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AGRICULTURAL ADJUSTMENT UNIT · UNIVERSITY OF NEWCASTLE UPON TYNE

Economic Aspects of the Dairy Manufacturing Industry

A Workshop Report

12

THE AGRICULTURAL ADJUSTMENT UNIT

THE UNIVERSITY OF NEWCASTLE UPON TYNE

In recent years the forces of change have been reshaping the whole economy and, in the process, the economic framework of our society has been subject to pressures from which the agricultural sector of the economy is not insulated. The rate of technical advance and innovation in agriculture has increased, generating inescapable economic forces. The organisation of production and marketing, as well as the social structure, come inevitably under stress.

In February 1966 the Agricultural Adjustment Unit was established within the Department of Agricultural Economics at the University of Newcastle upon Tyne. This was facilitated by a grant from the W. K. Kellogg Foundation at Battle Creek, Michigan, U.S.A. The purpose of the Unit is to collect and disseminate information concerning the changing role of agriculture in the British and Irish economies, in the belief that a better understanding of the problems and processes of change can lead to a smoother, less painful and more efficient adaptation to new conditions.

Publications

To achieve its major aim of disseminating information the Unit will be publishing a series of pamphlets, bulletins and books covering various aspects of agricultural adjustment. These publications will arise in a number of ways. They may report on special studies carried out by individuals; they may be the result of joint studies; they may be the reproduction of papers prepared in a particular context, but thought to be of more general interest.

The Unit would welcome comments on its publications and suggestions for future work. The Unit would also welcome approaches from other organisations and groups interested in the subject of agricultural adjustment. All such enquiries should be addressed to the Director of the Unit.

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ECONOMIC ASPECTS
OF THE
DAIRY MANUFACTURING
INDUSTRY

A WORKSHOP REPORT

Bulletin No. 12

AGRICULTURAL ADJUSTMENT UNIT
UNIVERSITY OF NEWCASTLE UPON TYNE

1970

PREFACE

Milk production is an important part of agriculture in both the U.K. and the Republic of Ireland. In both cases it represents a large proportion of the output of agriculture and it is also of special significance on farms with small acreages but, with increasing pressure of supplies on the world market for dairy products, the outlook for dairying presents special difficulties. Under the U.K. system, where production has been increasing, realisation prices for milk used in manufacture carry increasing weight in determining the actual prices paid to the milk producer. In the case of the Republic of Ireland where milk for manufacture is the main outlet of the industry, there is direct exposure to the fluctuations and hazards of international markets. The current situation in the dairy manufacturing industry and government policy towards it, have, therefore, important consequences for many farmers. In the long-term process of agricultural adjustment the resolution of some of the problems becomes a key issue.

In recognition of this central role of dairying the Agricultural Adjustment Unit convened a Study Workshop to examine and collate information on the development of dairy manufacturing. A Workshop comprises a number of specialists who are concerned with the area of study and on this occasion it brought together experts from the dairy manufacturing industry, Milk Marketing Boards, the universities and government services.

The report is the joint product of members of this group and therefore does not attribute individual authorship. The fact that it is a team effort does not imply that individual members of the workshop have no personal reservations about some of the points contained in it. Needless to say the views expressed in this bulletin do not necessarily reflect the views of the organisations from which members of the workshop are drawn. Membership of the workshop is given overleaf.

Members of the Workshop

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The workshop was an interesting co-operative attempt to achieve an understanding of the present situation and a consensus of opinion regarding the interpretation of this situation. It is hoped that the report which follows will contribute to the continuing discussion of future policies at all levels of agriculture and food industries and among those concerned with the formulation of future policies.

The Agricultural Adjustment Unit is most grateful to the participants in the workshop for their help and co-operation, and to the organisations in the industry which provided information.

JOHN ASHTON

March 1970

**ECONOMIC ASPECTS OF THE
DAIRY MANUFACTURING INDUSTRY**

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INTRODUCTION

In this bulletin the present situation in the dairy industries of the United Kingdom and the Republic of Ireland is reviewed, projections of recent trends are examined and some possible future policies are suggested. All these factors are considered with particular reference to the manufacturing sector of the industry. An attempt has been made to consider this sector as a whole, relating production on the farm and product manufacturing to one another and to the market situation. It was felt that too often solutions for problems on one side of the industry are proposed without consideration of the effect on the other side, or without reference to the market possibilities, and that it would therefore be valuable to try and provide an overall perspective. The aim is not to advocate any particular set of policies or solutions, but rather to give a reasonably detailed picture of how the industry operates at present and the direction in which current developments are leading. This leads to analysis of some of the problems and opportunities facing the industry and comment on how farmers might be affected by various policies that are being, or might be, considered.

In order to understand the present situation of the industry it is necessary to know a little of the historical background, particularly in terms of government policies. In the immediate post-war years governments were concerned with raising output, restoring standards of nutrition and conserving foreign exchange. Fair allocation of limited supplies was assured through retail price control and rationing of consumers. Milk production received priority and producer prices were maintained at appropriate levels to give an incentive to higher production. Farmers responded and total milk production rose steadily so that, in 1951, it was stated in the Annual Review White Paper,

‘At present levels of production there is a seasonal glut of milk . . . in the spring and early summer when there is a risk that more will be produced than the public will buy at prices which . . . enable the farmer to be paid a reasonable guaranteed price.’

