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OCDE/GD(94)58

STRUCTURAL CHANGE IN THE DAIRY SECTOR OF OECD COUNTRIES: RECENT TRENDS AND IMPLICATIONS FOR POLICIES

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Paris 1994

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This report was prepared by a consultant - Dr. Alison Burrell, Senior Lecturer, the Agricultural University, Wageningen, the Netherlands, for discussion by the Group on Meat and Dairy Products of the Working Party on Agricultural Policies and Markets of the Committee for Agriculture. **It is a contribution to the activity of the Committee for Agriculture on the structural adjustment in the agro-food sector, which in 1994 will include a study on the dairy sub-sector.**

This report is issued as a Consultant's report. The opinions expressed and the arguments employed in this document are the responsibility of the author and do not commit in any way either the responsibility of the Committee for Agriculture or of the governments of OECD countries.

FOREWORD

This report provides background information, data and analysis concerning structural change in the dairy sectors of OECD Member countries over the past 10 - 15 years. It presents a broad view of the recent and current structure of the dairy industry, in order to permit comparisons and stimulate discussion of trends across the OECD area as a whole. The basic data contained in this report were obtained from a questionnaire issued to individual countries by the Secretariat. An effort was made to make these tables as complete as possible by using selected supplementary data from various official national sources, as well as from the OECD agricultural database. The data and analysis covers topics such as: (a) the evolution of the number of farms producing milk; (b) average herd sizes an size distribution of herds; (c) changes in relative importance of dairy breeds; (d) regional shifts in milk production; (e) changes in dairy work force numbers; (f) changes in the age distribution of farmers; and, (g) trends in the milk processing sector.

The Committee for Agriculture, at its meeting of 1-3 March 1994 discussed this report and approved its publication as a consultant's report, published on the responsibility of the Secretary General of the OECD.

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STRUCTURAL CHANGE IN THE DAIRY SECTOR OF OECD COUNTRIES: RECENT TRENDS AND IMPLICATIONS FOR POLICIES

Introduction

This report summarises recent trends in the structure of the dairy industry in OECD countries. It is based on questionnaire responses provided by Member countries at the beginning of 1993, which have been supplemented by data from published sources (see Appendix 1). Statistics for Germany refer to the former Federal German Republic unless it is explicitly stated otherwise.

The main aim of the report is to present a broad view of the recent and current structure of the dairy industry, in order to permit comparisons and stimulate discussion of trends across the OECD area as a whole. This means that detailed information on developments in individual Member countries is not analysed in a systematic way, although throughout the report the discussion is illustrated with reference to the experience of particular countries and regions.

Following this introductory chapter, the next five chapters correspond to the five parts of the questionnaire. The main findings of the questionnaire are summarised in a series of tables. The numbering of these tables, and of the sections of this report in which they are discussed, matches the numbering of the questionnaire headings. The tables (A1.1.1 to A5.3.3) are available in Appendix 2. At the end of each chapter, there is a short summary and economic interpretation of the statistical findings. The main themes are discussed in the final chapter of the report.

By way of introduction, Table A.0.1 presents some background data on the distribution of dairy herds, dairy cows and milk production over twenty-two OECD countries. The heterogeneity of production conditions and policy environment amongst OECD countries is striking. The first three columns enable certain structural comparisons to be made: countries for which the figure in column 2 (dairy cow share) is greater than the figure in column 1 (dairy herd share) have average herd sizes above the mean for the OECD as a whole; when the figure in column 3 (share of milk production) is greater than column 2, the country concerned has an average milk yield per cow above the OECD mean; and where column 3 is greater than column 1, this implies that output per herd is above the OECD average.

This information is the basis for a three-way classification of OECD dairy sectors set out in Table 0.1. Countries are classified by their herd size and yield in relation to the OECD average. In addition, countries whose output per herd is below the OECD average are shown in italics. Countries in the top left-hand corner of the table have both natural and structural disadvantages. It follows inevitably from their small herd size and low yield that their average output per herd is also below the OECD mean. The opposite conclusion holds for countries in the bottom right-hand corner. Whether or not countries elsewhere in the table have below-average herd output depends on their relative deviations from the average OECD yield and size. For example, the structural advantages in Australia and New Zealand so outweigh the lower yields that output per herd remains well above the OECD average. This just holds true of Belgium. However, higher yields do not compensate for smaller herd sizes in the three countries in the lower left-hand corner of the table.

Table 0.1: Classification of OECD Dairy Sectors by Herd Size and Milk Yield, 1990

	Herd size more than 30% below OECD average	Herd size within ± 30% of OECD average	Herd size more than 30% above OECD average
Yield < OECD average	*Austria, Greece, Italy, Portugal, Spain*	*France, Germany, Ireland,* Belgium,	Australia, New Zealand
Yield ≥ OECD average	*Finland, Norway, Switzerland*	Japan, Sweden	Canada, Denmark, Netherlands, UK, US

Source: Derived from Table A0.1.

Table A0.2 presents production data and self-sufficiency ratios for some key dairy products for twenty-two OECD countries. Self-sufficiency ratios can give an indication of the importance of dairying in the economy and the extent to which the dairy industry is oriented towards export markets. However, self-sufficiency ratios for a single year need to be interpreted with some caution: production may be unusually high or low in a particular year because of weather, commercial decisions by processors or to policy measures, and net trade figures might reflect untypical movements in stocks that are not related to current production.

Table 0.2 classifies OECD countries according to their average herd size and their self-sufficiency in the main manufactured dairy products. Italics denote the presence of an overall supply control scheme. Underlying this table are the complex links between structure, domestic policy and trade. Countries in the bottom right-hand corner could have the most to gain in the short term from a reduction in protectionist trade measures for dairy products, as long as the continuation of volume control programmes does not prevent them from realising these gains. Trade liberalisation would mean relatively more pressure for structural change in countries with small herds. The age distribution of farmers, the degree of specialisation of farms that have dairy herds and the prevalence of other sources of income are also crucial factors when assessing the potential for rapid and less painful structural adjustment.

Table 0.2: Classification of OECD Dairy Sectors by Herd Size and Self-sufficiency, 1990

Self-sufficiency in butter, cheese and milk powder:	Herd size more than 30% below OECD average	Herd size within ± 30% of OECD average	Herd size more than 30% above OECD average
Deficit in all three products	*Greece, Italy*	Japan	
Deficit in one or two products	*Portugal* *Spain* *Switzerland*	*Belgium* *Germany* Sweden	*Canada* *United Kingdom* United States
Moderate self-sufficiency in all three products	*Austria* *Norway*	*France*	*Denmark* Australia
Self-sufficiency > 150% in all three products	*Finland*	*Ireland*	*Netherlands* New Zealand

Source: Derived from Table A0.2.

The above tables show the situation in a single year. However, when attempting to relate structure to performance, and to predict future trends and policy issues, it is important to consider the dynamics of the industry. Although this report presents longer-term trends wherever the data permit, the usual warning applies concerning extrapolating past trends into the future without adequate knowledge of their underlying causes.

Most of the tables in this report show physical and structural data. Such information does not permit definitive conclusions about comparative herd incomes, the future viability of dairy farming in particular countries or the efficiency ranking of different processing sectors. This is partly because output prices, production costs and policy measures affecting net profitability are not equal across countries. However, these aspects are outside the remit of the report. In addition, the role played by dairying in the economics of the farm business and in the total income of the farm family varies considerably between and within countries, as do the product mix and marketing strategy of the processing sector. These factors help to determine whether small, less productive herds or plants will have a future in a more competitive environment. Although this report presents some of the information relevant to these questions for certain countries, it needs to be stressed that it does not provide a complete picture.

The reader should therefore bear in mind the limitations of the report due to the absence of a real dynamic perspective and the lack of economic data. Moreover, the priority given to multi-country comparisons and identifying general trends means that many country-specific characteristics and much inter-country variation are not apparent in the tables, or are ignored in the commentary. Member countries should rely on national studies for in-depth analysis of their own situation.

1. Structure of Dairy Farming

1.1 Herd and Cow Numbers

Table A1.1.1 shows herd and cow numbers in OECD countries in 1990. The largest numbers of dairy herds are found in France, Germany, Italy, Spain and the United States. France, Germany, Italy, New Zealand, the United Kingdom and United States each have at least two million dairy cows. Suckler cows are also important in Canada, France, the United Kingdom and Spain. Figures on suckler cow populations were not available for Australia, New Zealand and the United States. New Zealand and Australia have the largest average herd size, followed at some distance by the United Kingdom and the United States.

Table A1.1.2 summarises the changes in numbers of herds and cows over the period from 1970 to 1990. The general picture is of a steep decline in herd numbers and a more moderate reduction in cow numbers. Exceptions are Japan, the Netherlands and New Zealand. Herd numbers fell by more than half in both Japan and the Netherlands, but cow numbers were virtually static in the Netherlands and increased in Japan. In New Zealand, the fall in herd numbers was much less severe than elsewhere and cow numbers increased by 20 per cent.

Comparing trends in the 1970s and 1980s, it appears that the reduction in herd numbers took place at a similar rate in both sub-periods in most countries. The contraction in livestock numbers was more concentrated in the second sub-period for EC countries, where the effect of relatively restrictive supply quotas reinforced the longer-term declining trend which is observed in most countries. In recent years, countries without overall supply controls (Australia, New Zealand, the United States and Japan) have had smaller falls in dairy cow numbers or, in the case of New Zealand, positive growth.

The effect on herd and cow numbers, as well as on production itself, of policies to curb milk supplies depends on the type of policy. The United States saw two such programs during the 1980s, the Milk Diversion Program (MDP) and the Dairy Termination Program (DTP)[1]. The impact of the DTP on milk production is thought to have been slightly longer-lasting than that of the MDP, but even with the DTP, the recovery rate of milk production was quite rapid as non-participating producers continued to expand their herd sizes and output[2]. The impact on structures may have been longer-lasting, although it is not clear whether over the medium term the policy merely altered the timing, rather than the net number, of exits from the industry.

Where exit programmes are accompanied by overall restrictive quota limits, such as those operated by EC countries during the 1980s, the structural consequences are more likely to be significant in the longer term, since both the re-entry of participants and entry of newcomers is more difficult, and the curb on expansion of those who remain maintains the pressure for producers to quit in subsequent years. In this case, however, the indirect effects on other types of production are likely to be greater[3].

Table A1.1.3 shows the implications for average herd size of the movements in herd and cow numbers over a 20-year period. Growth in the average size of dairy herds continued in most recent years in some EC countries (for example, Denmark and France), whereas it appears to have levelled off in others (United Kingdom, the Netherlands). These differences reflect different stages of structural development, different domestic policy regimes and, within the EC, different national strategies for managing the EC quota scheme. The relatively small size of herds and slow rate of herd size growth in the Nordic countries (with the exception of Sweden) is striking.

1.2 Specialisation of Production

The percentages of herds and cows on specialist dairy farms are indicators of the specialisation of production. The extent of specialisation of dairying can be compared between EC Member countries thanks to the EC survey of the Structure of Agricultural Holdings (Eurostat, 1991), which uses a standardised farm typology. The results for 1987 are summarised in Table A1.2.1. Data for Finland, Japan, Norway, Sweden and the United States are also included in this table, although their definitions of farm types are not strictly comparable with the EC classification system.

Table A1.2.1 shows that the majority of dairy herds are on specialist dairy farms. An even greater proportion of total dairy cows is found on farms that specialise in livestock in all the sixteen countries covered, except the four EC Mediterranean countries and Belgium. Only in Greece does the combination of dairying with field crops or mixed cropping predominate. By contrast, in the Netherlands, Ireland, the United Kingdom and the United States, the combination of dairying and cropping is little practised. In other northern European countries, about one herd in four is on a farm with significant cropping activity.

Because of the tendency for specialist dairy herds to be larger than herds on other types of farms, the concentration of milk-producing capacity on specialist dairy farms is greater than the relative numbers of specialist dairy herds suggest. At one extreme, 90 per cent or more of dairy cows are on specialist dairy farms in Ireland and the Netherlands, with 11 per cent in Greece at the other extreme. The very low average herd sizes observed in the Mediterranean countries are partly due to the low degree of specialisation. Other variations for individual countries are also of interest[4].

The percentage of all farms that have dairy herds indicates the frequency of dairying in the agricultural sector. A high frequency indicates that a large proportion of producers is affected by dairy policy. When a high degree of specialisation coincides with a high frequency, this indicates that the agricultural sector as a whole is relatively dependent on dairying.

Table 1.2 gives a two-way classification of sixteen countries according to specialisation and frequency of dairying. The Netherlands is seen to have the highest proportion of farms whose agricultural income depends strongly on dairying. In Ireland, Germany, France and Denmark this dependence is somewhat lower either because relatively fewer farms practise dairying or farms are more diversified, or both. Other northern European countries diverge further, either because dairying is less specialised although relatively widespread (Belgium), or less frequent despite a high degree of specialisation (Finland, the United Kingdom). One would expect to find that dairy pressure groups and producer organisations are more active and powerful, the further one moves to the right of this table. Such groups might also be more successful in countries in the lower part of the table.

Table 1.2: Specialisation and Frequency of Dairying

Specialisation: / Frequency:	< 30% of dairy herds on specialist dairy farms	30-50% of dairy herds on specialist dairy farms	50-70% of dairy herds on specialist dairy farms	>70% of dairy herds on specialist dairy farms
Dairy herds on <25% of farms	Greece Portugal	Spain Italy	United States Japan	United Kingdom Finland
Dairy herds on 25-35% of farms			Denmark France	Ireland Norway Sweden
Dairy herds on >35% of farms		Belgium	Germany	Netherlands

All information relates to 1987, except for Finland (1990), Japan (1990), Norway (1992) and Sweden (1990).
Source: Based on Table A1.2.1.

Information on longer-term trends in specialisation is available for only a few countries, but it is unanimous in indicating movement towards greater specialisation. During the 1970s and 1980s in the United States, Australia and the Netherlands, the percentage of herds on specialist dairy farms increased and the combination of dairying with cropping became increasingly less popular[5].

Only three countries (Sweden, the United Kingdom and Japan) provided figures on part-time farms with dairy herds. It is not clear whether comparable definitions of part-time farms have been used by all three countries. In each case, however, a decline in numbers was registered, and relative numbers also fell in the first two countries. In Sweden, the share of part-time dairy farms fell by a third between 1980 and 1990 to just 5 per cent. In the United Kingdom, the share of part-time holdings with dairy cows declined from over 13 per cent of all holdings with dairy cows in 1985 to 10 per cent in 1992. In Japan, the number of part-time dairy farms whose main income was from outside farming fell in absolute terms between 1970 and 1990, but increased as a percentage of all dairy farms to nearly 15 per cent. However, there was both an absolute and relative decline in such farms in the more dairy-oriented region of Hokkaido[6]. These trends are discussed in more detail in section 2.3

1.3 Distribution of Herds and Cows by Herd Size

Table A1.3.1 compares the distributions of herds and cows by herd size at the beginning and the end of the 1980s. The distributions of herds by size show the familiar skewed pattern with relatively large numbers of small herds and fewer larger herds. In all cases these distributions have been shifting towards larger herd sizes, although some more quickly than others. Redistribution of herds out of the size classes below 20 cows has been most significant in Denmark and France, somewhat less in Belgium, Germany, Ireland, Japan, Sweden and Switzerland. By contrast, in Austria, Finland and Norway redistribution has been within this size band, with relatively little movement to larger size groups. In Australia, the strongest movement was out of the 50-150 cow band towards larger herd sizes. The rate of size redistribution depends on natural advantages and constraints, as is illustrated dramatically by contrasting trends in Hokkaido and the rest of Japan[7].

