a recent study reported that 54 per cent of the farmers classed as having low incomes (less than $U.S.2,500) were aged 65 years or over; the corresponding figure for the higher income groups (more than $U.S.10,000) was seven per cent.[5]

[2] For further background, see: Bollman, F. H. and Ward, A. B. The changing distribution of Australian dairy cattle. Qrtly. Rev. Agric. Econ. 11: 75-84, 1958; Holmes, J. H. The changing distribution of dairying in coastal New South Wales. (Paper delivered to the second annual meeting of the Institute of Australian Geographers.) University of New England, 1961, pp. 20, mimeo; Bird, J. G. The dairy industry on the Far North Coast of New South Wales. Rev. Mktg. Agric. Econ. 30: 13-70, 1962; and Anon. Some initial results of the Australian dairy industry survey, 1961-62 to 1963-64. Qrtly. Rev. Agric. Econ. 18: 214-29, 1965.

[3] Lloyd, A. G. Trends in dairying (1933-54). Rev. Mktg. Agric. Econ. 24: 125-53, 1956.

[4] Lloyd, op. cit., p. 136.

[5] Organization for Economic Co-operation and Development. Low Incomes in Agriculture: Problems and Policies. O.E.C.D., Paris, 1964, p. 491.

In an Australian study of 126 dairy farms,[6] family income was cross-tabulated with the age group of the farmer. Of the 20 farms that gave a family income of less than $1,000 per annum, 70 per cent were worked by farmers who were older than 50 years of age. Of the nine farmers who had a family income of over $4,000 annually, only one was over 40 years of age.

This feature of low-income farming is, of course, partly related to the greater ease with which young farmers can turn to alternative avenues of employment.[7] Moreover, over the period 1933 to 1961, the male work-force of the Australian dairy industry, as a whole, has aged as is shown by the following figures:[8]

Census year:	1933	1947	1954	1961
Approximate mean age in years:	36·1	39·1	39·9	40·8
Percentage of work force under age 30 years:	44·4	33·9	30·4	28·4

It would be expected, therefore, that the continuing reduction in the dairy farm work force in New South Wales, and the recent sharp reduction in Queensland, would be reflected by differences in the age structure of the work force between these States and Victoria.

Age Structure: 1961

Details of the age structure and approximate mean age at the 1961 census are shown by States in Table 2. For present purposes the Commonwealth Statistician's classification by five-year age groups has been summarized to fifteen-year age groups. In making this change, the 10-14 years age group has been excluded.

A feature of the table is that differences between the States are quite unimportant. In Victoria, 40 per cent of the dairy farm work force were over 45 years of age. The corresponding figures for New South Wales and Queensland were 42·7 per cent and 42·1 per cent, respectively. Similarly, the approximate mean ages were virtually identical. The reasons underlying this unexpected result can best be explained by a study of losses from the particular age groups.

Approximate Cohort Analysis

In studying the age factor in United States agriculture, Kanel[9] and Clawson[10] used cohort analysis, i.e., the tracing of contemporary groups from census to census. This technique requires that the number of years between the census dates be equal to the number of years covered by

[6] Bureau of Agricultural Economics. Labour on Dairy Farms. (Evidence presented to the Dairy Industry Committee of Enquiry.) B.A.E., Canberra, 1959, pp. 5, mimeo.

[7] Roy, P. Factors related to leaving farming. *J. Farm. Econ.* 43: 666-74, 1961.

[8] The corresponding mean ages for all males employed in rural industries were: 1933 census, 37·7; 1947 census, 40·4; 1961 census, 40·8.

[9] Kanel, D. Age components of decrease in number of farmers, North Central States, 1890-1954. *J. Farm Econ.* 43: 247-63, 1961. Kanel, D. Farm adjustments by age groups, North Central States, 1950-1959. *J. Farm Econ.* 45: 47-60, 1963.

[10] Clawson, M. Aging farmers and agricultural policy. *J. Farm Econ.* 45: 13-30, 1963.