‘. . . there should be a damping down of the present rate of expansion.’

In the following years there was increasing preoccupation with the relative unprofitability of milk used in manufacturing and the 1954 White Paper drew attention to the

‘. . . growing difficulty in finding enough remunerative outlets for substantial supplies of milk above liquid requirements, . . . The increase in yield per cow should therefore be accompanied by a reduction in the dairy herd, so as to stabilise sales off farms somewhat below the present level. Unless this is done the amount of milk which will have to be sold for manufacturing purposes will become unmanageable and the Exchequer subsidy, which is already heavy, will

increase still further. Any later expansion must depend on whether the market for liquid milk can be expanded.'

In 1954 the Ministry of Food ceased its trading activities and marketing powers were restored to the Milk Marketing Boards in Great Britain with corresponding arrangements for Northern Ireland being operated through the Ministry of Agriculture. Prices and margins for liquid milk remained under government control and sales of milk for manufacturing became subject to negotiation between the Boards and buyers.

In the same year the price guarantee to producers was related to a 'standard quantity' of milk and a profit-and-loss sharing arrangement was introduced for milk manufactured into dairy products.

The guaranteed price for milk was reduced by one penny per gallon. The White Paper stated,

'This will make a small reduction in the profitability of milk production and it is expected that in consequence some producers will reduce their marginal production in favour of some alternative product, e.g. store raising or beef fattening.'

In 1955 the Milk Marketing Board for Northern Ireland was set up and took over marketing powers for milk from the Ministry of Agriculture.

Milk production increased rapidly but with no parallel increase in liquid consumption and the 1957 White Paper drew attention to the fact that,

'Supplies for manufacture, produced at considerable expense in imported feed, now threaten to exceed the available manufacturing capacity at peak period, while abundant supplies of milk products are available from Commonwealth countries which are particularly suited to the production of those commodities. Some reduction in output is therefore needed in the national interest and this must be sought by a reduction of profitability.'

During the latter part of the 1950's and the early 1960's, the Government remained concerned that the rise in milk production in the United Kingdom was outstripping the increase in liquid consumption and continually pointed out that the effect was to reduce the average price per gallon received by producers. However, the net cash value to producers in the United Kingdom for sales of milk off farms did increase over the period, from £313 million in 1955-56 to £375 million in 1964-65. Although the pressure on prices forced many of the smaller producers to give up milk production the effect on those that remained was to stimulate them to increase herd size and stocking rates so as to maintain incomes. Dairy manufacturing did increase, although still looked upon by the Government as a necessary evil, for dealing with seasonal surpluses. Indeed, overseas suppliers were given assurances that the Government did not wish home manufacture to be increased to the detriment of the volume of imports from traditional suppliers.

In 1961 the Annual Review White Paper recorded that,

'Milk production has for some time now been increasing at a faster rate than has the consumption of liquid milk, and as a direct consequence of this the pool price paid to farmers has been falling.'

'The need is to devise some modification of the pooling arrangements under the milk marketing schemes, which have the effect of obscuring from producers the consequences of producing more than can be sold profitably. In other words, the principles implicit in the national standard quantity for milk must be applied to the payments to individual producers.'

The Farmers unions with the help of the Milk Marketing Boards and the Agricultural Departments, agreed to examine means of achieving this object but no satisfactory system was evolved.

Since the middle sixties, some change in Government attitude has become apparent, mainly in connection with their desire for expanded home beef production. Since the dairy herd is a main source for beef, it was recognised that if beef production was to increase milk production would also have to increase. For instance, the 1966 Review White Paper stated:

'The Government . . . recognise that if the dairy herd is expanded to meet the need for increased beef production, and the increased milk production due to this expansion of the herd has to be sold for purposes other than liquid consumption, this could result in a dilution of the pool price and they give an assurance that they will take these facts into account in the determinations on milk at future Reviews within the period of the present Plan.'

' . . . an increase in beef production will . . . entail an increase in milk production which, after meeting our requirements of liquid milk and fresh cream, will supply a substantial part of the additional demand for milk products.'

Again, in 1967, the Review White Paper said:

'The Government consider that . . . there must be more dairy cows in order to ensure an adequate supply of calves for beef rearing.'

The Government has not yet become committed to encouraging an increase of milk production except in this context of expansion for beef, but in recent years there have been signs of a change of thinking in official circles. Balance of payment difficulties have led to some support for the view, expressed by the Agricultural 'Little Neddy' in 1968 and endorsed by the House of Commons Select Committee on Agriculture, that home production should be expanded to save imports. This view, if accepted, would translate milk manufacturing into a 'respectable' industry in its own right, rather than serving a purely subsidiary role to the liquid market.

The situation of the home dairy industry must, however, be viewed against an international backcloth of expansion in milk production in most of the main

dairying areas, and particularly in the E.E.C. countries. This expansion has placed great strain on the world dairy product markets, of which the United Kingdom is the most important. With the exception of New Zealand, the policy of most countries has been to support agricultural production and this has sometimes meant subsidising exports, which has distorted patterns of trade.