Cow numbers represent milk-producing capacity. Shifts in the distribution of cows over herds depend on changes in the herd size distribution in a non-proportional way: quite small relative gains in the proportion of large herds give rise to a much greater increase of the proportion of milk-producing capacity in these herds. This is illustrated well by the United States, where an increase of just 1 percentage point in the proportion of herds over 200 cows between 1978 and 1987 led to an extra 7 percentage points of total capacity in this size group. The extent of concentration in the industry depends very much on how large the herds are in the upper tail of the distribution. At one extreme, 23 per cent of capacity was in the 2.7 per cent largest herds in the US in 1987 whereas in Denmark in 1990 the largest 2 per cent of producers controlled only 7 per cent of the cows (despite a smaller proportion of very small herds than in the United States[8]).

The relevance of these size distributions for dairy policy depends on the relationship between herd size and economic performance. There is evidence of significant economies of size in milk production up to herd sizes of 50-60 cows[9], and that beyond this point further size economies can be achieved. At first sight, this evidence is difficult to reconcile with the continuing existence of large numbers of small dairy herds, as shown in Table A1.3.2. If there are size economies in dairying, a high proportion of milk producing capacity in larger herds would mean that the industry is operating closer to its potential efficiency maximum. On the other hand, a continuing predominance of small herds in some countries raises a number of questions with interesting policy implications, which are discussed in section 1.6.

1.4 Regional Distribution of Dairying

The distribution of dairying over regions traditionally reflects natural advantages (climatic and topographic conditions), proximity to large centres of population and competition from other agricultural activities. Changes in the regional distribution of dairy herds and cows show the industry's response to changes in relative prices, technical progress in dairying, structural and technological developments in downstream sectors including transport, changing rural demography and regional population shifts. Agricultural and regional policy measures are also relevant factors.

The detailed information on the regional distribution of herds and cows that is available for many Member countries is not easy to summarise or to compare across countries. Regional boundaries within individual countries often reflect the historical and administrative logic of the country concerned, and cannot be standardised in a common framework. Clearly, if herd or cow numbers in each region are changing at the same rate in all regions, the corresponding distribution over regions remains unchanged. Where regional trends diverge, some regions are gaining in importance relative to others, and regional redistribution is taking place. However, a simple comparison of regional trends within a country can lead to incorrect conclusions about the true extent of regional redistribution: regions with the most extreme trends relative to the national average may well be rather unimportant for dairying, so that despite their relatively rapid rates of growth or decline the overall distribution of herds and dairy cows can remain quite stable.

Table A1.4.1 summarises the regional movement within twelve countries using an index of regional variation. This index is the average absolute deviation of regional trends from the national trend, where each region's deviation is weighted by its importance in the total. A value of zero means that regional proportions have remained unchanged. Because some countries use a much more disaggregated regional breakdown than others, the index is not strictly comparable between countries. However, changes in the index for the same country between sub-periods, and comparisons of the indices for herds and cows for the same country, are more informative. Where the difference between the index for herds and cows

is large, this implies that average herd sizes are changing at different rates in different regions. However, it cannot indicate whether regional averages have been converging or moving apart[10].

Table A1.4.1 shows that, over the period 1970-90, the United States and Norway[11] had the greatest shifts in the regional distribution of herds. In the case of cows, the rates of regional redistribution over the same period were lowest for Canada and the Netherlands[12], and highest in Australia[13], Japan[14] and the United States[15]. For Australia this movement was concentrated in the first of the two decades, for Japan in the second, whereas for the United States it continued at a similar rate in both periods. The major shift in herds and cows in the United States has been from the northern traditional dairying states to the South West and Florida. Although this has been accompanied by a significant population shift, it is thought that climatic and technological factors favourable to dairying are probably more important than demand-pull from expanding markets in explaining the relocation of milk production[16].

Regional redistribution appears to be greater when output is expanding or contracting (examples are Japan, United States, Norway and Australia during the 1970s) than when it is reasonably stable, but this is not always the case, as a comparison of the trends between the 1970s and 1980s in Canada, Germany and the Netherlands shows[17]. Although there appears to be a tendency for regional redistribution of both herds and cows to be slower in the second decade for those countries that adopted a quota scheme during the 1980s, more detailed analysis would be required before any causal connection could be accepted unequivocally. In general, no strong overall trend emerges, although patterns of regional distribution are of interest at national level[18].

1.5 Most Popular Dairy Breeds

Table A1.5.1 summarises the information obtained on the breakdown of national herds by breed of cow. The strong popularity of Friesian-Holstein-type cows is evident, although in northern and alpine regions the more hardy red and red/white breeds still dominate. The figures available suggest that the adoption of Friesian-Holstein cows began to gather momentum in Europe in the 1970s, often at the expense of local breeds, whereas Holsteins were already dominant in Canada in 1971. There has not been a comparable innovation in breeds during the 1980s. Only the Netherlands has indicated an increase in "meat" breeds kept as dairy cattle (from 4 per cent in 1985 to 14 per cent in 1990), undoubtedly in an attempt to improve herd incomes in response to milk quota restrictions.

Table A1.5.2 compares the performance of some of these breeds between some countries. The strong growth in yields for all breeds and countries shown is striking, as is the consistently higher yield performance of the black and white breeds. Variations in yields between countries also reflect the different farming systems and natural advantages of the countries concerned. The persistence of apparent untapped yield potential in France is of interest.

1.6 Summary: Significant Change, Continuing Diversity

Herd sizes and herd size growth vary considerably between countries. In countries with large herds (New Zealand, Australia and the United Kingdom) average herd size grew by about 30 per cent during the 1980s, but the fastest growing herd averages were in countries with herd size closer to the OECD mean (Belgium, Japan, France). There was also significant herd size growth in most countries with very small herds, but size gaps did not narrow. Rates of decline in the number of very small herds during the 1980s

were lowest in countries with small average herd sizes. The extent of regional redistribution of both herds and cows during the last two decades also varies considerably.

The persistence of a wide range of herd sizes within individual countries is often quoted in the debate on the optimal size of herd. The debate takes on a further dimension due to the significant differences in average herd size *between* countries. The evidence of significant size economies below about 60 cows (approximately 300 thousand litres) referred to above, comes from the United Kingdom and Canada. The UK evidence shows clearly that these size economies derive particularly from economies in labour use and, to a lesser extent, to improvements in feed efficiency, including the efficiency of feed produced on the farm.

There is less evidence on the potential for size economies at much larger herd sizes. In the UK and Canadian studies, there were too few "large" herds to permit any conclusions. However, evidence from the United States, where very large herds are more common, indicates that there are economies of size in capital use to be gained even when all economies due to the efficient use of (fixed) family labour resources have been exhausted[19]. Although many of these large US herds continue to be run as family businesses, it is acknowledged that they require a wider range and higher level of management skills, and possibly a different business philosophy from that of the more typical family dairy farm. These factors are not so easily included in empirical studies. The following discussion will concentrate on the issue of size economies at the lower end of the size distribution, since it is here that the policy implications are more acute.

The evidence of significant potential economies at the start of the size distribution is based on farm management data where operator-owned resources, particularly family labour, are costed at market rates. This evidence can therefore be challenged on the grounds that it is due to the use of inappropriate imputed values. We return to this point in Chapter 6. It can also be argued that the environmental costs and benefits associated with different dairying technologies that are related to herd size should also be taken into account in a complete study of efficiency. Others have chosen to interpret the results as evidence of irrationality on the part of small producers. However, behaviour that may appear irrational in a context where milk production is the only activity, and where all resources and outputs are both measurable and mobile at their market rate, is open to other interpretations outside this context. It is clear that this context is less applicable to the small herd on a mixed or part-time farm than to the large commercially-oriented specialist dairy farm.

Thus, various explanations have been offered for the apparent "irrationality" of small producers who continue to produce milk at a high cost per unit, and consequently low or negative net income. These explanations include: the view that farmers perceive the opportunity cost of their owned resources to be less than market rates; that there are significant non-pecuniary benefits in dairy production (job-satisfaction from working closely with animals, being independent) so that the *net* opportunity cost is in fact low; that small-scale producers would expand if they could, but they face insuperable capital constraints, and high income support enables them to continue despite their non-optimal scale of production; the search for income stability; that small-scale dairying is subsidised by other on-farm or off-farm activities, with milk production playing a role in an integrated mixed farming system, and it should therefore be assessed in the context of the whole system. Each of these explanations is likely to be valid in some circumstances or for some producers, and they should be borne in mind when the policy implications of small herds are discussed in Chapter 6.

2. Farmers and Farm Labour

2.1 Age Distribution of Dairy Farmers

Table A2.1.1 summarises the distribution of herds according to the age of the farmer, as recorded at the end of the 1980s. Where data permit, a longer-term perspective is also given and critical points in the age distribution for farmers as a whole are included for comparison.

According to the most recent figures, the countries with the largest shares of dairy farmers under 45 years of age are Canada, Finland and Norway. The highest proportions of dairy farmers over the age of 65 are found in Greece, Ireland, Italy and Spain (more than 15 per cent), followed by Sweden, the United Kingdom and the United States (12-14 per cent). However, relatively fewer dairy farmers are older than 65 years of age compared with the population of farmers as a whole, at least in those countries where the data required for this comparison are available. In addition, a consistently higher proportion of dairy farmers are younger than 45 years of age than in the farming population as a whole[20].

Significant improvements in the age distribution of dairy farmers in the period 1980-90 took place in France and Norway. In other countries where data availability allows a comparison over time, the distribution has been remarkably stable (see, for instance, Canada, Denmark, Sweden and the United States). In the Netherlands, the distribution has become more concentrated, with a larger peak in the 55-65 age band, whereas in Japan there is evidence of an ageing population of dairy farmers during the 1980s.

Several factors help to explain these various differences. The higher labour input and all-year-round demands of dairying probably encourage retirement from milk production at an earlier age than in some other types of farming. National traditions relating to the handing over of farming assets to the next generation, and pension arrangements for retired farmers, differ between countries[21]. Some countries pursued vigorous buy-out programmes and early retirement schemes after the introduction of their milk quota regimes during the period under study[22]. Quota schemes where quotas are marketable may also make retirement from dairying more financially attractive in these countries.

The increasing capital intensiveness of dairying is often thought to act as a barrier to younger entrants, particularly where purchase of quota is required. Table A2.1.2 throws some indirect light on this view. Evidence for the six countries reported suggests that there is not a strong tendency for younger farmers to have smaller herds, with the exception perhaps of the United States, although the tendency for the oldest farmers to have to the smallest herds is marked everywhere. However, to investigate the hypothesis of entry barriers fully, farmers' heirs should be distinguished from young incomers to the industry, and information would be needed on the indebtedness of both groups.

2.2 Tenure Status of Dairy Farmers

The information available on the tenure status of dairy farmers is not standardised and is difficult to summarise for OECD countries as a whole. Moreover, the picture presented in Table A2.2.1 is somewhat incomplete. However, some general comments can be made.

First, owner-occupancy appears to be the most popular form of tenure, although it should be noted that definitions are not totally consistent[23]. Second, there is a tendency for dairy farms that are mainly owner-operated to have smaller herds than those that are mainly tenanted, or wholly tenanted. Third, although the proportion of dairy farm land that is tenanted varies between countries, it is very similar to

the average proportion of tenanted land for all farms in the same country, except in Greece, Italy and Portugal where a smaller proportion of the land on dairy farms is owned by the farmer than for all types of holding[24].

The very sparse evidence on trends in tenure status over time gives a mixed picture. In Canada and Norway there appears to be a slow trend towards greater tenancy, whereas the reverse is the case in the Netherlands. Only Norway was able to provide information on the relationship between tenure status and the age of the farmer, showing that tenants are on average significantly younger than owner-operators.

Information on tenure status is of interest to policy makers for several reasons. Low rates of owner-occupancy may indicate that farmers have difficulty in obtaining credit to finance expansion, given the preference of lending institutions for land as collateral for loans. In countries that combine a high proportion of small farms with a relatively high tenancy rate and a high average age of farmer, it cannot therefore be assumed that the retirement of older farmers will automatically lead to the expansion of those remaining to a more viable size. Because of this, restructuring programmes in countries where small farms tend to be tenanted might include credit schemes alongside outgoers' schemes, thus creating opportunities for farmers to move further in as well as out. Tenure status may also be important during transition from market price support of farm incomes to direct income payments[25].

2.3 Labour on Dairy Farms

Table A2.3.1 summarises the information available on labour use in the dairy sector at the end of the 1980s. Most of the data relate to the European Community, and come from Eurostat's Farm Structure Survey, for which a harmonised methodology is used. Only three Member countries from outside the European Community (Finland, Japan and Norway) are represented, and their data may not be strictly comparable. In particular, the EC's annual work units are based on time worked, and are not comparable with data on "persons" which aggregate full-time and part-time workers indiscriminately. This caveat should be borne in mind when interpreting the relatively high figures for labour per holding for Finland and Japan, where labour is measured in terms of persons.

The most striking feature of Table A2.3.1 is the overwhelming importance of family labour in dairy farming. Only the United Kingdom and Norway rely on hired labour for more than 20 per cent of the labour input, and in the majority of countries hired labour is less than 10 per cent. The figures suggest a considerable input from family members other than the farmer. In the four countries that provided information on the role of the farmer's wife, this is seen to be significant, although in the two cases where longer-term trends are available (the Netherlands and Norway) it is clear that it is diminishing in importance. The relative importance of the farmer's own labour is greatest in Belgium and Denmark, and smallest in Portugal and the United Kingdom. Most hired labour is permanent in all those countries whose data distinguish between permanent and casual hired labour.

The figures for labour per holding are consistent with the key role played by labour in achieving economies of size: in 1987, the United Kingdom used on average 2.6 annual work units per specialist dairy farm (average size: 63 cows) compared with 1.8 AWUs in Denmark (37 cows), 1.7 AWUs in France (24 cows) and 1.6 AWUs in Ireland (27 cows). The Netherlands had the most efficient average labour use, with 1.6 AWUs per holding and an average herd size of 46 cows.

Table A2.3.2 assembles some evidence on longer-term trends in different categories of dairy labour. It is not possible to reach general conclusions on the basis of the five countries reported. However, the greater variability in hired labour trends in different sub-periods appears to suggest that hired labour acts as a buffer for family labour in absorbing the impact of policy changes or changes in the macroeconomic climate. The positive rates of change in the Netherlands are also of interest.