TABLE 2

Age Structure of Males Employed in Dairying: Victoria, New South Wales and Queensland: 1961 Census[a]

Age group	Victoria		New South Wales		Queensland	
	Number in age group	Number in age group as per cent of total number	Number in age group	Number in age group as per cent of total number	Number in age group	Number in age group as per cent of total number
	Number	%	Number	%	Number	%
15-29	8,142	27·5	6,076	27·5	6,041	28·3
30-44	9,617	32·5	6,595	29·8	6,336	29·6
45-59	8,305	28·1	6,574	29·8	6,238	29·2
60 & over	3,508	11·9	2,841	12·9	2,764	12·9
Total	29,572	100·0	22,086	100·0	21,379	100·0
Approximate mean age — years	40·6		40·9		40·7	

[a] Excluding the 10-14 year age group which numbered 43, 43 and 377 in Victoria, New South Wales and Queensland, respectively.

Source: Commonwealth Statistician.

each group in the age classification. If this is so, the principle of the technique can be summarized by the equation:

$$(1) \qquad n_{ij} = n_{(i-1)(j-1)} + a - w$$

where n_{ij} is the number of people of the i-th age group in the occupation at the j-th census; $n_{(i-1)(j-1)}$ is the number in the next youngest age group at the preceding census; a represents the number of additions to the contemporary group in that occupation from other occupations between the census dates; and w represents the number of withdrawals in favour of other occupations, or through death, over the same period.[11]

In Australia, as the census period is seven years while the age classification is in five-year groups, cohort analysis cannot be used accurately. However, as the interval between two census dates is fourteen years, and as three age groups cover fifteen years, it is possible to apply the principle in an approximate analysis. Thus most of the dairy farmers falling in the 15-29 years age group in 1933, provided that they remained in dairy farming, would be in the 30-44 years age group in 1947 and the 45-60 years age group in 1961.[12]

[11] "Occupations" include schooling, unemployment and retirement.

[12] The error involved in applying cohort analysis to Australian census data can, it is felt, be ignored in analyses that only trace cohorts between two or three census dates. It will be seen that with fourteen years between the census dates, the number in the 30-44 age group at the j-th census equals the number in the 15-29 age group at the $(j — 1)$-th census, plus additions (a), minus withdrawals (w), *plus* the number of people (x) who were 30 at the $(j — 1)$-th census (and were therefore only 44 at the j-th census), *less* the number of people (y) who were 15 at the $(j — 1)$-th census and were therefore only 29 at the j-th census. The error is thus the absolute value of $x — y$ and will rarely be so large initially as to cause any confusion of the analysis. However, it progressively accumulates from census to census. Estimates of the magnitude of the error can be readily prepared and would be of significance in any more detailed study.

TABLE 3

Approximate Cohort Analysis of the Male Dairy Farm Work Force[(a)]

Census date (and age group at that date)	Victoria		New South Wales		Queensland	
	Number in cohort at census date	Percentage change from previous census	Number in cohort at census date	Percentage change from previous census	Number in cohort at census date	Percentage change from previous census
	No.	%	No.	%	No.	%
Cohort 1. 15-29 Years from 1933 Census						
1933 (15-29)	9,965		15,369		9,331	
1947 (30-44)	9,208	—7·6	8,509	—44·6	8,197	—12·2
1961 (45-59)	8,305	—9·8	6,574	—22·7	6,238	—24·0
Cohort 2. 30-44 Years from 1933 Census						
1933 (30-44)	6,710		8,453		5,660	
1947 (45-59)	7,084	5·6	6,340	—25·0	5,939	5·0
1961 (Over 60)	3,508	—50·5	2,841	—55·2	2,764	—53·4
Cohort 3. 45-59 Years from 1933 Census						
1933 (45-59)	5,025		6,764		4,238	
1947 (Over 60)	3,981	—20·8	3,421	—49·4	2,833	—33·2
Cohort 0. 15-29 Years from 1947 Census						
1947 (15-29)	9,744		9,404		8,448	
1961 (30-44)	9,617	—1·3	6,595	—29·9	6,336	—25·0

(a) The analysis commences with the 1933 census.
Source: Commonwealth Statistician.

Table 3 shows the results of an approximate cohort analysis of the age structure of the male dairy farm work force in Victoria, New South Wales, and Queensland. With only three census dates, covering a span of 28 years, the cohorts are all truncated. It will be noted that although the "60 years and over" age group is open ended, it is reasonable to assume that very few members of this group will be included in the same group fourteen years later. Table 3 is in four sections, each dealing with a specific contemporary group. These groups will be referred to by the cohort number given in Table 3.