The major trade policy decisions of importance to the dairy industry over the years have been the quota system for butter imports and the agreement for restraint on cheese imports. Imports of butter have been subject to licensing control since April 1962 with individual country quotas announced before the beginning of each year. Near-butters have been subject to quota control of imports since 1968. The governments of New Zealand, Australia and the Republic of Ireland agreed in March 1969 to co-operate in a scheme of voluntary restraint in deliveries of cheddar-type cheese to the U.K. market. Canada, Holland, France, Denmark and South Africa later agreed to the scheme. These two schemes for import regulation have brought a degree of stability to the U.K. market for butter and cheese but prices for dairy products generally remain low.

In the Republic of Ireland, the official policies with regard to milk production and processing have been expressed in the documents relating to the three Economic Programmes which have been published. In the detailed study undertaken in 1958 of Economic Development, on which the First Programme of Economic Expansion was largely based, the essential factors in the dairy situation were set out as:

- (i) Most of the additional milk output in recent years has been manufactured into creamery butter. The number of cows on farms supplying milk to creameries, and the number of creamery milk suppliers, have increased in recent years. As home consumption of butter has fallen recently (though still well above pre-war levels), the increasing output must be disposed of in export markets. At present, and for some time at least, this can be done only at a loss by comparison with the home market return. The loss is so great—on exports of the 1957–58 season's production it is estimated at £2.5 million—that the rest of the economy would suffer if it had indefinitely to bear, either in higher taxes or prices, a subsidy of this magnitude.
- (ii) The principle to be aimed at in the disposal of milk is that production above home requirements should be disposed of, in whatever form, at the best price obtainable on the export market without State subsidy. Since our competitors in the British market now subsidise their dairying exports to a greater or lesser degree, this ideal may not be attainable in the immediate future but the subsidy must be kept to a minimum and should be used to the best advantage, which is not necessarily to subsidise butter exports.

- (iii) State assistance should be arranged so as to leave creameries an incentive to find the most economic outlets for surplus milk and to leave suppliers an economic choice between delivering their milk to creameries or using it themselves to rear calves.
- (iv) With this in view, it has been decided that, while the Exchequer will bear in full the losses on the export of creamery butter produced in the 1957-58 season, the State subsidy in respect of exports of butter produced in the 1958-59 season will be limited to two-thirds of such losses. The remainder will be contributed by the dairying industry—by means of a levy on butter production.

Producers now face the reality that butter exports do not realise the prices which home consumers are compelled to pay and it is to be hoped that they will take an active interest in ensuring that the gap is narrowed, as far as possible, by efficient marketing of milk abroad in the most economic forms.'

Some of these factors were further developed in the Second Programme for Economic Expansion 1963.

'The existing trends of supply and demand in the main export markets do not give much hope of a lessening of marketing difficulties in the years ahead. Though occasional shortages may from time to time relieve the pressure of supplies, there appears to be no definite prospect of a substantial and long-term improvement in the international market for dairy products. It is possible that the growing concern with the problem of malnutrition and hunger in some of the developing countries may lead to more ambitious schemes than are at present in operation for the supply of dairy products to these countries, thus relieving some of the supply pressure on world markets. As, however, these schemes have up to the present utilised skim milk powder mainly, it is likely that the problem of disposal of butterfat would remain.

There is an obvious need to raise efficiency in milk production and in the manufacture of dairy products to the highest possible level and to develop product, trade and marketing policies to take the best advantage of the export outlets available. The urgency will remain even if export market conditions in the years ahead should prove to be no worse than those prevailing in recent years. The Irish Republic has certain basic advantages in dairying as climate, soil and other relevant factors are suitable for developing highly competitive milk production based mainly on grass. Other countries of North Western Europe use more purchased foods and root and other crops for feeding milch cows and consequently their milk production costs as well as their milk prices are generally higher than ours. In comparing prices and production costs of milk, account must also be taken of market outlets. Countries which are able to use a large proportion of their production in the more profitable domestic

liquid milk trade, and which depend to a less extent than this country on outside markets for disposal of dairy products, can pay their farmers a relatively high price for milk without incurring correspondingly high subsidy charges since the major part of the cost involved can be passed directly to the consumer.'

The problems facing the dairy industry in the Republic were set out in the most recent Programme for Economic and Social Development 1969-72.

'World markets for dairy produce are seriously depressed at present. One of the factors influencing this situation has been the huge increase in milk production in the European Economic Community, which has resulted in a very substantial surplus of dairy products in the Community with consequential pressure on international dairy markets. The lack of remunerative markets for dairy products in developed countries and the fact that developing countries are unable to finance large scale purchases of such products do not present an encouraging outlook for exporters of dairy produce. Also, international efforts to deal with the dairy products market situation have so far been quite unsuccessful. Any benefits that may accrue from more orderly organisation of world markets, from liquidation of existing world surpluses and from increasing prosperity in the less developed countries are long-term prospects. Marketing difficulties for dairy produce are likely to continue and the necessity for substantial Exchequer support for exports will persist.