Table A2.3.3 presents information on labour use by specialist dairy farms in eleven EC countries and relates it to the farming sector as a whole. There is wide variation between countries in the importance of specialist dairy farms as employers of farm labour: specialist dairy farms employ over 30 per cent of all farm labour in Germany, Ireland and the Netherlands, and 2 per cent or less in Portugal and Greece. Compared with farming as a whole, dairying has a somewhat greater reliance on regular (non-casual, non-seasonal) labour. Family labour makes up a far greater proportion of specialist dairy labour than for farming generally, with only Italy and Portugal deviating from this pattern. Variations between countries in the importance of hired labour in dairying, which were apparent in Table A2.3.2, are seen here to be strongly correlated with the importance of hired labour in farming as a whole, and not specific to the dairy sector.

The evidence on part-time work and off-farm income is of particular interest. The percentages of persons working on specialist dairy farms who are employed full-time range from 66 per cent in the United Kingdom to under 13 per cent in Greece. These percentages are higher for specialist dairy farms than for farming as a whole, although the percentage of dairy labour that is employed full-time is highly correlated with the figure for the whole sector. The percentage of specialist dairy farmers working less than 50 per cent of the time on the holding varies from 2 per cent in the Netherlands to 55 per cent in Greece[26]. In Germany, over 30 per cent of specialist dairy holders have other gainful activity (some kind of off-farm employment), in line with the high frequency of multiple job-holding amongst German farmers generally (43 per cent) and the relatively small size of specialist dairy farms. In Denmark and Ireland the proportion of other family members with off-farm income is over 40 per cent, due in part to the high incidence of farmers' wives working off the farm, whereas in other countries 20 per cent or less of family members on specialist dairy farms have other gainful activity. In each country this rate is lower than the average for all farm types taken together.

Three typical cases can therefore be distinguished: the relatively full-time farmers and workers in the Netherlands, the United Kingdom, Belgium, Denmark and France; the more part-time, multiple-job-holding dairy farming families of Germany and Ireland, and to an extent Portugal; and the situation of Italy, Greece and Spain where part-time workers predominate and more than one in four farmers with dairy cows works less than 50 per cent of the time on the holding, yet other gainful activity is relatively low. There may well be further models of labour use in Member non-EC countries.

The evidence in Table A2.3.3 relates to the European Community only. It is not necessarily a good basis for generalisations outside these countries. Moreover, it gives a static picture, and is incomplete without reference to longer-term trends. One should be cautious about linking this static evidence on part-time working with the evidence of the declining importance of part-time *farms* presented in section 1.2, since part-time farms are more usually defined in terms of size rather than the labour allocation of farmers and other workers.

The information on longer-term trends in full- and part-time dairy farms in Japan may, however, be more comparable, since here farms are classified specifically according to whether all or most household income is earned from farming, or from other jobs. In Japan, dairy farm households whose income is earned mainly from outside farming increased from 10 per cent to 15 per cent of all dairy farm households between 1970 and 1990, while dairy farm households without any off-farm income also rose from 37 per

cent to 48 per cent of all dairy farm households. This polarisation of dairy farm households between those wholly dependent on farming and those mainly dependent on non-farm income also has regional and farm-size dimensions in Japan: in Hokkaido where dairying has been expanding and farm sizes are larger, dairy farm households mainly dependent on off-farm income have had a *declining* share.

Other, less systematic evidence suggests that similar divergent trends may be at work in Europe even if, in some regions, some of the dairy farms with part-time farmers and other gainful activity may disappear when improved macroeconomic conditions and demographic changes permit. But it is also possible that a polarised "two-track" dairy sector is sustainable over the longer term. In the United States, the continuation of a significant small-herd group is striking: in 1987, 24 per cent of herds had fewer than 10 cows, although 34 per cent of herds had more than 50 cows (see Table A1.3.1 and note 8). Moreover, the under-10-cow group gained in relative importance during the 1970s, even though the upper tail of the herd size distribution was steadily moving to the right.

2.4 Summary: Dual Profile of Dairy Farmers

Dairy farmers are becoming younger in most countries. Younger farmers do not appear to be particularly disadvantaged in terms of their operating size, although they may be more heavily indebted. Many countries have a significant share of dairy farmers over the age of retirement, although this share seems to be smaller in dairying than in farming as a whole, and the importance of this age group in the dairy sector has been declining.

Owner-occupancy is the most popular form of tenure. The importance of farm tenancies and rented land in dairying varies greatly between countries. This variation appears in most cases to be strongly linked to differences in conditions affecting farming as a whole.

Much of the information on dairy labour presented in this chapter refers to the European Community. Since the EC accounts for nearly 70 per cent of dairy herds and over half the output in the OECD area, this information deserves discussion in its own right and may stimulate useful insights into the broader situation. However, the following discussion should not necessarily be extended to other Member countries.

The EC evidence shows that dairying remains a labour intensive activity, and that the farm family is still the most important source of this labour. The number of people who are economically active on dairy farms can be far greater than figures on annual work units or full-time equivalents might suggest, due to the importance of part-time work. In the European Community, this part-time work is predominantly on a regular (non-casual) basis and the dairy farmer himself is often a part-time worker on the holding. Nevertheless, dairy farming stands out as having a greater incidence of full-time workers and farmers working full-time than any other type of farming[27]. In addition, dairy farm family members, including the holder, are less involved in economic activity off the farm than farm families on other types of holding.

What are the implications of these special characteristics of dairy farmers and dairy farm labour for dairy policy? Clearly, if present structures are taken as given, these data can be used to show that dairy farmers have above-average dependency on income generated by agriculture, and might be quoted to justify special treatment for milk producers relative to other types of producer. However, this view ignores the fact that where structures have evolved, full-time dairying is highly profitable and nevertheless could continue to be profitable at lower support levels, especially if volume controls could be eased. It is important to note

that dairy farmers' off-farm earning is lowest in countries with the largest average herds (the Netherlands and the United Kingdom); presumably these farmers' marginal income is higher if they work on the farm.

The evidence reviewed here would therefore support the case for structural measures to encourage the development of full-time commercially viable dairy farms (or at least not to impede it), as well as for rural development measures to improve the prospects for off-farm employment and multiple job-holding for small dairy farmers in those areas that are not well suited to the first option. Such measures would reinforce rather than work against the trends observed statistically in Japan and anecdotally in other countries. Although these trends lead in the direction of a polarisation of dairy farms into two contrasting farming styles, both extremes should be economically viable in the medium term in a more competitive environment, but with the second form possibly disappearing altogether in many areas in the long term.

3. Input and Management Data

Table A3.1 summarises the information received from Member countries on feed use, the ratio of milk price to feed price and debt/equity ratios. The coverage is rather incomplete, and no general conclusions can be drawn, although it may be possible to identify various trends in different OECD regions.

In Japan and the United States milk prices increased, or held steady, against feed prices during the 1980s and there was growth in feeding rates. By contrast, economic conditions in the three Scandinavian countries were less favourable in the early 1980s although trends were reversed in Finland and Norway in the second half of the decade.

The evidence suggests that relative prices within the European Community have been favourable to dairying in recent years, although producers have been prevented from responding fully to them in the usual way because of volume controls. In assessing the rates of change of feed use and prices for the EC, it should be borne in mind that 1985 was the first full year after the introduction of quotas, and saw a large drop in both feeding rates and feed prices in dairying countries. This makes 1985 a rather unsatisfactory end-point for measuring changes in both the first and second halves of the decade[28]. In the second half of the decade, feed prices continued to fall in real terms whereas the milk price has remained relatively steady, resulting in the very strong positive change in this price ratio in the second part of the 1980s.

Debt/equity ratios appear to have been stable during the 1980s in the Netherlands and the United Kingdom (although at very different levels), slightly increased in Scandinavia and decreased in Japan. Inter-country differences probably reflect different national norms for the level of gearing of farm businesses, and should not be interpreted as indicating relative financial vulnerability, although *changes* in a country's ratio over time are a better indicator of financial pressures. These sector averages give an idea of the financial indebtedness of the industry as a whole but can hide considerable fluctuations in the (small) percentages of farmers in severe financial difficulty.

Replies to other questions in this part of the questionnaire were too sparse to warrant tabulation[29].

4. Milk Supplies

4.1 Composition of Raw Milk

Table A4.1.1 shows the evolution of the fat and protein content of raw milk between 1970 and 1990 for some countries, and gives a more complete comparison of these figures for 1990. Fat percentages have continued to increase during the 1980s, despite the saturation of the market for milkfat and the swing in consumer tastes in developed countries towards low-fat products. There is no discernible overall trend towards an improvement in protein content.

4.2 Utilisation of Milk

Tables A4.2.1 and A4.2.2 present data on the utilisation of milk in 21 countries. Deliveries to dairies account for over 90 per cent of production except in Austria, Belgium, Greece, Italy, Portugal, Spain and Switzerland. In Denmark, France, Germany and the Netherlands, this percentage was slightly lower in 1990 than in 1980[30].

Total deliveries fell significantly in most European countries in the second half of the 1980s, which has resulted in considerable excess capacity in the downstream sector. This has increased the pace of restructuring of the processing industry, which is documented in the next chapter.

There is considerable variation between countries in the share of production going to the liquid market. This is due to different degrees of self-sufficiency in milk and to differences in consumer preferences between liquid milk and other dairy products. Per capita consumption data (Table A4.2.2) suggest that convergence in liquid milk consumption rates has been taking place: in countries with consumption below 100 kg of liquid milk per head per year, liquid milk sales have been increasing, whereas where consumption is over about 100 kg per head, the liquid milk market has been declining. Exceptions to this generalisation are Finland and Ireland, where very high per capita consumption rates have been fairly stable in recent years, and Italy whose below-average liquid milk consumption has been falling. In some countries, liquid milk sales have been rising more rapidly (or falling less sharply) than total deliveries. Without a corresponding decline in domestic consumption of other products, this increases the competition among processing firms for quota-controlled raw milk supplies. Another development has been the growing demand for cheese, which has helped to maintain overall consumption of milkfat in the face of sharply declining butter demand, and the shift in tastes to low-fat milk and milk products.

4.3 Summary: Implications of Changes in Utilisation

These changes in the structure of demand have important consequences for the processing sector and indirect but significant implications for the structure and management of dairy herds. Much attention has been focused on policy changes at the milk-producing end of the marketing chain in recent years, while the quiet revolution in consumer tastes and the growing range and sophistication of processed dairy products has received less prominence.

Strong competition in consumer markets for processed dairy products has resulted in an emphasis on quality and reliability, and the promotion of brand identities for mass consumption products. This increases the need for investment capital, both for the equipment necessary to manufacture and deliver high quality consumer products, as well as for developing new products and launching them on the market. This

has favoured the growth of large organisations that can combine access to capital with the flexibility derived from operating multiple plants in different regions. Paradoxically, these changes in the markets for dairy products for mass consumption, together with the growing sophistication of food consumers, have also created a space for the development of niche products with a relatively small turnover but high value added, more typically catered for by small businesses that may be locally or regionally based.

These developments have indirect consequences for milk producers. First, as market requirements for quality and reliability are transmitted back up the marketing chain, producers come under increasing pressure from processors to supply a standardised product meeting a high quality specification. Second, some producers can take advantage of longer-term contracts with processors to supply milk to a given specification that is required for use in the manufacture of a particular product. More generally, producers may encounter pressure to alter the fat and non-fat composition of their milk so that the constituents of whole milk, once broken down, better match the pattern of market demand[31]. Third, the growing demand for niche products is creating opportunities for some producers to start or expand on-farm processing of artisanal or "farmhouse" cheeses, icecream, and a range of products made from organically produced milk.

The implications for the structure of dairy farms are clear: small farms, with poor access to capital and insufficient output to justify investing in the equipment and know-how to add value to their product in these ways, may not be able to take advantage of these new trends. Their milk will command a lower value per litre, thereby adding to their size disadvantage. The potential role of small farms as the mainstay of local liquid milk markets may also be unrealistic as collection costs increase. Although there are always exceptions to such generalisations[32], these trends should be noted.

5. Processing

5.1 Producer Processors and Retailers

Table A5.1.1 assembles some evidence on those milk producers who sell their milk directly to the public, in liquid form or after processing it on the farm. Statistical information on this group of producers is not easily available. Definitions may not be consistent across countries and can be misleading[33]. To supplement the information supplied by eight Member countries on this question, the table shows the direct sales quota for eleven European Community countries. Although direct sales quota may not be filled every year, and can be used by individual producers to offset over-quota wholesale deliveries, it is an indicator of the importance of direct sales in total milk sales. These figures taken together do not show any clear pattern across countries, and no general trend is discernible.

5.2 Structure of the Processing Sector

Table A5.2.1 presents data on the ownership structure and productivity of the processing sector in thirteen countries. It should be borne in mind that the breakdown of the sector into cooperatives and private firms, whether at the level of organisations or plants, need not reflect the market shares of these two types of organisation. In France, for instance, the multi-plant structure of cooperative dairies gives them a much larger share of plants than of organisations, yet the smaller average size of these plants means that the share of milk deliveries going to cooperative dairies is actually less than its share of the plants[34]. The reverse is true for Denmark[35].

In the United States, 76 per cent of milk production was marketed through farmer-owned cooperatives, although only about half this milk was processed by the cooperatives themselves. Nevertheless, cooperatives were responsible for 83 per cent of butter production, 91 per cent of dry milk products and 45 per cent of cheese production in the United States in 1987[36]. This contrasts with the relatively small share of cooperatives in the fluid milk market (see table 5.3.3). There is evidence that milk-processing capacity has not relocated geographically as rapidly as milk production (see section 1.4). A recent study refers to over-capacity since the late 1970s in some states with declining production, and asserts that periodic shortages of processing capacity have acted as a brake on milk output expansion in the South West and West[37].

Considering the performance of the sector as a whole, the Netherlands stands out as having on average the largest plants, followed by Germany and Denmark. Throughput per employee is also highest in these three countries, and the inverse correlation between average plant size and labour productivity is marked. On the other hand, there is no straightforward link between ownership structure and the productivity and input ratios given in the table[38]. Labour productivity is positively associated with plant size. However, this is not the only relevant factor, as the comparison between Canada and France underlines: average output per worker is about 50 per cent higher in Canada than in France, although average plant size is about 10 per cent lower.

Table A5.2.2 summarises the changes over the period 1970 to 1990 in numbers of organisations and plants, and in average plant size, for those countries where data are available. A steep decline in the number of plants is noted for most countries. Where the number of organisations has fallen more sharply than the number of plants (for example, the cooperative sector in the Netherlands), this indicates that structural rationalisation has involved the amalgamation of management structures as well as plant closures. The number of workers in the processing sector has not declined as rapidly as the number of plants, indicating that plant closures have been concentrated at the lower end of the size distribution (see also Tables A5.3.1 and A5.3.3). Average plant sizes have increased considerably in most countries[39].

5.3 Size of Processing Plants

Table A5.3.1 shows the size distribution of processing plants in ten countries, and the evolution of this distribution over the last 10-20 years, where data are available. When interpreting these figures it should be remembered that for some countries they may include plants that treat liquid milk only, whilst in other countries they may not. Therefore, comparisons of average plant sizes between countries, and rates of disappearance of small plants, could give an inaccurate picture of the structure of the manufacturing sector as strictly defined.