A further comparison is given in Table 4 which shows the number of males in the youngest age group at the four census dates (including 1954 which cannot be included in the cohort analysis).

TABLE 4

Number of Males Employed in Dairying in 15-29 Age Group at Census Dates from 1933 to 1961

Census date	Victoria	New South Wales	Queensland
	No.	No.	No.
1933	9,965	15,369	9,331
1947	9,744	9,404	8,448
1954	9,279	8,145	8,221
1961	8,142	6,076	6,041

Source: Commonwealth Statistician.

Discussion

From Table 3, the large reduction in the dairy industry work force in New South Wales, between 1933 and 1947, can be broken down into: (i) a very large loss from Cohort 1 of 45 per cent; (ii) a substantial loss from Cohort 2 of 25 per cent; and (iii) a high rate of retirement in Cohort 3 of 49 per cent. Over the same period, the other States showed small losses from Cohort 1, gains in Cohort 2, and a relatively low rate of retirement.

Between 1947 and 1961, in both New South Wales and Queensland, there was a substantial loss (30 per cent and 25 per cent, respectively) from the youngest age group, Cohort 0, and a relatively large percentage loss (23 per cent and 24 per cent) from the next youngest age group, Cohort 1. In contrast, the Victorian losses from these cohorts were small. Over the same period, the rate of retirement (Cohort 2) was high in all States.

By showing the number in the youngest age group at each of the census dates, Table 4 highlights the reduction in the number of young males entering the industry. If the entrants during the fourteen years to 1961 are expressed as a percentage of the entrants during the 14 years to 1947, the relevant figures are 83·5 per cent for Victoria, 64·5 per cent for New South Wales, and 71·5 per cent for Queensland.

In passing, it should not be overlooked that the similarity in age structures between the States has partly been maintained by the higher rate of entry into the industry in the northern States of young people who have subsequently left the industry. Instead of entering dairying, it would almost certainly have been more efficient and satisfactory for these people to have proceeded to other industries or to higher levels of educa-

tion. Thus, a more accurate assessment of the long-term prospects of the industry in these areas may have avoided a significant social waste.

It can be concluded that the higher rates of reduction in the dairy farm work force in New South Wales and Queensland since 1947, and the lower rates of entry into the industry in these States, have been accompanied by surprisingly high losses from the middle-aged and elderly sections of the work force. The net effect has been the maintenance of an age structure in the dairy work force of these States that is quite similar to the age structure in Victoria. Considering only age as a measure of labour quality, dairying in New South Wales and Queensland is, therefore, not especially handicapped in its continuing struggle to compete with dairying in Victoria.

Because relevant data are not available for individual Statistical Regions, it has been necessary to ignore within-State differences that may be of substantial importance. In particular, the analysis may have overlooked differences between the fluid milk and milk product areas in each State and between the temperate and sub-tropical areas of New South Wales. Also, no attempt has been made to explain the differences between States in relation to differences in the role of dairying as a sideline industry, productivity levels, the influence of the depression of the 1930's, World War II, and soldier settlement schemes. It is considered, however, that the analysis shows the feasibility of applying short-term approximate cohort analyses to rural data, despite the shortcomings of the Australian census data for this purpose. As well, it effectively highlights an interesting aspect of Australian dairy industry adjustment.[13]

[13] For some additional references on farm population and age structure see: Williams, D. B. and Fraser, S. B. The age of Australian farmers. *Qrtly. Rev. Agric. Econ.* 5: 94-6, 1952; Nalson, J. S. and Hogstrom, A. W. Farm population and land development in Western Australia. *Farm Policy* 4: 126-35, 1965. A detailed report by Nalson and Hogstrom, under the same title, is to be published by the John Thomson Agricultural Economics Centre, University of Western Australia. Parker, M. L. and Schapper, Henry P. *A Resurvey of Dairy Farming in the Far South West of Western Australia.* Agricultural Economics Research Report No. 2, Institute of Agriculture, University of Western Australia, 1961, presents some interesting survey data in relation to dairy farmers who have left their properties. (See especially p. 31.)