The Government are concerned at the steady and sharp increase in the cost of milk support and with the open-ended nature of the present system of support. It seems likely that the quantity of milk available for processing will continue to exceed the gallonage that can be disposed of annually on home, U.K. and foreign markets at subsidy levels that are regarded as tolerable. The disposal of the extra milk imposes a very considerable burden on the Exchequer without a commensurate increase in the income of the farmer; unless improved access to, and returns from, export markets can be secured, this burden will increase.

While full regard must be had to the inter-relationship between milk and beef production and the need to preserve the viability of the traditional dairy farmer, Government policy must take into account that the Exchequer resources which can be made available for agricultural support are not unlimited and that an unduly high proportion of the total should not be devoted to milk at the expense of other economic and profitable branches of agricultural activity. In examining the scope for moderating the rate of increase in State support for milk, consideration will be given to the possibility of extending the phased system of price support so as to channel a larger share of State support to the traditional supplier who is less well able to meet increasing costs than the large scale commercial producer.'

The foregoing brief review highlights the rapidly changing environment within which milk producers and manufacturers have been operating in recent years both at home and to a certain extent abroad. Further changes are imminent, and therefore this is an opportune time to examine the demand for milk and dairy produce, the production and manufacturing sectors of the industry and possible future courses of action.

I. THE MARKET FOR MILK AND DAIRY PRODUCTS

This section deals with the size and changing structure of the milk market in the United Kingdom and the Republic of Ireland.* It also examines factors inducing change, with a view to assessing the pace and direction of future developments, particularly the possible decline or growth in the demand for individual milk products.

Size of the Market and Domestic Share

In the United Kingdom, producers currently receive about £460 million per annum for milk and a further £20 million for farm dairy produce. Total consumer expenditure on milk and dairy products amounts to £900 million per annum, and imported dairy produce accounts for £250 million of this total. These products account for over 16 per cent of total consumer expenditure on food.

The liquid milk market is of the utmost importance to dairy farmers because it accounts for two thirds of domestic production in volume and considerably more in value. Within the total market for all milk and dairy products (domestic and imported), it only accounts for one-third by volume, and this proportion has remained almost unchanged for several years. The position is quite different in the Republic of Ireland where some four-fifths of all milk produced is manufactured and butter manufacture takes up the major share of total supplies.

The position in the milk market is set out in Table I.1 for 1968.

When total supplies in the United Kingdom are being considered then it is clear that the dairy products sector absorbs far and away the greater amount of milk. Within this sector, the contribution of domestic supplies varies widely from one product to another. They supply the major part of the relatively small but growing markets for cream and other products, and about one-tenth and two-fifths respectively of the larger markets for butter and cheese. In terms of milk equivalent, imports have, on average, accounted for about three-quarters of all manufactured products from 1961 to 1967. The United Kingdom imports about 30 per cent of all dairy products entering world markets.

In the Republic of Ireland the total market has been overwhelmingly dominated by the liquid milk and butter manufacture markets. In 1968, the home market for liquid milk and butter absorbed over 330 million gallons and cheese just over 15 million gallons, while other dairy products (such as cream, condensed milk, dried milk, chocolate crumb) absorbed slightly less. Since the consumption of liquid milk and butter per person is high by international standards the Republic

* It should be borne in mind throughout that statistics on milk production and utilisation in the Republic are not available on a comparable basis to those for the United Kingdom and this makes comparisons difficult.

has very little scope for increasing such sales at home, and has to rely on exports for expansion, but more could possibly be done to increase sales of cream and cheese.

TABLE I.1
DOMESTIC AND IMPORTED SUPPLIES OF MILK AND DAIRY
PRODUCTS, 1968
(milk equivalent—million gallons)

<i>Item</i>	<i>United Kingdom</i>				<i>Republic of Ireland</i>
	<i>Total Supply</i>	<i>Home Production</i>	<i>Net Imports</i>	<i>Home Production as per cent of Total Supplies</i>	<i>Home Production</i>
Liquid milk	1,654	1,654	—	100	133
Butter	2,545	265	2,280	10	399*
Cheese	690	273	417	40	62
Condensed milk	75	88	-13	118	†
Chocolate crumb	68	48	20	70	35
Milk powder	64	48	16	75	22
Cream: Fresh	151	145	6	96	13
Sterilised	32	20	12	62	—
Others	24	24	—	100	8
Total	5,303	2,565	2,738	48	672

* Including Farmers' butter.

† Included with others.

Source: (1) Dairy Facts and Figures, 1969. Federation of U.K. Milk Marketing Boards.

(2) Central Statistics Office, Dublin.

Consumer Demand

Average consumption of milk and dairy products per person is shown in Table I.2.