Taking the information in Table A5.3.1 at face value, its most striking feature is the extent of restructuring in Germany in the 1970s and 1980s, both as regards the decline in the total number of plants (-68 per cent) and the strong shift of the industry to plant sizes with a throughput of over 50 million litres per year. The decline in plant numbers in Denmark was even sharper (-73 per cent in just nine years) but this occurred more evenly across the size spectrum. In France, Norway and Sweden there has been vigorous restructuring in the lower half of the distribution. By contrast, in Greece the smallest size groups increased in importance.

The concentration of milk-processing capacity is further documented in Table A5.3.2. In 1991, 18 per cent of milk processed in Germany was in plants with a throughput of over 300 million litres, and 64 per cent was processed in plants handling more than 100 million litres. In France and the United Kingdom, plants with an annual capacity greater than 100 million litres handled 51 per cent and 54 per cent of processed milk respectively[40]. The French figures for the distributions of milk and milk suppliers over plants show a tendency for larger producers to supply to larger plants.

Table A5.3.3 presents a detailed breakdown of the US fluid milk sector by plant size, ownership and type of plant. In 1988, 65 per cent of fluid milk plants were owned by private local firms and had half the fluid milk market. A fairly even distribution of total plants over sizes up to an annual capacity of 120 million litres masks significant differences in the size distribution for different types of organisation. Plants operated by local, single-unit organisations, whether privately or cooperatively owned, are more likely to be small, whereas regional and national firms and cooperatives have relatively few small plants. About half the plants with a capacity of under 30 million litres per year closed between 1980 and 1988. There was no statistical information available on plant sizes in the US manufacturing milk sector.

5.4 Summary: Diversity of Structures and Trends

The role of direct sellers is negligible in most countries. Where they are more active, it probably reflects one or both of several trends: the survival of less developed local marketing structures and more recently inspired attempts by milk producers to add value to their product on the farm.

Despite significant restructuring during the 1980s, great diversity remains between countries regarding ownership structure, size of milk plant and output per worker. There is some correlation between labour productivity and plant size.

During the 1980s, the rate of change of plant size was most marked in Denmark, Germany, the Netherlands and France. By 1990, the first three of these countries had an average plant size of over 80 million litres per year. The average size in France was much lower, due to the persistence of a significant proportion of small plants, some of which serve local liquid milk markets only or produce specialty products. Restructuring was slowest in Austria, Norway, Canada and the United Kingdom. In 1990, the first two of these countries, along with Japan and Portugal, had the smallest average plant size (less than 15 million litres per year) amongst those countries for which data are available.

These comparisons, based on unharmonised data, are intended to suggest orders of magnitude and to identify issues for further discussion or future study, rather than to establish definitive rankings of Member countries. The range of products and production activities in the processing sector, and the marketing structures underlying the organisation of milk processing, are far more complex and differ more between countries and regions than is the case for upstream milk-producing activities. It follows that the potential pitfalls from using unharmonised data, and the scope for misleading interpretation of broad aggregates and national averages, are greater in this chapter of the report than in earlier chapters.

6. Conclusions

This chapter assembles and summarises some of the policy-oriented issues that have been identified earlier in the report.

The first issue concerns the economic basis of small herds. The question of economies of size was raised in Chapter 1. The evidence of potential size economies obtained from econometric studies depends in part on the assumption that farm-supplied resources, especially labour, should be valued at market rates. If these imputed values reflect true opportunity costs, then milk production by small herds is apparently inefficient. Apart from the controversy over the cost of labour, it was also noted that these analyses typically consider the dairy enterprise in isolation from other activities on the same farm, and from other income-generating activities of the farm household. This may overlook the true role played by the dairying activity in the economics of the farm household, and in stabilising farm household income in countries which operate guaranteed prices. Moreover, this type of analysis does not to date allow for the environmental effects both positive and negative of dairying.

It remains true that low economic returns to small dairy herds are often cited as the justification for programmes to support the incomes of dairy farmers. However, a small herd does not necessarily indicate a potential farm income problem. A small herd that persists on a mixed farm with a good resource base or with various on- or off-farm sources of income, presumably has an economic rationale in the overall farm system and in the allocation of household labour. Providing *total* farm income is adequate, no policy response can be justified in the dairy sector alone, even where the dairy activity viewed in isolation may appear economically marginal. If the total income of a small non-specialised farm with a dairy herd is low, it is because the farm's total resource base is small. Dairy policy is unlikely to be the most effective measure for addressing the problem. Structural programmes and whole-farm measures such as income safety-nets, rather than commodity policies in general and dairy policy in particular, would be more appropriate measures.

In countries where average dairy herd sizes are small but dairying is specialised, the farm income problem is more likely to be perceived as a problem specifically of *dairy* incomes. High levels of income support by means of dairy support programmes enable these producers to continue producing milk at a high social cost per unit. It is argued in some countries that there are, in fact, commensurate social benefits because these producers provide additional non-marketable services[41] that society remunerates indirectly via the higher price of milk. But it is often difficult to verify these arguments and to monitor the efficiency of the extra payment without more market-oriented mechanisms for rewarding these activities. Governments are coming under increasing pressure to adopt more transparent and accountable measures for dealing with such externality and public good issues, and to develop targeted policies that directly address the production externalities and public goods generated by agriculture.

Finally, even where dairying does not provide additional non-marketed benefits, dairy policy may be inspired by a belief that producers who rely on dairying for their livelihood should receive incomes that are comparable with those in other economic sectors. In this case, regardless of the opportunity cost of dairy labour as a productive resource, it is appropriate in the policy context to cost it at relevant market rates since this is both the payment that society deems it should have and its cost to society via the policy mechanism. As already indicated, when labour is computed in this way, the cost per litre of milk from small herds is high compared to larger herds. If the distribution of milk-producing capacity is concentrated in small herds, then the industry is inefficient and its lack of efficiency carries a social cost. Neither is their disappearance costless, if restructuring and adjustment costs are incurred in the short to medium term.

Clearly, given the great diversity between and within OECD countries, the issue of the optimal herd size, or range of herd sizes, is complex and cannot be settled here. Nonetheless, the figures presented in this report on the variation in herd sizes both within and between countries raise questions about the extent to which Member countries' current structures and rate of structural change are leading them closer to realising their own efficiency potential.

The second issue is the possible emergence of a "two-track" dairy sector, characterised by multiple-job-holding farm families with small dairy herds at one end of the size spectrum, and large commercially-oriented specialist dairy farms at the other end. This pattern is appearing within a number of countries, although it is unclear whether the herds at the small-scale end of the spectrum are in a transition phase prior to disappearing altogether or whether they have a long-term future. The question is: is this polarisation a cause for concern? The general answer is that such a situation need not matter as long as these trends are a response to market forces, and as long as health and animal welfare standards, environmental criteria and other relevant requirements can be satisfied at both ends of the spectrum.

Moreover, if dairy policies attempt to restrain either or both of these divergent trends, they are likely to prove costly and ineffective in the long term. Policy approaches involving structural and rural development policies that are designed to improve the viability of both models would be preferable if governments feel compelled to intervene.

One factor that may limit or reinforce these divergent trends in the milk-producing sector is their compatibility with the needs and commercial logic of the processing sector. The pressure on processors from consumer demand for competitively-priced, high-quality products has increased the concentration of the industry and forced the pace of new technology. This combination of consumer-led and technology-driven forces has implications in turn for the organisation of dairying, and the specification of the product supplied by dairy farmers. In a market-oriented system, it may depend on the economic imperatives of the processing sector as to whether small non-specialised producers continue to deliver milk for mass processing. Without these outlets they will depend on local liquid milk markets and small-scale manufacturers of niche products.

An interesting variant of this issue concerns whether the widespread adoption of administered bovine somatotropin (BST), with the impact on structures that it would entail, depends solely on regulatory decisions, or whether it is consumer pressure, transmitted via the marketing chain, that will prove more decisive. It can be speculated that we are beginning to witness a shift in the balance between consumer and market interests, on the one hand, and farmer-oriented dairy policy on the other, in shaping longer-term structural trends in the industry.

This discussion highlights the third issue raised by the present report, namely whether current policies for the milk-producing segment of the marketing chain can continue to be so highly regulated alongside a much more competitive and market-oriented processing sector. Do strong regulation and support policies in dairy farming inhibit or enhance structural change in the processing sector, or are other factors such as the extent to which national processors compete domestically and on international markets more important? Will structural developments in the processing sector force the pace of moves towards market orientation in dairy farm policy?

Table 6.1: Changes in Average Herd and Plant Size, 1980-1990

Percentage change in	*Average plant size:*		
Average herd size:	< 30	30-60	> 60
< 30	Austria Canada	Netherlands	
30-40	Norway United Kingdom	Finland Sweden	Australia Denmark Germany
> 40	Belgium	Japan	France, US[1]

1. Fluid milk plants only.
Source: OECD questionnaire.

As a background to this discussion, it seems logical to compare the rates of structural change in dairy farming and in the milk-processing sector. Table 6.1 classifies fourteen countries according to their rate of growth of herd size and size of processing plant during the 1980s. Table 6.2 classifies them according to their average size of herd and plant at the end of that period. With several exceptions, it is not possible to discern in these tables any pattern that might be related to domestic dairy policies, and in particular to policies regulating milk production. Moreover, although most of the countries in the bottom right-hand corner of both tables are important exporters, this can also be said of other countries in all parts of the table. In fact, more details of individual countries' circumstances and policies are needed in order to explain the different national trends and positions in these tables. However, it is possible that constraints imposed on one sector by the other may increase in future years.

The interdependence between the milk producing and processing sectors is illustrated by the experience of regional relocation of milk production in the United States (see paragraph 79). In this case, however, failure of milk-processing capacity to relocate as rapidly as milk production is thought to have acted as a constraint on structural change in the milk-producing sector.

Table 6.2: Average Herd and Plant Size, 1990

	Average plant size (mn litres per year):			
Average herd size (cows):	≤ 15	15-30	30-50	> 80
< 10	Austria Portugal			
10-30	Norway Japan	Finland France	Belgium Sweden	Germany
30-60		Canada	US[1]	Denmark Netherlands
> 60		UK	Australia	

1. Fluid milk plants only.
Source: OECD questionnaire.

The final issue to emerge from the preparation of this report concerns the usefulness of the information that is available to policy makers on the milk-producing and processing sectors. The coverage of the questionnaire responses listed in Appendix 1 presumably reflects the statistical information that is currently easily to hand in national administrations. It gives the impression that, while census-type data on production structures (herds and plants) are readily accessible, statistics relating to the whole farm on which milk is produced, and to dairy farmers and their families, whether as owners or farm workers, are either not collected or at least not easily available.

The focus of farm policy is moving away from individual commodities towards the economic situation of the farm as a whole and, even further, to the consideration as a possible policy target the income earned by the farming family from all sources, including those off the farm. Agricultural policies are becoming more targeted, aimed more directly at particular types of farm or farmer. At the interface between agricultural policy and rural development policies, this focus is particularly apposite.

Policy makers need to have an appropriate data base to hand for designing such policies. It is true that much of the agricultural data that is collected is in fact an *ex post* byproduct of the implementation and monitoring of policies. However, it is clear that a strong information base is needed for the design and *ex ante* evaluation of new policies intended to target selected types of farmer in specific ways instead of all farmers, impersonally, through market regulation. This suggests that it may be of interest to particular countries to review their current methodology for gathering and processing data on the dairy sector, in order to ensure that the information to hand is most likely to satisfy the information needs of policy makers in coming years.

Notes

1. Under the Milk Diversion Program (1984-85), producers contracted to reduce their milk supply by between 5% and 30% of a historical base output level. Under the Dairy Termination Program (1986-87), producers received a payment to compensate them for selling or exporting all their female dairy cattle, leaving milk producing facilities idle and not engaging in milk production for the next 5 years.

2. See Dixon *et al* (1991).

3. A study on the impact of the EC quota scheme in the United Kingdom has estimated that, after 5 years of the scheme, there were 7.6% fewer milk producers and 12% fewer dairy cows than there would have been without quotas. Average herd size was also 8.5% lower. By contrast, suckler cow numbers were 4.4% higher, the breeding ewe flock was 8.3% larger, and there were 19% more lambs under 1 year of age on farms than there would have been in the absence of milk quotas (Burrell, 1992).

4. For example, Portugal stands out, compared even with southern European neighbours, in that nearly one in five herds is combined with a cropping pattern that includes permanent crops. Belgium and the Netherlands are more likely than other countries to combine dairying with intensive livestock; although no EC country had more than 5 per cent of its milk producing capacity on this type of farm, such herds tend to be relatively large, particularly in France and Ireland.

5. In the US, the percentage of herds on specialist dairy farms rose from 56 per cent to 68 per cent between 1969 and 1987, whilst the percentage of dairy herds on predominantly livestock farms rose from 83 per cent to 93 per cent. In Australia, between 1980 and 1992, the percentage of dairy herds on livestock farms increased from 85 per cent to 95 per cent. In the Netherlands, 79 per cent of herds were on specialist dairy herds in 1990 compared with 64 per cent in 1971, whereas the proportion of dairy herds on farms with field crops fell from 11 per cent to 1 per cent over the same period.

6. In Sweden, part-time farms fell from 7.5 per cent of dairy farms in 1980 to 4.9 per cent in 1990, an absolute fall of 62 per cent. In the United Kingdom, part-time holdings with dairy cows declined from 13.6 per cent of all holdings with dairy cows in 1985 to 10.1 per cent in 1992, a fall of about 43 per cent over 7 years. In Japan, the number of part-time dairy farms whose main income was from outside farming fell in absolute terms by 59 per cent between 1970 and 1990. Although this category increased, as a percentage of all dairy farms, from 9.8 per cent to 14.7 per cent, there was both an absolute and relative decline in this category of farm in the more dairy-oriented region of Hokkaido (where the proportion fell from 4.6 per cent in 1970 to just 1.5 per cent in 1990).

7. Herd size distributions in Hokkaido province and the rest of Japan

	Percentage of herds with				Percentage of cows in herds with			
Cows:	< 10	< 20	< 50	<100	< 10	< 20	< 50	<100
Hokkaido								
1970	60	92	99.9		32	79	97.4	
1980	18	39	90		4	15	79	
1990	7	19	73	99.2	1	6	57	97.5
Tohuken								
1970	90	98	99.9		36	90	98.9	
1980	57	80	98.6		13	50	93	
1990	35	60	90	99.8	6	27	72	98.5

Note: In Hokkaido province, fewer constraints on land availability for grazing and forage crops have favoured the local dairy industry: Cow numbers doubled between 1970 and 1992, accompanied by a significant rationalisation of the herd size distribution. In the rest of Japan (Tohuken), cow numbers grew by less than 25% and despite a fall of over 80% in herd numbers, herd size growth has lagged behind.

Source: Japanese Delegation to the OECD.

8. In 1992, only about 120 thousand of the 172 thousand US dairy farms were classified as "commercial dairy farms" (that is, dairy farms with at least $10,000 of farm sales by the Standard Industrial Classification 024) (Fallert *et al* (1993), p.10).

9. For evidence based on econometric studies, see Burrell (1990), Dawson and Hubbard (1987) (United Kingdom), Moschini (1988) (Canada). For less analytical evidence, based on a much wider range of herd sizes, see Fallert *et al* (1993).