In the United Kingdom, consumption of liquid milk per head shows a marked increase since pre-war, rising to a peak in the 1950's but levelling off to a lower but fairly stable level in the early 60's. There has been a further slight decline in the

late 60's. In interpreting these data, many factors must be taken into account. For instance, lower pre-war incomes made for lower liquid consumption but a level may now have been reached where further increases in income will not induce much more consumption. Again, food rationing probably boosted milk sales when alternative foods were in short supply. Furthermore, the impact of

TABLE I.2
ESTIMATED CONSUMPTION PER HEAD OF DAIRY PRODUCTS
(lb per annum)

Item	United Kingdom						
	Pre-war	1955	1961	1963	1965	1967	1968
Liquid milk	217.1	332.6	324.1	325.9	325.2	322.4	320.1
Butter	24.7	14.6	19.7	19.3	19.5	20.5	19.7
Cheese	8.8	9.0	10.2	10.3	10.1	10.7	11.0
Evaporated and Condensed milk	13.1	6.3	7.8	7.6	7.7	8.3	8.3
Milk powder	1.4	3.1	3.9	4.4	4.1	4.0	3.9
Cream (40 per cent fat content)	1.5	0.7	1.7	2.2	2.3	2.7	2.8
Other products	1.1	n.a.	14.9	14.8	15.3	17.2	17.5
Margarine	8.7	15.2	13.3	13.5	12.0	11.7	11.3
<i>Republic of Ireland*</i>							
Liquid milk	324.2	431.4	473.8	471.8	477.9	473.8	471.6
Butter	32.1	38.6	35.1	35.1	33.5	29.9	29.9
Cheese	0.8	2.1	3.0	3.5	3.9	4.4	4.7
Margarine	2.5	4.9	6.7	6.9	7.2	8.0	8.4

* Estimates for the Republic are not directly comparable with those for the United Kingdom.

Source: (1) Dairy Facts and Figures, 1969, Federation of U.K. Milk Marketing Boards.

(2) Central Statistics Office, Dublin.

advertising, price changes, the cut back in the school milk scheme and the reduction of welfare milk allowances must all have influenced consumption. There is also some evidence that the fairly stable levels of consumption may conceal two opposing trends—an increase in household consumption and a decrease in catering use.

Skim powder sales are replacing some liquid milk sales and they are now estimated to be equivalent to 60–100 million gallons per annum, about 4 to 6 per cent of the liquid market. It is likely that substitutes have only eroded liquid sales by 2 or 3 per cent, the rest of the sales having replaced condensed and evaporated milk. The major users of skim powder are the institutional caterers such as hospitals and local education authorities and they are able to make savings of as much as 3s. 6d. per gallon by using this product. The scope for further substitution in this field is limited by the comparatively small size of this institutional market. It should be stressed that skim milk powder cannot be regarded as an adequate substitute for whole milk but it has a part to play in the catering trade.

The level of butter consumption has been fairly stable in the 60's but is well below the pre-war level—this decrease has been matched by increased margarine sales. Both cream and cheese consumption are increasing, being now well above the pre-war levels, and this may be due to higher incomes. The use of fresh cream in the confectionery trade has accounted for a substantial part of the increased demand for this product and, over the last three years, the overall demand has increased by the equivalent of 10 million gallons of milk each year but this is not expected to continue at this rate. Evaporated and condensed milk consumption levels are well down on pre-war. Milk powder however shows an upward trend, only about a quarter being full cream powder.

The greatest relative increase in consumption of dairy products is in 'other' products, but this category still only accounts for a small proportion of the total market for home-produced milk. Chocolate crumb* is the main product, but new items such as U.H.T. desserts and ready-made custards are gaining in popularity. There is a growing market for yogurt in Britain—most of it being produced from skim milk.

Comparison of the United Kingdom data with consumption levels in the Republic of Ireland shows that for both liquid milk and butter, consumption levels per head in recent years have been higher, while those of cheese have been lower, in the Republic. There is however a downward trend in butter consumption and an upward trend for cheese, which is gradually bringing consumption levels closer to those in the United Kingdom. Margarine consumption per head is still well below that recorded in the United Kingdom.

The levels of consumption of different products are of extreme importance in the United Kingdom because of the varying prices realised for milk in different use. Table I.3 shows the average prices realised in the 60's. Liquid milk realised a very much higher price than milk used for all other products with butter having the lowest return per gallon.

* Partially evaporated milk mixed with chocolate and sugar.

It is noticeable that during the 60's prices for liquid milk have been increasing, and those for all other products, apart from butter, have been fairly static. The average prices realised for milk manufactured into butter have fallen recently and in 1968-69 only averaged 13.45 pence per gallon.

TABLE I.3
AVERAGE PRICES REALISED FOR MILK IN DIFFERENT USES
(U.K. Milk Marketing Boards)

<i>Year ending March</i>	1961-62	1963-64	1965-66	1967-68	1968-69
<i>Milk used for</i>	<i>pence per gallon of milk</i>				
Liquid consumption	42.10	42.71	47.43	50.35	52.50
Butter	11.45	16.43	18.31	16.83	13.45
Cheese	19.39	20.68	22.33	22.92	22.78
Condensed milk	21.54	21.03	22.10	22.45	23.42
Chocolate crumb	22.57	22.03	23.12	22.88	22.49
Milk powder	22.18	21.40	22.38	22.33	21.75
Cream: Fresh	} 24.09	25.07	26.85	27.33	27.34
Sterilised		19.60	21.87	22.41	22.37
Other products	24.57	25.16	26.00	25.92	26.02

Source: Dairy Facts and Figures, 1969. Federation of U.K. Milk Marketing Boards.

The importance of the different products in the total milk market is further emphasised in Table I.4.

TABLE I.4
APPROXIMATE VALUE OF MILK IN VARIOUS USES
REALISED BY UNITED KINGDOM MILK MARKETING BOARDS
(1968-69, April-March year)

<i>Item</i>	<i>£ million</i>	<i>Item</i>	<i>£ million</i>
Liquid milk	380.3	Milk powder	4.5
Butter	15.2	Cream: Fresh	16.6
Cheese	25.9	Sterilised	2.0
Condensed milk	8.7	Other products	2.5
Chocolate crumb	4.6		
		Total	460.3

Source: Derived from Dairy Facts and Figures, 1969. Federation of U.K. Milk Marketing Boards (calculated from gross average prices before deduction of marketing allowances).

Information on food expenditure at the retail level is contained in the reports of the National Food Survey Committee. In 1968, the average weekly household expenditure on food was almost 38s. per person. Expenditure on milk and dairy products amounted to 6s. 3d. of which nearly 1s. 9d. related to imported dairy produce. By comparison, very much more was spent on meat (11s. 5d.), slightly more on fruit and vegetables (6s. 8d.) and almost as much on items such as bread, cake, flour and breakfast foods included in the category of cereals (5s. 4d.).

The home market expenditure per head was almost exactly the same in the Republic—6s. 0d.—but this is a slightly higher proportion because less was spent on food.

Factors Affecting Demand

Consumption is limited by the supply available and the willingness of the consumer to purchase. Changes in consumption are, however, the result of relatively small movements in the levels of existing supply and demand. Attention is concentrated here on the demand side whilst acknowledging that supply in turn is affected by changes in techniques, costs and prices. Changes in total demand are influenced by changes in (a) the size and structure of the population, (b) personal incomes, (c) the prices of the products concerned and of alternatives to those products and (d) consumer tastes.

Since 1951 the population of the United Kingdom has increased by 4 to 5 millions to 54·7 millions in 1966. This is a net result of births and deaths on the one hand, and the flows of immigrants and emigrants, on the other. At their best, population predictions can only be tentative, but short and long-run forecasts indicate a total population of 58 millions in 1975 and 68–72 millions in the year 2000. They show some decrease in the proportion of the population of working age, a temporary increase in the more elderly and a continuing increase in the proportion of children. The proportion of school children in the population will be further increased by the raising of the school leaving age in 1972.

In the Republic the population was declining up to the early 60's but in recent years there has been a clear upward trend. This is expected to bring an increase of about 10 per cent in the total population over the decade 1966–76 (from just under 2·9 millions to 3·1 millions) i.e. a rate of increase somewhat faster than that projected for the United Kingdom. This upward trend is expected in the younger age groups up to 35 years. These changes in the age distribution are not expected to have a marked effect on the demand for milk and dairy products, for the fall in the farm/urban ratio will probably lead to some reduction in the average consumption of these products.

In the United Kingdom, personal incomes, in terms of current money have grown in recent years at around 5 per cent per year, and in real terms, at about

2 per cent per year. Not unnaturally, consumers' expenditure has followed the pattern of growth in incomes. It is worth noting, however, that expenditure on food has increased much less and has been almost stationary in recent years. This is a reflection of the low income elasticity of demand for food—this has declined from 0.5 some 10 years ago to 0.2 in recent years. Since this is measured at the retail level and therefore includes all the quality, service and convenience elements, the increase in the quantity of food demanded, when incomes rise, is very small. The following figures* indicate the estimated percentage change in quantity purchased for each one per cent change in income for certain dairy products in Great Britain in 1967.

Condensed milk	-0.16
Cream	+0.80
Cheese: natural	+0.28
processed	+0.14
Butter	+0.14

In view of these figures, it is not surprising that the proportion of consumers' total expenditure spent on food over the past 10 years has declined from 30 to about 26 per cent in the United Kingdom. This proportion will continue to decline as real incomes increase.

The position in the Republic is shown in Table I.5. This shows that in the 60's,

TABLE I.5

INDICES OF INCOME AND EXPENDITURE, REPUBLIC OF IRELAND
(1963 = 100)

<i>Item</i>	1960	1962	1964	1966	1967
Personal Disposable Income (in current money terms)	82.0	95.1	114.3	126.7	135.9
Average Weekly Earnings	80.8	95.3	110.7	128.7	139.3
Total Consumer Expenditure:					
at current prices	83.0	94.1	111.2	123.5	129.0
at constant prices	90.6	96.4	104.6	107.6	109.2
Total Food Expenditure:					
at current prices	90.8	97.7	110.9	120.7	121.6
at constant prices	96.3	98.9	103.9	106.5	105.7

Source: Derived from National Income and Expenditure, 1967.
Irish Statistical Bulletin, 1967, C.S.O. Dublin.

personal incomes have been increasing at a much faster rate than in the United Kingdom and consequently consumer expenditure has been rising more rapidly.