10. For example, the process was convergent in Canada, where provinces with smaller herd sizes such as Manitoba, Alberta and the Maritime provinces moved closer to the larger herds in Quebec and Ontario. In Australia, there has been a similar catching up process by states with smaller herds (Tasmania and South Australia), as in Belgium. The movement has been divergent in the United States, where herds in the Southeast and Pacific regions, already larger than average, have grown more rapidly than average.

11. In Norway, the relative shift has been away from the area close to Oslo to the western coast north of Bergen. Over a third of the herds and dairy cows are now in this area.

12. In Canada, despite some variation in rates of change for different regions, regional shares of cow numbers have remained remarkably stable (with over 70% of capacity remaining concentrated in Quebec and Ontario). The prairie provinces have had much higher rates of herd disappearance which has helped to improve their relatively small herd size. We would expect to observe relatively more regional variation in trends in producer numbers than in cow numbers under a quota scheme where quota is transferred more easily between producers within provinces than between provinces. However, if dairying is already concentrated in areas with comparative advantage in milk production and conditions do not become less favourable, there would have been little regional redistribution even without quotas. In this connection, note the low rate of redistribution of cows in the Netherlands, both before and after quotas. The limited regional variation in trends for cow numbers that is recorded occurs in regions whose contribution to the total is small (Flevoland, Zeeland) leaving overall regional distribution relatively unchanged.

13. In Australia, Western Australia went against the trend in the rest of the country, losing cows less rapidly and even gaining herds in some subperiods. However, its overall contribution to the national totals remains small although it still has the largest herd sizes. More significant is the strong shift of capacity to Victoria from NSW and Queensland (between 1970 and 1992, Victoria's share of cow numbers rose from 45% to 60%).

14. Hokkaido's share of cow numbers went from 28% to 42% (1970-90) and gained a further 2% of the total capacity from 1990 to 1992. The emerging predominance of Hokkaido has been largely at the expense of several traditional dairying areas where herd expansion is constrained.

15. In the United States, there has been a strong absolute gain in cow numbers in the west (Pacific +58%, Mountain +28%) between 1969 and 1987, and to a small extent in the southern plains (+2%), at the expense of sharp falls in the Corn Belt (-27%), Northern Plains (-31%) and Delta States (-35%). In 1987, over 20% of dairy cows but about 10% of the herds were in the Pacific and Mountain regions, compared with 12% and 8% respectively in 1967. So great has the shift to the West been that, between 1969 and 1978, the Pacific region went against the strong national trend and increased herd numbers. This region has consistently had the largest average herd sizes, by 1987 more than three times the national average at 173 cows.

16. See Fallert *et al*, pp.3-5.

17. In Canada, milk production was fairly constant during the two sub-periods, whereas it increased by 30% and 50% in Germany and the Netherlands respectively between 1970 and 1980, and then fell (by 13% in Germany and by 2% in the Netherlands) (see Table A4.2.1); and yet the rates of regional redistribution were higher in Canada in both periods than in the two European countries, and the differences between the two sub-periods for Germany and the Netherlands are not very marked.

18. In Belgium, milk-producing capacity has shifted away from the east and southeast to the southern and western regions, although herd sizes remain below average in these regions. The United Kingdom has seen a shift towards Northern Ireland, where herd size has trebled over 20 years. Cow numbers in Northern Ireland increased by 29% between 1970-92 against falling trends elsewhere in the country, but this has only raised Northern Ireland's share of national milk-producing capacity from 6 to 10% of national capacity. The high level of regional aggregation in the UK statistics masks the decline of dairying in the eastern regions of England. Although there was insufficient data to calculate the index for Switzerland, the data supplied suggest that the decline in herds in prealpine and mountain areas has been less marked than in lowland areas.

19. This evidence is quoted from the paper by Fallert *et al* (1993), which is based on several documented studies as well as more anecdotal evidence. These authors stress the lower investments per cow of the large-scale dairies in the South West relative to smaller dairy farms in the North. This evidence also needs careful interpretation, due to the concentration of large-scale dairying in warmer areas. In 1987, of the 1268 US herds with more than 500 cows, 725 were in California alone and a further 37 were in New Mexico (compared with just 7 in Pennsylvania and 9 in Wisconsin). Of the 353 herds with more than 1000 cows, about 60% were in California. Therefore, climatic factors need to be disentangled from those due to size. For example, Fallert *et al* note that dairy cattle do not require winter housing in the South West, which would lower the capital requirement per cow significantly regardless of herd size. At the same time, they note the prevalence of continuous shift milking and more efficient exploitation of fixed equipment on the larger farms, which is a pure scale effect.

20. This is true of all countries reported in Table A2.1.1 except Greece.

21. Unfortunately, comparable data were not available on the age distribution of farmers in New Zealand, where according to anecdotal evidence farmer retirement at 65 is the norm.

22. The effects were particularly noticeable in France where the number of herds declined by 44 per cent between 1984 and 1990, with large numbers of elderly farmers with small herds accepting exit payments to leave the industry.

23. Tenure classes in Australia and New Zealand are defined according to operating type rather than ownership. The category of owner operators includes those who lease their farm. The defining characteristic of owner operators in the New Zealand context is that they receive all farm receipts, from which they may pay wages for hired management and labour. By contrast, sharemilkers operate the farm on behalf of the owner for a fixed share of the farm receipts. The most popular type of sharemilking agreement (about 75 % of all such agreements in 1990) attributes half the receipts to the sharemilker. He owns the herd and maintains the property. Other types of agreement involve a larger share going to the owner, who is then more involved in management. Sharemilking is usually a first step towards ownership. Contract milkers are contracted to milk the owner's herd at a set price per kg of milkfat. This type of arrangement is the most variable category, fluctuating between about 3 and 11 per cent of herds in recent years. In Australia, almost all dairy farms are owner-operated. Of those farms that do have sharefarmers, in only 30% of cases does the sharefarmer receive more than 50% of total farm receipts.

24. This might indicate the presence in these countries of capital constraints experienced by the (typically small) farmers in these countries that impose a choice between owning expensive livestock and owning land; alternatively, small tenant farmers in these countries may be more likely to own a few dairy cows in order to maintain their cash flow.

25. Price support tends to be capitalised into land values and is reflected in farm rents. Where direct income payments remain coupled to hectares or livestock headage, land values are likely to be maintained. However, where these payments are linked directly to persons the situation regarding the claims of landlords and tenants may need clarification. In general, owner occupiers are more exposed to policy risk, since both their tangible wealth and their income-earning human capital are tied up in agriculture.

26. The proportion of holders who work less than 50 per cent of the time on the holding exceeds the proportion of holders with other gainful activity in Greece, Italy, Portugal, Spain and the United Kingdom. This suggests the presence of disguised unemployment, semi-retired holders drawing pensions or individuals with other forms of unearned income.

27. In 1987, only 28 per cent of all farmers in EC-10 (excluding Spain and Portugal) worked 100 % of the time on the holding, compared with 69 per cent of farmers on specialist dairy holdings.

28. This helps to explain the apparent restraint of Dutch and British farmers in the use of feed during 1980-1985, despite what looks like a favourable change in the milk/feed price ratio, and the improvement in the milk price/feed price ratio in 1985 relative to 1980 in all the EC countries shown.

29. Very few countries provided information on stocking rates and fertiliser use. The impression given is of a slight movement towards extensification in Europe (stocking densities and rates of fertiliser application just maintained or reduced), but increased stocking densities in Japan. The prevalence of milking parlours seems to be positively correlated with average herd size.

30. In Germany, milk fed to animals increased by 50% between 1980 and 1990, and in 1990 this accounted for two-thirds of milk retained on farms. In the United Kingdom, there appears to have been an increase in on-farm processing into cheese and other products.

31. For example, in the United Kingdom in April 1984, the rate of payment per litre per 1 per cent for protein and lactose, relative to butterfat, was 97.9% and 14.9% respectively. By April 1992, these ratios had risen to 115.6% and 16.1%.

32. For example, the production of summer milk in the Swiss mountains, which commands a price premium for the manufacture of specialty cheese, relies on the existence of small family-run herds that can be grazed on these alpine pastures during the summer.

33. For example, farmhouse cheese makers in the United Kingdom are recorded in national statistics as delivering their milk to a dairy, from which it is then "re-purchased". The figures for producer processors in the United Kingdom given in Table A5.1.1 include farmhouse cheese producers who deliver some of their milk to a dairy in the normal way, but exclude producer retailers and processors who do not deliver any of their milk to dairies.

34. In 1985, French cooperative plants (58% of all plants) received 48% of deliveries.

35. The proportion of different agricultural commodities sold through cooperatives in the European Community varies between products and commodities. The figures in the following table complement the percentages on cooperative ownership of milk-processing plants given in Table A5.2.1.

Percentage of agricultural commodities sold through cooperatives, 1990

Country	Milk	Pigmeat	Cereals	Fruit
Belgium	65	15	25-30	60-65
Denmark	91	98	47	90
France	50	78	75	45
Germany	64		49	30-40
Greece	20	5	49	51
Ireland	95		38	14
Italy	32	15	35	31
Netherlands	84	24	65	77
Spain	10	2	26	26
United Kingdom	4	17	19	21

Source: EC Commission

36. See Ling *et al* (1989).

37. See Fallert *et al* (1993). The causes of this lack of adjustment, and its relationship to the ownership and size structure, would be worth examining further.

38. Detailed figures for France show that, throughout the 1980s, the cooperatives' share of the workforce in the milk processing sector was significantly lower than its share in the volume of milk processed. This is due to factors such as the relative size of plant, the type of products produced and management characteristics. It is worth noting that cooperatives play a far greater role in the milk sector in France than in agribusiness generally (29% of milk processing firms as opposed to 7% of agribusiness firms as a whole) and have maintained their market share during the rapid restructuring of the 1980s.

39. See note 40 regarding the United Kingdom.

40. These figures for the United Kingdom are inconsistent with those given for the change in average size of plant in Table A5.2.2.

41. The role of small-scale dairying in improving the quality of the landscape and maintaining rural populations in remote areas is often cited. For example, the grazing of alpine pastures in the summer months is quoted as a positive externality, to the benefit of the winter tourist industry in Switzerland and Austria.

Appendix 1: Sources and References

Information received from Member countries

	Questionnaire returned?	Information provided on the following tables:												
		1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	3.1	4.1	4.2	5.1	5.2	5.3
Australia	Yes	■	■	■	■	-	-	■	-	-	■	■	-	■	-
Austria	Yes	■	-	■	-	-	-	-	-	-	■	-	-	■	■
Belgium	Yes	■	-	■	■	■	-	-	-	■	■	-	■	■	■
Canada	Yes	■	-	■	■	■	■	■	-	■	■	■	-	■	-
Denmark	Yes	■	-	■	-	■	■	-	■	■	■	■	-	■	■
Finland	Yes	■	■	■	■	■	■	-	■	■	■	■	■	■	-
France	No														
Germany	Yes	■	-	■	■	-	-	-	-	-	■	■	-	■	■
Greece	Yes	■	■	■	-	-	■	-	■	-	■	■	-	-	■
Iceland	No														
Ireland	No														
Italy	No														
Japan	Yes	■	■	■	■	■	■	-	■	■	■	■	-	■	■
Luxembourg	No														
New Zealand	No														
Norway	Yes	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Netherlands	Yes	■	■	■	■	■	■	■	■	■	■	■	■	■	-
Portugal	Yes	■	-	■	■	-	-	■	-	■	-	-	-	■	■
Spain	No														
Sweden	Yes	■	■	■	■	■	■	-	-	■	■	■	■	-	■
Switzerland	Yes	■	-	■	■	■	-	-	-	-	■	■	-	-	-
Turkey	No														
United Kingdom	Yes	■	■	■	■	-	-	-	■	■	■	■	■	■	■
United States	Yes	■	■	■	■	-	■	■	-	■	■	■	■	-	-

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Appendix 2: Tables: OECD Countries

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Table A0.1: Basic Dairy Data, OECD countries, 1990

Country	Holdings with dairy cows Per cent of total	Dairy cows Per cent of total	Milk output Per cent of total	Quota scheme?	Net percentage PSE 1990 %
Australia	0.9	3.8	2.9	No	36
Austria	6.7	2.1	1.5	1978-	66
Belgium	1.6	2.0	1.6	1984-	69[EC]
Canada[1991]	2.0	3.2	3.4	1970/4-	82
Denmark	1.1	1.8	2.1	1984-	69[EC]
Finland	2.4	1.2	1.2	1985-	76
France	12.5	12.3	11.8	1984-	69[EC]
Germany[1]	14.3	11.2	10.8	1984-	69[EC]
Greece	[1989]2.6	0.5	0.3	1984-	69[EC]
Ireland	2.9	3.2	2.4	1984-	69[EC]
Italy	12.6	6.2	5.0	1984-	69[EC]
Japan	3.1	3.3	3.7	1979-[3]	86
Luxembourg	0.1	0.1	0.1	1984-	69[EC]
Netherlands	2.5	4.6	5.1	1984-	69[EC]
New Zealand	0.8	5.6	3.4	No	3
Norway	1.4	0.8	0.9	1983-	80
Portugal	5.1	0.9	0.8	1986-	69[EC]
Spain	10.8	3.8	2.6	1986-	69[EC]
Sweden	1.4	1.4	1.6	1985-89	73
Switzerland	2.6	1.7	1.7	1979-	85
UK	2.3	6.7	6.9	1984-	69[EC]
US[1987]	10.5	23.8	30.3	No	63
EC	68.5	53.3	49.4	Yes	69
EFTA-5	14.5	7.2	6.9	Yes	76[2]
Oceania	1.6	9.5	6.3	No	18[2]
OECD-22[1]	100.0	100.0	100.0		69

1. Germany as prior to 3/10/1990.
2. Average weighted by production shares.
3. Liquid milk market only.

Sources: OECD Questionnaire, OECD Database and FAO, Agricultural Production and Trade Yearbooks.

Table A0.2: Production and Self-sufficiency, OECD countries, 1990

Country	Cheese production		Butter production		Milk powder production[1]	
	% of OECD-22	Self-sufficiency %	% of OECD-22	Self-sufficiency %	% of OECD-22	Self-sufficiency %
Australia	1.8	125	3.1	185	4.6	575
Austria	1.2	201	1.2	102	0.9	139
Belgium/Luxembourg	0.8	45	2.6	117	3.3	162
Canada	3.0	96	3.1	104	2.6	172
Denmark	3.1	390	2.7	190	3.1	109
Finland	1.0	141	1.8	241	1.1	259
France	15.2	115	15.7	108	19.6	159
Germany[2]	13.0	98	18.9	113	14.8	161
Greece	1.7	85	0.1	37	0.0	0
Ireland	0.7	368	4.3	872	5.1	199
Italy	9.2	95	3.0	83	0.1	1
Japan	0.7	43	2.2	92	6.5	77
Netherlands	6.3	267	6.3	420	5.9	142
New Zealand	1.3	356	7.5	630	10.3	356
Norway	0.9	141	0.6	265	0.2	114
Portugal	0.5	71	0.5	101	0.5	120
Spain	1.7	80	1.3	241	1.4	110
Sweden	1.2	87	2.1	181	1.4	201
Switzerland	1.4	137	1.1	90	0.9	112
UK	3.3	78	4.0	78	5.8	265
US	32.3	96	17.7	113	12.1	102
EC-12	55.5	111	59.4	123	59.5	141
EFTA-5	5.7	119	6.8	114	4.5	158
Oceania	3.1	172	10.6	371	14.9	403
Total OECD-22[1]	100.0	105	100.0	129	100.0	142

1. Whole and skim milk powder.
2. Germany as prior to 3/10/1990.

Sources: OECD Questionnaire, OECD Database and FAO, Agricultural Production and Trade Yearbooks.

Table A1.1.1: Herd and Livestock Numbers, 1990

Country	Holdings with cows	Holdings with dairy cows	Holdings with suckler cows	Number of dairy cows	Average dairy cows per holding	Number of suckler cows	Average suckler cows per holding
Australia		17 030		1 653 000	97		
Austria	125 090[1]			904 620	8[1]	47 020	
Belgium		31 300	22 990	846 310	27	317 310	14
Canada[1,4]	145 510	38 980	103 990	1 310 350	34	2 138 100	21
Denmark	31 890	21 940	11 880	753 110	34	86 870	7
Finland		46 760		489 920	10		
France	400 000	241 000	232 000	5 218 000	22	3 708 000	16
Germany		275 100	60 340	4 775 000	17	244 000	4
Greece[5]	67 950	50 110	48 770	216 000	5	118 700	2
Ireland		49 100		1 464 000	28	731 000	
Italy		206 400		2 970 000	14	511 000	
Japan		59 500		1 285 000	22		
Netherlands	49 870	47 100	2 890	1 914 000	41	56 000	19
New Zealand		14 690		2 402 150	164		
Norway	28 960	27 550		326 780	12		
Portugal[5]	166 890	99 040		396 000	4	205 000	
Spain		206 800		1 615 000	7	1 080 330	
Sweden	35 490	25 920	10 880	576 410	22	74 540	7
Switzerland	66 020[2]	50 330		719 920	14		
United Kingdom	106 830	44 800	73 660	2 847 000	64	1 599 000	22
United States[3]	1 176 350	202 070		10 084 700	50		

1. 1991.
2. 1988.
3. 1987.
4. Excluding Newfoundland.
5. Figures for holdings are for 1989, cow numbers are for 1990.

Source: OECD questionnaire.

Table A1.1.2: Trends in Dairy Herds and Dairy Cow Numbers

Country	Total percentage change % 1970-1990		Total percentage change % 1970-1980		Total percentage change % 1980-1990		Annual percentage change % p.a. Most recent period		
	Herds	Cows	Herds	Cows	Herds	Cows	Herds	Cows	Period
Australia		- 38		- 30	- 35	- 12	- 5.7	- 1.8	1985-90
Austria									
Belgium	- 69	- 15	- 45	- 2	- 43	- 13	- 6.9	- 2.8	1985-90
Canada[1]	[2] - 73	[2] - 42	[3] - 53	[3] - 22	[4] - 43	[4] - 26	- 4.8	- 2.0	1986-91
Denmark	- 77	- 35	- 56	- 10	- 48	- 28	- 7.1	- 3.4	1985-90
Finland	[5] - 78	[5] - 50	[6] - 61	[6] - 34	- 45	- 24	- 5.3	- 3.1	1986-90
France	- 68	- 28	- 32	+3	- 53	- 30	- 8.1	- 5.1	1985-90
Germany	- 56	- 13	- 32	- 0	- 36	-13	- 4.0	- 2.4	1985-90
Greece					[7] - 41	- 35	- 4.2	+ 1.2	1986-90
Ireland					[7] - 53	- 14	- 8.2	- 4.0	1986-90
Italy					[7] - 56	- 5	- 10.9	- 3.2	1986-90
Japan	- 75	+21	[8] - 60	[8] +23	[7] - 38	[7] - 2	- 4.9	- 0.6	1985-90
Netherlands	- 60	+ 2	- 42	+24	- 30	- 18	- 4.1	- 3.9	1985-90
New Zealand	[9] -19	[9] +20			- 8	+19	- 1.5	+0.5	1985-90
Norway							- 3.2	- 2.5	1985-90
Portugal					[10]- 27	[10]+18			
Spain									
Sweden		- 20		- 9	- 51	- 12	- 5.9	- 2.2	1985-90
Switzerland									
UK	- 59	- 12	- 43	- 1	- 33	- 12	- 3.7	- 2.0	1985-90
US	[11] - 55	[11] - 7	[12] - 26	[12] - 4	[13] - 39	[13] - 3	- 3.2	- 0.5	1987-92

1. Excluding Newfoundland. 2. 1971-91.
3. 1971-81. 4. 1981-91. 5. 1969-90. 6. 1969-80.
7. 1981-90. 8. 1970-81. 9. 1974/5-1990/1. 10. 1979-89.
11. 1969-87. 12. 1969-78. 13. 1978-87.

Source: OECD questionnaire.

Table A1.1.3: Average Dairy Herd Size, 1970-1990

Country	Average number of cows per dairy herd			
	1970	1980	1985	1990
Australia		71.8	79.1	97.1
Austria		1979 5.6	6.6	
Belgium	9.8	17.6	21.7	27.0
Canada	1971 15.6	1981 26.1	1986 29.1	
Denmark	12.0	24.5	28.2	34.3
Finland	4.5	7.6	9.4	10.5
France	9.5	13.0	19.0	21.7
Germany	8.7	12.7	15.9	17.3
Greece		1977 2.7	3.4	4.6
Ireland	1973 10	1979 14	1984 17.8	27.7
Italy	1973 5	1981 6	1984 7.2	14.4
Japan	4.4	1981 3.6	17.3	21.6
Netherlands	16.3	35.1	40.8	41.2
New Zealand	1974 112.2	126.0	147.3	163.6
Norway			11.5	11.9
Portugal		1979 2.5		4.1
Spain			1987 6.7	7.7
Sweden		14.9	18.4	22.2
Switzerland				14.3
United Kingdom	29.6	51.4	58.2	63.5
United States	1969 23.9	1978 31.0	1987 49.9	

Source: OECD questionnaire.

Table A1.2.1: Distribution of Dairy Herds and Dairy Cows over Different Types of Farm[1]

	Percentage of dairy herds on different types of farm				Percentage of dairy cows on different types of farm				Average size of dairy herd on different types of farm			
Country[2]	Specialist dairy	Livestock	Specialist arable	Cropping	Specialist dairy	Livestock	Specialist arable	Cropping	Specialist dairy	Livestock	Specialist arable	Cropping
Belgium	48	73	3	26	58	78	3	22	30	26	24	21
Denmark	58	75	4	26	71	84	1	16	37	34	6	19
Finland	93											
France	54	76	4	23	65	81	2	18	24	21	9	16
Germany	54	75	2	25	67	83	1	17	20	18	7	11
Greece	3	16	48	79	11	31	33	67	12	7	3	3
Ireland	75	97	..	2	92	98	..	1	27	22	10	13
Italy	34	62	4	34	53	78	2	21	15	12	5	6
Japan	59											
Netherlands	78	94	1	4	90	98	..	2	46	41	10	20
Norway	77	77	..	22								
Portugal	7	52	2	47	24	66	1	32	11	4	2	2
Spain	31	70	6	28	47	79	4	20	10	8	5	5
Sweden	88	100										
UK	75	88	2	11	77	85	2	15	63	58	61	81
US	68	93	3	7								

.. = less than 0.5.

1. For EC countries, farm type definitions are based on the EC typology, which classifies farms according to the break-down of their gross margin over different activities. The definitions used in this table are: Specialist dairy=41; Livestock=41, 42 (specialised rearing and fattening), 43 (dairy, rearing and fattening), 44 (sheep, goats and other), 71 (mixed livestock, mainly grazing), 72 (mixed livestock, mainly granivores); Specialist arable=11 (cereals), 12 (general field cropping); Cropping=11, 12 (general field cropping), 60 (mixed cropping), 81 (field crops and grazing livestock), 82 (various crops and livestock). Japan, Norway, Sweden and US apply national definitions.

2. All data are for 1987, with the exception of Finland (1990), Japan (1990), Norway (1992) and Sweden (1990).

Source: OECD questionnaire.

Table A1.3.1: Distribution of Herds and Cows by Herd Size

	Percentage of herds with						Percentage of cows in herds with					
Cows:	< 10	< 20	< 50	< 100	< 150	< 200	< 10	< 20	< 50	< 100	< 150	< 200
Australia 1980	14	17	27	54	79	91						
1990	10	12	18	34	58	77						
Austria 1979	88	99	99.9	100			67	95	99.7	100		
1991	76	97	99.9	100			49	90	99.6	100		
Belgium 1980	33	65	96	99.8		99.9	11	34	86	98.7		99.9
1990	17	41	88	99.3		99.9	3	16	70	97		99.8
Canada[3] 1981		<18 43	<48 85	<78 96	<123 99.2	<178 99.9		<18 8	<48 59	<78 85	<123 95	<178 97.7
1991		<18 28	<48 77	<78 94	<123 98.7	<178 99.6		<18 4	<48 52	<78 81	<123 93	<178 97.2
Denmark 1980	23	50	90	99.1			4	20	71	95		
1990	10	28	79	98			2	9	58	93		
Finland 1980	73	96	99.9				47	88	99.3			
1990	49	93	99.9				27	83	99.4			
France 1980	44	75	98	99.9			14	44	92	99.6		
1990	16	41	92	99.7			5	21	81	98.9		
Germany 1980	49	79	99	99.9			19	51	93	96		99.9
1990	35	65	97	99.5			10	34	87	99		99.9
Greece 1981	97	99	99.9									
1990	91	96	99.8									
Ireland 1981	54	75	95	99								
1990	25	51	88	98								

Table A1.3.1 (continued): Distribution of Herds and Cows by Herd Size

		Percentage of herds with						Percentage of cows in herds with					
Cows:		< 10	< 20	< 50	< 100	< 150	< 200	< 10	< 20	< 50	< 100	< 150	< 200
Italy	1981	86	94	98	99.5								
	1990	65	84	96	99.2								
Japan	1980	49	72	96.9				16	37	88			
	1990	29	51	91				6	18	73	98.1		
Netherlands	1980	18	33	75	97	99.5		2	8	47	89		
	1990	11	23	70	97	99.4		1	6	45	89		
New Zealand[1]	1982			4	27	69	88			1	15	54	78
	1990			3	15	48	74			0.5	6	31	58
Norway	1980	59	91	99.7				30	74	98	99.7	99.9	
	1990	39	91	99.8				21	81	99	99.8	100	
Portugal	1990	91	97	99.9				[1989] 51	69	87			97
Spain	1990	77	94	99.1									
Sweden	1980	39	[<25] 85	98	99.7			14	[<25] 62	90	97.2		
	1990	20	[<25] 66	90	99.3			5	[<25] 39	82	95.2		
Switzerland	1978	55	90	99.7				27	75	98.6			
	1990	24	76	99.7				11	67	98.9	99.9		
United Kingdom[2]	1981	11	23	60	86		98.2	1	4	25	65		99.1
	1990	8	16	48	82		97.8	0.5	2	20	58		90
United States	1969	36	55	89	98		99.4	5	15	60	83		91
	1978	41	50	81	95		98.7	3	17	39	69		84
	1987	24	33	66	90		97.3	1	3	26	58		77

1. Dairy factory supply herds (over 90% of cows).
2. 1981 figure for herds <10 cows is an estimate.
3. Excluding Newfoundland.

Source: OECD questionnaire.

Table A1.3.2: Small Herds in OECD countries,1980-1990

	Producers with less than 10 cows			Producers with less than 20 cows		
Country	**thousands1980**	**thousands1990**	**% change 1980-90**	**thousands1980**	**thousands1990**	**% of total 1990**
Australia	3.8	1.6	-57	4.8	2.0	0.2
Austria	121.9	104.1	-15	143.1	130.9	10.6
Belgium	18.2	5.3	-71	35.8	13.0	1.1
Canada[1, 4]				[1981] 29.2	[1991] 11.0	0.9
Denmark	9.6	2.4	-75	21.1	6.3	0.5
Finland	61.8	23.0	-63	82.1	43.3	3.5
France	227.3	54.0	-76	387.0	116.0	9.4
Germany[2]	214.0	96.1	-55	342.8	118.9	9.7
Greece	88.8	43.0	-52	91.3	46.0	3.7
Ireland	52.0	14.9	-71	75.4	29.0	2.4
Italy	263.1	158.8	-40	301.5	203.0	16.5
Japan	44.8	16.8	-63	65.5	29.3	2.4
Netherlands	11.9	5.3	-55	22.2	11.0	0.9
New Zealand						
Norway	[1979] 23.1	10.8	-53	35.4	25.4	2.1
Portugal	133.0	96.0	-28	135.2	102.0	8.3
Spain	[1983] 265.3	179.0	-33	[1983] 294.7	217.0	17.6
Sweden	17.2	5.2	-70	31.2	13.2	1.1
Switzerland	[1978] 45.5	11.9	-74	74.7	41.0	3.3
UK[3]	[1981] 6.3	3.6	-43	12.6	7.2	0.6
US	[1978] 137.1	[1987] 49.9	-64	[1978] 167.9	[1987] 65.8	5.3
EC-11		514.5			869.3	70.6
EFTA-5		155.1			253.7	20.5
OECD-20					1 231.1	100.0

1. Figures are for herds with less than 18 cows.
2. As prior to 3/10/1990.
3. 1981 figures are estimates.
4. Excluding Newfoundland.

Source: OECD questionnaire.

Table A1.4.1: Regional Redistribution of Herds and Cows: Average Deviation from National Trends, 1970-1990[1]

Country	Number of regions	Regional variation 1970-1990		Regional variation 1970-1980		Regional variation 1980-1990	
		Herds	Cows	Herds	Cows	Herds	Cows
Australia	6		15.9		14.4	7.8	5.9
Belgium	9	4.4	11.9	4.4	7.7	5.6	7.2
Canada[2]	9	7.4	4.2	7.0	4.6	8.4	5.4
Finland	12					4.1	6.9
France[3]	22	5.1		4.6		5.3	5.5
Germany[3, 4]	10[5]	6.0	7.7	5.3	5.0	4.8	3.7
Japan	10	5.2	13.3	4.7	2.5	6.7	10.1
Netherlands	12	5.2	3.3	5.6	2.2	3.4	2.1
Norway	18	8.2	12.3	7.0	12.2	5.6	6.3
Sweden	24					4.4	4.8
UK	4	2.0	7.4	3.2	3.9	1.0	3.2
US[6]	10	10.7	15.4	10.9	7.9	9.8	7.5

1. The index of regional variation shown in the table is calculated as follows:

$$Index = \sum_{r=1}^{R} w_r \mid d_r - \bar{d} \mid / R$$

where d_r is the total percentage change in region r, d-bar is the total percentage change at national level, R is the total number of regions and w_r is the share of region r in the national total (herds or cows). Higher values of this index denote higher rates of redistribution between regions. A high value could be due to a large shift between two important regions, or to less marked redistribution involving more regions.