* From Household Food Consumption and Expenditure, 1967.

Part of the additional expenditure has been on food but it constitutes a smaller proportion than that for other consumer expenditure. In common with the United Kingdom, expenditure on food is at retail prices and includes a considerable element of convenience food.

Demand is also influenced by prices. An indication of the movement in Great Britain of the retail prices of dairy products compared with all food prices is given in Table I.6.

TABLE I.6
PRICE INDICES FOR MILK, DAIRY PRODUCTS AND
ALL FOODS, GREAT BRITAIN
(1963 = 100)

<i>Item</i>	1960	1962	1964	1966	1967
Liquid milk	93.3	98.5	105.1	112.1	115.2
Other milk and cream	104.0	100.0	101.1	102.2	104.5
Cheese	99.7	98.8	105.5	113.1	115.3
Butter	94.6	90.2	103.7	97.4	96.6
All foods	94.1	98.3	102.9	109.9	112.2

Source: Household Food Consumption and Expenditure, 1967.

Liquid milk and cheese prices have kept in line with the index of prices for all foods. Butter prices, however, have tended to stagnate over the period. Estimates of the impact of price on demand vary considerably, but the reports of the National Food Survey Committee indicate the following percentage changes in demand for a one per cent change in the price of each product in 1967:

Condensed milk	-2.36
Cream	-0.68
Cheese: natural	-0.32
processed	-0.84
Butter	-0.19
Liquid milk (1963)	-0.13

The foregoing evidence of the inelastic nature of the demand for the major dairy produce, both with regard to income and price changes, indicates that the expansion in the consumption of milk and dairy products is unlikely to be very different from the rate of growth of population. This general statement would need modification if there were changes in the arrangements for supplying dairy produce at special rates.

Prior to September 1968, the milk-in-schools scheme applied to children of all ages, but since this date it has been restricted to Primary and Special schools. The

withdrawal of this service from Secondary schools has probably resulted in a loss of liquid milk sales of up to 15 million gallons per year. Furthermore, from April 1968 the price of milk under the Welfare Milk Scheme was adjusted from 4 pence to 6 pence per pint. This scheme provides a pint of milk per day at reduced prices for expectant and nursing mothers, children under five and handicapped children from five to sixteen years old and may be provided free for certain eligible cases. Even with the upward adjustment, the prices are still low compared with ordinary commercial prices and it is difficult to estimate the effect of the change. However, some fall in sales is believed to have taken place and the combined effect of the changes in School and Welfare schemes could amount to about 30 million gallons in a full year.

Changes in prices, population and incomes can be measured but consumer tastes cannot. It is important, however, to be aware of specific consumer preference for or resistance to certain products, e.g. the demand for a 'sharp' Cheddar cheese—an acid product unsuitable for maturing—by smokers in public houses, and the absence of demand for homogenised milk when distributors sought to introduce it.

American experience is not necessarily indicative of what will occur in the United Kingdom. Indeed, the lack of refrigeration and of car-parking facilities adjacent to supermarkets often discourage the adoption of American shopping methods, particularly in the sale of liquid milk. In Britain, the dairy industry strongly believes that daily delivery contributes to the maintenance of demand for liquid milk. These factors must be borne in mind and possible reactions to innovations must be carefully assessed. In the long run, both technology and economic factors will change the present pattern of the dairy industry.

Prospective Demand for Products

If there were no influence of substitutes, if welfare provisions and food prices remained unchanged, if the effectiveness of advertising and sales promotion did not alter, and if population grew as predicted and real incomes per head increased by 2 per cent per annum, then liquid milk consumption in 1975 would be between 1,785 and 1,825 million gallons. It may be that the greatest upset to these estimates will be caused by substitutes, particularly powdered milk, since this product obviates so many problems such as weight, bulk and storage. Skim milk powder is already widely used in catering because of its convenience and, with increased use of vending machines, sales are likely to expand still further. Such developments will carry price implications for farmers. In the past, milk and cream have enjoyed a natural protection from overseas competition but this may not continue unchanged. Therefore, there is some doubt as to whether milk consumption will reach the level estimated above for 1975. A decline in liquid consumption cannot then be ruled out but the likeliest forecast is an increase of about 150 million gallons.

If the same assumptions are made for butter, that population and income growth are the only factors at work, then there is the possibility that about 40,000 tons more will be needed by 1975 to satisfy the increased market demand. This would represent over 200 million gallons of milk. If this extra quantity was supplied from domestic sources it would require a doubling of the average gallonage utilised for butter production in the United Kingdom in recent years. Two factors are likely to cast doubt upon this level of growth. Firstly, the effect of rising incomes may lead to a fall in consumption of bread, and a restriction on the intake of fats. Secondly, changes in agricultural policy and possible association with the European Economic Community would undoubtedly affect the price of butter. An increase of 25 per cent in the butter price by 1975 would probably eliminate all the prospective growth in consumption.