2. Periods are: 1971-91, 1971-81, 1981-91. Excluding Newfoundland.
3. Periods are: 1973-90, 1973-80, 1980-90.
4. As prior to 3/10/1990.
5. West Berlin not included.
6. Periods are: 1969-1987, 1969-78, 1978-87.

Source: OECD questionnaire.

Table A1.5.1: Most Popular Dairy Breeds, 1980-1990

Country	Black and white breed			Other most important breed(s), 1990		
	1980 %	1990 %	Name given in questionnaire	Breed	1980 %	1990 %
Belgium	49	55	Belgian black and white	Belgian red and white	51	45
Canada	1981 92	1991 92	Holstein	Ayrshire	1981 4	1991 4
Denmark	1978 46		Black & white Danish	Red Danish	1978 19	
Finland	1991 15	1991 21	Friesian	Ayrshire	1981 78	1991 71
France	1977 37	1988 65	Friesian-Holstein	Jersey	1978 22	1988 17
Japan	98	100	Holstein			
Netherlands		64	Black and white	Red and white "Meat"		21 14
New Zealand[1]		67	Holstein-Friesian	Jersey		26
Norway				Norwegian Red (NRF)		1991 99
Sweden	34	40	Swedish black and white	Swedish red and white	64	58
Switzerland	1978 9	1988 11	Black and white	Brown Swiss Red and white	1978 44 1978 44	1988 40 1988 44
United Kingdom[1]: England & Wales		95	Friesian-Holstein	Jersey		2
Scotland		90	Friesian-Holstein	Ayrshire		8

1. Percentage of artificial inseminations, by breed of bull.

Source: OECD questionnaire.

Table A1.5.2: Milk Yield by Breed, 1980-1990

Country	Black and white breed		Other most important breed(s) in 1990		
	1980 kg/cow/yr	1990 kg/cow/yr	1980 kg/cow/yr	1990 kg/cow/yr	Breed
Canada	1981 6973	1991 7625	1981 5426	1991 6151	Ayrshire
France	1977 3349	1988 4752	1978 3122	1988 4198	Jersey
Japan	6331	7794	3918	4833	Jersey
Netherlands	5502	[1] 7204	5412	[1] 6387	Red and white
New Zealand		[2] 3465		[3] 2672	Jersey
Norway			5769	6329	NRF
Sweden	5500	6640	5210	6370	Swedish red and white
United Kingdom: England & Wales		[4] 5925 [5] 6703		4163	Jersey
Scotland		[4] 5963 [5] 6755		5577	Ayrshire

1. At first lactation.
2. Litres/cow/year (average 4.46% milkfat).
3. Litres/cow/year (average 5.74% milkfat).
4. British Friesian.
5. British Holstein.

Source: OECD questionnaire.

Table A2.1.1: Distribution of Herds by Age of Farmer

Country/Year		Percentage of dairy farmers of age					% of all farmers of age	
	Years:	<25	<35	<45	<55	<65	<45	<65
Australia	1990	<30 2	<40 23	<50 59	<60 71	91		
Belgium[1]	1987			32	61	93	31	87
Canada	1971	2	16	41	<60 86			
	1986	2	21	45	<60 84			
Denmark	1980	<30 4	<40 20	<50 46	<60 77	<70 95		
	1990	<30 5	<40 21	<50 45	<60 73	<70 92		
[1]	1987			36	66	92	31	81
Finland	1986		16	36	64	89		
	1990		18	42	69	92		
France	1978		9	<50 45	65	89		
	1990		15	<50 37	65	95		
[1]	1987			31	61	95	27	85
Germany[1]	1987			36	71	96	34	94
Greece[1]	1987			14	38	74	20	72
Ireland[1]	1987			29	57	84	25	77
Italy[1]	1987			20	46	81	17	72
Japan	1984	<30 5		<50 46	<60 84			
	1990	<30 1		<50 41	<60 74			
Netherlands	1977		12	36	65	89		
	1990		9	31	59	91	31	87
Norway	1969		7	24	52	82		
	1979		14	32	57	86		
	1990		18	46	70	91		
Portugal[1]	1987			32	59	84	18	70
Spain[1]	1987			17	42	76	18	74
Sweden	1980	<30 5	<40 20	<50 40	55	87		
	1990	<30 4	<40 22	<50 48	59	86		
United Kingdom[1]	1987			30	58	87	27	79
United States	1969		12	35	65	90		
	1978		15	34	60	86		
	1987		17	39	61	85		

1. Herds on specialist dairy farms (see Table A1.2.1).

Source: OECD questionnaire.

Table A2.1.2: Distribution of Herds and Cows by Age of Farmer, 1990

Country/Year		Herds where the farmer's age is					
	Years:	<30	30-39	40-49	50-59	60-64	≥65
Australia, 1990	% of herds	2	21	36	11	20	9
	% of cows	1	20	40	13	18	8
	Average herd size	105	161	189	188	155	147
Denmark, 1990	% of herds	5	16	24	30	20	5
	% of cows	6	21	29	28	13	3
	Average herd size	32	31	32	27	18	14
	Years:		<35	35-44	45-54	55-64	≥65
Finland, 1990	% of herds		18	25	27	22	8
	% of cows		19	29	29	19	5
	Average herd size		11	12	11	9	6
France, 1990	% of herds		15	22	27	30	5
	% of cows		20	26	28	24	2
	Average herd size		30	27	23	18	9
Norway, 1990	% of herds		18	28	25	21	9
	% of cows		19	29	26	20	6
	Average herd size		12	12	13	11	8
	Years:	<30	30-39	40-49	50-54	55-64	≥65
Sweden, 1990	% of herds	4	18	25	13	27	14
	% of cows	4	21	30	12	27	9
	Average herd size	23	26	26	22	21	16
	Years:		<35	35-44	45-54	55-64	≥65
United States, 1987	% of herds		17	22	22	24	15
	% of cows		15	23	26	25	11
	Average herd size		49	61	65	65	58

Source: OECD questionnaire.

Table A2.2.1: Tenure Status of Dairy Farmers

		Mainly owner operated			Mainly tenanted			% of agricultural area that is owner-operated	
		% of herds	average herd size	average age of farmer	% of herds	average herd size	average age of farmer	specialist dairy holdings	all types of holding
Australia[1]	1990	97	161	46	3	323	na	>92	na
Belgium	1987							31	32
Canada[2]	1976	owner-operated 67.0							
		mixed tenure 30.8			wholly tenanted 2.3				
	1986	owner-operated 58.8							
		mixed tenure 38.9			wholly tenanted 2.4				
Denmark	1987							81	82
France	1987							41	47
Germany	1987							66	64
Greece	1987							49	77
Ireland	1987							95	96
Italy	1987							59	80
Japan: Hokkaido	1980							90	
	1990							88	
Japan: Tohuken[3]	1980							72	
	1990							62	

Table A2.2.1 (continued): Tenure Status of Dairy Farmers

		Mainly owner-operated			Mainly tenanted			% of agricultural area that is owner-operated	
		% of herds	average herd size	average age of farmer	% of herds	average herd size	average age of farmer	specialist dairy holdings	all types of holding
Netherlands	1973	61.2	24		39.8	26			
	1987	75.0			25.0			65	66
New Zealand[4]	1990	68.7	160		31.3	191			
Norway	1969	93.7	5	55	6.3	6	47		
	1979	91.3	9	53	8.7	9	47		
	1989	89.8	12	51	10.2	12	4		
Portugal	1987							40	66
	1989	80.8			19.2				
Spain	1987							69	70
United Kingdom	1987							65	63
United States	1969	[5] 88.2	24		[4] 11.8	25			
	1978	[5] 91.0	31		[4] 9.0	35			
	1987	[5] 89.3	41		[4] 10.7	54			

1. The mainly owner-operated category includes those who lease all or part of their farms. The "mainly tenanted" category contains producers with status as share farmers and contract milkers, whose share is more than 50%. Average herd size for mainly tenanted farms refers to farms where the majority of the herd is owned by the share farmer. 79% of the Australian dairy herd is on farms that are more than 90% freehold, and 8% of the national herd is on farms that are more than 90% leasehold land. of leasehold and freehold land.
2. Canadian statistics distinguish three categories: wholly owner-operated, mixed tenure, and wholly tenanted.
3. Rest of Japan.
4. Statistics for New Zealand owner-operators include those who lease their farms. The "mainly tenanted" category contains producers with status as sharemilkers and contract milkers (see note 23).
5. United States "mainly owner-operated" category contains owner-operators and producers with mixed tenure. The percentages in the "mainly tenanted" column in the table refer to pure tenants.

Source: OECD questionnaire.

Table A2.3.1: Labour on Dairy Farms

Country/Year		Total labour	Total labour per holding[1]	Units	Family labour: percentage of total			Hired labour: percentage of total	
					All family labour	Excluding holder	Spouses	All hired labour	Permanent labour only
Belgium	1987	219 000	1.2	AWU[2] on SD holdings	99.5	25.6		0.5	
Denmark	1987	272 000	1.8	AWU[2] on SD holdings	82.3	16.9		17.6	14.7
Finland	1990	120 890	2.6	Persons	99.3		15.5	0.7	0.7
France	1987	282 600	1.7	AWU[2] on SD holdings	86.9	37.3		13.1	12.4
Germany	1987	265 900	1.5	AWU[2] on SD holdings	97.2	45.8		2.8	2.5
Greece	1987	2 200	1.0	AWU[2] on SD holdings	91.0	41.0		9.0	
Ireland	1987	88 100	1.6	AWU[2] on SD holdings	90.8	36.5		9.2	8.1
Italy	1987	150 200	1.6	AWU[2] on SD holdings	93.1	46.7		6.9	4.7
Japan	1990	190 170	3.2	Persons[3]	99.3			0.7	0.7
Netherlands	1987	73 500	1.6	AWU[2] on SD holdings	96.2	41.8		3.8	
Netherlands	1990	72 400	2.0	Persons SD holdings	96.6		20.6	3.4	
Norway	1990	54 300	2.0	Man years	78.3		15.3	21.7	
Portugal	1987	18 800	2.0	AWU[2] on SD holdings	88.8	51.1		11.2	
Spain	1987	144 100	1.6	AWU[2] on SD holdings	96.9	55.9		3.1	2.2
United Kingdom	1987	95 200	2.6	AWU[2] on SD holdings	74.2	37.9		25.8	23.8
	1990	98 200	2.6	Full-time equivalents	70.4		8.1	29.6	22.9

1. Where total labour refers to SD (specialist dairy) holdings only, then only SD holdings are considered in this ratio.
2. Annual Work Units.
3. On farms that keep dairy cows over 2 years old. Casual hired labour not included.

Source: OECD questionnaire

Table A2.3.2: Trends in Dairy Labour

Country	Period	Annual Rates of Change, %		
		Total labour	Family labour	Hired labour
Denmark[1]	1985-90	- 5.5	- 5.4	- 5.9
	1990-91	- 3.4	- 4.0	- 1.1
Japan[2]	1970-80	- 8.5		
	1980-85	- 4.5	- 4.4	- 7.7
	1985-90	- 4.4	- 0.3	- 4.4
Netherlands[3]	1972-80	- 4.2	- 4.4	+ 0.0
	1980-85	- 3.6	- 3.6	- 3.5
	1985-89	- 4.6	- 4.2	- 13.2
	1989-91	+3.5	+3.0	+16.1
Norway[4]	1970-80	- 4.1	- 4.2	- 3.7
	1980-90	- 3.0	- 3.2	- 2.2
	1990-91	- 4.6	- 4.0	- 6.8
United Kingdom[5]	1985-90	- 3.3	- 2.7	- 4.7

1. Labour measured as persons on specialist dairy farms.
2. Persons over 16 engaged in farming the previous year.
3. Labour measured as persons on specialist dairy farms.
4. Labour measured in man years.
5. Labour measured in Full Time Equivalents.

Source: OECD questionnaire.

Table A2.3.3: Features of Farm Labour Distribution on Specialist Dairy Farms, European Community, 1987

	Belgium	Denmark	Germany	Spain	France	Greece	Ireland	Italy	Netherlands	Portugal	United Kingdom
Totals AWUs in specialist dairy farms:	21.9	27.2	265.9	144.1	282.6	2.2	88.1	150.2	73.5	18.8	95.2
As % of AWUs in agriculture	22	24	31	9	19	0.3	35	7	31	2	18
Regular labour as % of all AWUs											
Specialist dairy	100.0	97.1	99.7	99.1	99.3	90.9	98.9	97.8	99.7	100.0	98.0
All holdings	99.0	95.2	98.6	87.3	95.3	86.3	98.5	90.1	96.3	97.3	95.1
Non-family regular labour as % of all regular labour											
Specialist dairy	0.5	15.2	2.5	2.2	12.5	0.0	8.2	4.8	3.5	11.2	24.3
All holdings	4.3	20.3	8.9	9.7	20.1	0.5	10.8	4.1	17.2	9.8	37.2
Persons regularly employed on specialist dairy farms	29.1	30.3	454	209.9	359.6	4.7	120.6	245.4	90.9	27.8	117.7
of which % full time	59.7	58.2	35.0	48.4	52.8	12.7	49.0	32.3	61.2	47.1	66.2
% full time on all holdings	51.7	44.4	29.7	24.3	44.6	6.5	36.5	12.2	52.0	27.2	53.0
% of holders working less than 50% of the time on the holding											
Specialist dairy holdings	10.1	5.3	29.3	32.5	7.2	55.2	11.8	27	2.1	26.5	10
All holdings	28.5	29.5	48	64	28.1	69	33.4	69.4	11.9	47.3	21.6
% of holders with other gainfaul activity											
Specialist dairy holdings	13.3	15	31	10.5	16	19.3	15.7	9.7	6.4	23.7	7.6
All holdings	32.5	32.9	33.3	28.1	31.8	33.3	35.3	24.0	23.7	38.3	23.6
% of family members with other gainful activity											
Specialist dairy holdings	9.7	42.8	15.8	12.5	19.4	13.9	47.7	20.4	..	16.7	15.8
All holdings	10.0	75.5	15.7	29.4	29.4	15.7	55.0	24.7	3.1	27.4	26.4

Source: OECD questionnaire.

Table A3.1: Feed Use, Prices and Debt/Equity Ratios

Country	Concentrate feed rate			Milk price/feed price		Debt/equity ratio		
	1990 tonnes/cow	1980-85 % Change	1985-90 % Change	1980-85 % Change	1985-90 % Change	1980 per cent	1985 per cent	1990 per cent
Australia						11	13	13
Belgium				+9.0	+17.5			
Canada	2.27		+45.1				45	45
Denmark				- 1.4	+25.9		[1] 4.33	[1] 4.10
Finland	1.94	+1.7	+10.3	- 13.5	+13.3	24	26	29
Germany				+7.3	+53.0			
Italy				+10.3	+15.3			
Japan	2.81	+22.9	+13.3	+16.9	+15.3	26	21	17
Netherlands	2.10	+4.8	- 4.6	+12.8	+29.3	[7] 78	73	76
Norway	1.83	- 11.0	+12.0	- 6.7	+15.5	38	41	42
Sweden	0.38	- 15.0	- 2.3	- 7.2	- 1.9		44	51
United Kingdom	[2] 1.50	- 9.6		+7.2	+12.7	12	17	13
United States	[3] 2.60	[4] +12.0	[5] +6.6	+5.2	+0.6	[6] 38	[3] 32	
European Community	1.03	- 4.9	+33.8	+9.5	+39.4			

1. Ratio of debt to farm net value added.
2. 1985.
3. 1987.
4. 1978-82.
5. 1982-87.
6. 1982.
7. 1979.

Source: OECD questionnaire.

Table A4.1.1: Composition of Raw Milk (%), 1970-1990

Country	Fat content			Protein content		
	1970	1980	1990	1970	1980	1990
Australia			4.30			3.32
Austria	3.86	3.93	4.05			3.24
Belgium	3.33	3.50	3.87		3.20	3.38
Canada[1]		3.60	3.79		3.34	3.27
Denmark	4.23	4.22	4.43		3.36	3.37
Finland	4.31	4.32	4.35		3.34	3.26
France	3.68	3.80	3.95		3.13	3.10
Germany	3.80	3.84	4.10		3.24	3.32
Greece		1981 3.60	3.54		3.49	3.38
Ireland	3.60	3.49	3.54		3.18	3.22
Italy	3.53	3.50	3.59		3.20	2.98
Japan	3.27	3.54	3.72	[2] (8.27)	[2] (8.40)	[2] (8.58)
Netherlands	3.85	4.00	4.38	3.33	3.35	3.44
New Zealand		4.68	4.71			3.65
Norway	4.00	3.86	3.86	3.20	3.20	3.25
Portugal		3.50	3.40			3.06
Spain			3.49			3.06
Sweden	3.99	4.14	4.31			3.36
Switzerland	3.79	3.81	4.02		3.19	3.20
United Kingdom	3.83	3.88	4.01		3.35	3.27
United States	1969 3.67	1982 3.65	3.65			

1. kg/hectolitre.
2. Non-fat solids.

Source: OECD questionnaire.

Table A4.2.1: Utilisation of Milk, 1970-1990

Country	Deliveries to dairies				Deliveries as a percentage of production			Liquid market as a percentage of deliveries		
	Units	1970	1980	1990	1970	1980	1990	1970	1980	1990
Australia	mn litres	7551	5432	6262				19.0	27.7	27.6
Austria	’000 t	2050	2236	2243		67.0	67.0			26.1
Belgium	’000 t	2426	2986	2988	64.8	79.4	82.8	22.7	23.9	27.2
Canada	mn litres	7172	7187	7318	93.2	89.9	94.5	32.0	36.1	32.0
Denmark	’000 t	4280	4917	4542	92.3	96.1	95.8	11.8	11.9	11.8
Finland	mn litres	2992	2968	2604	86.8	93.5	95.4			30.7
France	’000 t	18219	24830	24137	79.3	92.4	91.8	12.7	12.7	15.6
Germany	’000 t	18371	22948	21474	84.1	92.6	90.7	17.0	14.2	19.1
Greece	’000 t		447	560		54.1	78.2		42.7	54.2
Ireland	’000 t	2791	4556	5268	76.8	96.8	97.2	12.6	10.2	9.6
Italy	’000 t	6691	7867	10026	71.3	73.9	90.2	29.2	36.8	30.7
Japan	’000 t	4586	6322	8061	96.3	97.2	98.4	57.2	63.8	62.8
Netherlands	’000 t	7737	11444	10778	93.9	97.1	95.5	14.5	8.7	8.7
New Zealand	’000 t		6512	7375		97.4	95.8			5.9
Norway	mn litres	1611	1906	1927	96.1	96.3	96.8	50.3	46.2	39.4
Portugal	’000 t		880	1467		59.2	84.8			49.4
Spain	’000 t		4230	4502		74.4	78.3			55.6
Sweden	’000 t	2420	3288	3390	93.5	96.3	97.8	54.9	47.8	42.2
Switzerland	’000 t		3019	2970		82.6	77.3		23.0	19.3
United Kingdom	’000 t	12204	15494	14650	84.1	86.9	96.1	61.4	46.9	46.3
United States	’000 t	50709	[1982] 53885	66349	96.3	[1982]	98.6		41.5	37.4

Source: OECD questionnaire.

Table A4.2.2: Changes in Utilisation of Milk, 1980-1990, and Consumption Levels of Certain Dairy Products in 1990

Country	Percentage change in deliveries		Percentage change in liquid sales		Per capita consumption in 1990, kg of product per head*		
	1980-85	1985-90	1980-85	1985-90	Liquid milk	Butter	Cheese
Australia	+11.1	+3.8	+5.9	+8.4	103.6	2.9	8.9
Austria				[5] +6.9	94.0	4.5	11.0
Belgium	+4.7	- 4.4	+6.7	+6.8	42.1	7.7	14.3
Canada	+1.1	+0.8	+0.8	+3.8	92.0	3.6	14.0
Denmark	- 0.4	- 7.3	- 1.9	- 7.0	100.0	9.5	14.7
Finland	- 5.3	- 7.4		+0.5	178.7	6.6	13.6
France	+2.3	- 5.0	+15.1	+3.5	60.2	8.8	22.7
Germany	- 3.0	- 9.2	+10.8	+13.8	47.9	9.4	20.9
Greece	[1] +17.8	+21.5	[1] +8.4	+46.9	31.9	1.1	19.7
Ireland	+24.7	- 7.3	+13.0	- 3.8	160.8	4.9	5.4
Italy	+11.7	+14.1	+0.8	+5.5	74.4	2.2	16.2
Japan	+15.0	+10.8	+8.0	+17.5	41.9	0.7	1.2
Netherlands	+6.9	-11.9	+0.5	- 6.1	90.2	3.4	15.2
New Zealand					[2] 123.3	9.9	7.7
Norway	+0.4	+0.7	- 10.2	- 4.1	158.8	3.1	12.7
Portugal		+ 38.8		[5] +12.1	[3] 72.1	1.5	6.3
Spain	+12.6	- 5.4		[5] - 8.6	66.6	0.5	5.2
Sweden	+7.7	- 4.3	- 3.4	- 7.5	135.9	5.4	16.4
Switzerland				[5] +1.2	105.9	5.6	16.2
United Kingdom	+0.6	- 6.0	- 4.5	- 2.4	117.5	3.8	7.1
United States	[4] 5.5	[5] +4.2	[4] +6.3	[5] +0.9	[2,3] 107.5	[3] 1.9	[3] 12.3

* Note that consumption figures are from non-harmonised sources. Definitions of product categories may not be comparable.
1. 1981-85.
2. Including cream.
3. 1989.
4. 1982-87.
5. 1987-90.

Source: OECD questionnaire.

Table A5.1.1: Direct Sales: Producer Processors and Retailers

Country	Percentage of producers 1990 %	Percentage of total quota[1] 1991/92	Direct sales as % of total milk production % 1990	Direct sales of milk and dairy products		Processed dairy products as % of direct sales (milk equivalent)			Farm production, 1990 thousand tonnes of	
				% change 1970-80	% change 1980-90	1970	1980	1990	butter	cheese
Belgium	19.0	12.8	10.9	- 38	- 40	71	76	75	11.0	0.6
Denmark		..							0.0	0.0
Finland			0.6	- 79	- 55	30	29	71		
France		3.1							6.0	11.0
Germany[2]		0.4							2.0	0.3
Ireland		0.3							1.0	0.5
Italy		8.6							2.8	9.8
Japan	..		..							
Netherlands	1.3	0.9	0.7	+41	- 2	100	100	100	0.0	9.0
Norway	0.5									
Portugal		6.8							0.0	0.0
Spain		11.6							0.7	10.4
Sweden	..		0.1							
United Kingdom	5.6	2.8	2.2	- 26	+9	10	9	26		
United States[3]	..		..							

'..' less than 0.1 per cent.
1. Direct Sales quota as a percentage of direct sales plus wholesale quota.
2. Boundaries after 3/10/1990.
3. Information about fluid milk available only.
Source: OECD questionnaire.

Table A5.2.1: Ownership and Productivity of the Processing Sector, 1990

Country	Organisations			Plants			Employees	Milk/ plant	Employees/ plant	Milk/ employees
	Total	Cooperatives %	Private %	Total	Cooperatives %	Private %	Total	'000 t/ plant		tonnes/ employee
Australia	70	40	60	137	48	52		[1] 45.7		
Austria				189	80	20	7230	11.9	38	310
Belgium				90				33.2		
Canada				361	26	74	[2] 14000	20.1	39	517
Denmark				53	51	49	[3] 8600	85.7	[3] 100	[3] 570
Finland				110	87	13	8170	24.3	74	328
France	463	25	75	1059	[3] 58	[3] 42	71930	22.8	68	336
Germany				315	77	23	42850	92.0	136	676
Japan				973	11	89	45350	8.3	47	178
Netherlands	30	70	30	95	83	17	19060	113.5	201	566
Norway	138	94	6	139	94	6	[4] 6000	13.8	[2] 46	[2] 301
United Kingdom	541			740				19.1		
United States[5,6]				640	13	87		39.8		

1. Million litres per plant.
2. Estimate.
3. 1985.
4. Cooperatives only.
5. 1988.
6. Fluid milk factories only.

Source: OECD questionnaire.

Table A5.2.2: Structural Changes in the Processing Sector, 1970-1990

Country	Percentage change in number of organisations				Percentage change in number of plants				Percentage change in			
	Total		of which: Cooperatives		Total		of which: Cooperatives		Number of employees		Size of plant[1]	
	1970-80	1980-90	1970-80	1980-90	1970-80	1980-90	1970-80	1980-90	1970-80	1980-90	1970-80	1980-90
Australia		- 44		- 45		- 30		- 23				+64
Austria					- 36	- 10	- 38	- 8	- 17	- 13	+70	+11
Belgium						+18						- 17
Canada					- 48	- 21			+0	[2] +3	+93	+27
Denmark						- 75		- 82		[2] -14		+263
Finland						- 37		- 40		- 27		+40
France	[3] - 8	- 16	[3] - 14	- 32	[3] - 11	- 39			[3] - 5	- 18	[3] +27	+61
Germany					[4]- 51	[5]- 50	[4]- 54	[5]- 49	[4]- 13	[5]- 9	[4] +188	[5]+97
Japan					[6] - 16	- 16	- 15	- 24	- 14	- 11	[6] +58	+52
Netherlands	- 57	- 47	- 54	- 53	- 47	- 38	- 40	- 39	- 12	- 14	+180	+52
Norway	- 25	- 27	- 26	- 27	- 25	- 26	- 26	- 27	[7] +35	[7] - 16	+58	+38
Sweden					- 43	[8] - 24					+140	+36
United Kingdom		[9] - 13				[9] - 11						[9]- 3

1. Average plant size, measured in million litres per plant.
2. 1980-1985.
3. 1977-1980.
4. 1970-1979.
5. 1979-1991.
6. 1973-1980.
7. Cooperatives only.
8. 1980-1989.
9. 1982-1990.

Source: OECD questionnaire.

Table A5.3.1: Size Distribution of Processing Plants, 1970-1991

Country/Year	Percentage of plants with annual throughput (million litres) of									Total
Austria		**< 5**	**< 10**	**< 20**	**< 30**	**< 60**	**> 60**			
1971		62	69	87	93	99	1			298
1984		45	57	70	84	98	2			203
1991		42	58	71	82	98	2			182
Denmark		**< 5**	**< 10**		**< 50**	**< 100**	**> 100**	**> 150**		
1979		23	59		94			2		238
1988		23			91	91	9			65
France	**< 1**	**< 5**	**< 10**		**< 50**	**< 100**		**> 200**		
1976	38	74	82		94	97		1		1762
1985	27	65	73		90	95		1		1424
1991	22	60	69		86	93		2		1003
Germany		**< 5**	**< 10**	**< 20**	**< 50**	**< 100**	**< 200**		**> 300**	
1970		37	59	78	93	97	99		0	1274
1979		16	29	49	76	91	98		1	780
1991		13	19	28	54	75	93		3	412
Greece	**< 1**	**< 5**	**< 10**	**> 10**						
1982	88	97	98	2						1138
1985	91	98	99	1						985

Table A5.3.1 (continued): Size Distribution of Processing Plants, 1970-1991

Country/Year	Percentage of plants with annual throughput (million litres) of									Total
Japan	**< 0.73**	**< 3.65**	**< 7.3**	**< 14.6**	**> 14.6**					
1970	73	85	91	95	5					1714
1980	57	74	81	91	9					1118
1991	50	68	77	84	16					918
Norway	**< 1**	**< 5**	**< 10**	**< 25**	**< 50**	**> 75**				
1970	5	55	83	95	99	..				225
1980	2	37	66	92	99	0				166
1992	0	10	33	81	96	2				108
Portugal	**< 0.5**	**< 1**			**< 50**		**> 100**			
1985	68	96			98		2			103
1990	60	93			97		3			103
Sweden		**< 5**	**< 10**	**< 20**	**< 40**	**> 40**				
1970		27	49	74	92	8				174
Sweden			**< 10**	**< 30**	**< 50**	**< 100**	**< 150**	**> 200**		
1980			24	60	76	95	100	0		99
1989			19	47	69	91	96	1		75

Source: OECD questionnaire.

Table A5.3.2: Distribution of Milk Processed by Size of Processing Plant, 1960-1991

Country/Year	Percentage of milk processed in plants with annual throughput (million litres) of								
Germany		**< 5**	**< 10**	**< 20**	**< 50**	**< 100**	**< 200**		**> 300**
1960		24	49	72					
1970		6	16	33	61	78	91		0
1979		1	3	12	34	61	86		7
1991		..	1	3	15	36	70		18
United Kingdom[1]	**< 1**	**< 5**	**< 10**	**< 25**	**< 50**	**< 100**	**> 100**	**> 200**	
1982	1	3	6	12	33	55		12	
1991		3		9	25	46	54		
France	**< 1**	**< 5**	**< 10**		**< 50**	**< 100**		**> 200**	
1991	0.5	4	7		26	49		21	
	Percentage of suppliers delivering milk to processing plants with annual throughput (mn litres) of								
	< 1	**< 5**	**< 10**		**< 50**	**< 100**		**> 200**	
1991	0.9	6	9		30	53		18	

1. Size classes defined in terms of thousand tonnes of milk delivered.

Source: OECD questionnaire.

Table A5.3.3: Distribution of Fluid Milk Plants in the United States by Size and Type, 1988

Plant size Throughput in million litres milk/year	Number of establishments									
	Firms				Cooperatives			Total in size group	Size group as % of all plants	% Change 1980-88 (excluding California)
	National	Regional	Local multi-unit	Local single unit	Regional	Local multi-unit	Local single unit			
<6	3	1	2	149	1	1	4	161	25	- 60
6-30	21	1	11	104	7	15	8	167	26	- 46
30-60	37	13	10	49	15	7	1	135	21	- 20
60-120	30	14	11	49	14	7	2	127	20	{ - 9
> 120	11	11	10	14	2	2	0	50	8	{
Type of plant as percentage of total	16	6	7	58	6	5	2	100		- 41[2]
Total number	102	40	44	368	39	32	15	640		- 440[1]
Market share %	22.5	12.5	50.2		14.8					

1. Number of plants closed down.
2. Percentage of plants closed down 1980-88 (except California).

Source: Lough (1991)