Expansion in the market for cheese in response to rising population and average incomes per head seems unlikely to require more than the equivalent of about 25 million gallons of extra milk by 1975. While cheese consumption per head is lower in the United Kingdom than in some European countries, it has to be recognised that in such countries there often are different dietary habits (as in Italy and the Netherlands) and a greater variety of cheeses (as in France and Italy). If British dietary habits changed or varieties of good cheeses increased, then consumption in the United Kingdom might rise from its present average level of about three ounces per person per week. Furthermore, if meat became relatively more expensive, this again might result in greater cheese consumption.

With regard to cream consumption, if the household market responded to rising incomes and population, then rather more than 20 million additional gallons of milk would be required for cream by 1975. A further 10 million gallons would be needed if the whole cream market responded similarly. These estimates fall short of the increases achieved in the late 60's.

A simple summation of the possible demands for milk and dairy products in 1975 indicates an additional requirement of around 400 million gallons, although some doubt has been expressed about the estimates for the liquid milk and butter markets. It does seem, however, that the manufacturing market may expand by about 250 million gallons in total by 1975. If domestic supplies were used to satisfy this additional demand it would represent an increase of about 27 per cent. If, in addition, domestic supplies replaced some imports, then the pressure on our manufacturing capacity would be considerable.

In the Republic, the growth in the home market is likely to be small. At the moment, the decline in butter consumption is greater than the increased consumption of all other dairy products and the growth in population is hardly sufficient to compensate for the discrepancy. This means that all additional milk output, and possibly more, will have to be sold abroad and it is unlikely that this position will change significantly in the foreseeable future.

Exports and Imports

Preserved milks—mainly condensed or dried—are the only exports of commercial significance to the United Kingdom dairy industry. Whilst no great changes may occur in the immediate future, it must be expected that the world demand for dairy products will grow substantially (even if it falls short of the 60–80 per cent increase over 20 years, projected by F.A.O.). It would be reasonable to expect that some, at least, of the demand from the tropics would be met in the form of preserved milk from temperate areas. Whether Britain would make her contribution in the form of milk products or equipment and technology would depend on the interaction of many varied factors. A massive expansion of food aid has been suggested but there is no immediate likelihood of this happening.

At present, most dairy imports into the United Kingdom are notionally subject to tariffs of up to 15 per cent. However, various measures such as (a) the suspension of duty on butter as long as the quota arrangements operate, (b) the waiving of duty on Commonwealth supplies and (c) the duty-free entry of cream and blue-veined cheese from E.F.T.A. countries, mean that few dairy imports are impeded by tariffs. The Government butter quota arrangements have brought more order into the market but quota reductions early in 1969, in the face of heavy butter stocks and low prices, have restricted imports particularly from non-traditional suppliers. Agreement between the dairy industry representatives of the main countries traditionally supplying Cheddar cheese has stabilised the market through much of the past decade. However, in view of the growth of supplies of Cheddar cheese from other countries, the Government has now initiated a scheme for import restraint which it is hoped can be operated on a 'voluntary' basis.

Any marked change in policy which affected either the quantity or price of dairy products entering the United Kingdom would affect both farmers and manufacturers. Price changes at retail level would also influence the quantities which consumers would buy. Elasticities are believed to be low but there can be no certainty that present estimates would hold if there were large changes in price.

II. THE PRODUCTION OF MILK

In this section, the location of milk production in the United Kingdom and the Republic of Ireland is illustrated on the basis of the present distribution of national dairy herds and the pattern of milk sales from farms. The existing seasonal patterns of milk production are also examined and an effort made to distinguish their impact on production costs. The characteristics of milk production in recent years are noted with regard to area changes, not only in volumes of sales but also in quantities manufactured, and seasonal patterns of production. Finally, an attempt is made to discern trends in herd sizes and breeds in the different countries. The data are examined in the light of their possible effects on future milk supplies.

Present Patterns of Milk Production

England and Wales occupy a dominant position in the production of milk in the countries studied. This feature is brought out in Table II.1, these two countries

TABLE II.1
NUMBERS AND DISTRIBUTION OF DAIRY COWS
UNITED KINGDOM AND REPUBLIC OF IRELAND

Areas	June 1968		June 1969	
	000's	%	000's	%
North	843	26.1	872	26.6
South and East	457	14.2	459	14.1
Midland	396	12.3	400	12.1
South West	665	20.7	678	20.7
Wales	334	10.4	337	10.2
England and Wales	2,695	83.7	2,746	83.7
Scotland	329	10.2	327	9.9
Northern Ireland	201	6.1	205	6.4
United Kingdom	3,225	100.0	3,278	100.0
Republic of Ireland*	1,607	—	1,655	—

* Includes all cows. Cows from creamery milk-selling herds have in recent years been estimated to total some 1,100,000.

together having nearly 84 per cent of the total dairy cow population of the United Kingdom. In view of the fact that production patterns and methods differ widely, England and Wales have been divided into five broad areas by combining certain

Milk Marketing Board regions. The areas are defined below.* The combining of these regions into areas was largely determined by the relative importance of liquid sales as well as by geographical location. The North and South West areas account for the major part of production in England and Wales. The South West and Wales represent the production areas most remote from the main consuming centres. By comparison with England and Wales, the dairy cow populations of Scotland and Northern Ireland are relatively small.

TABLE II.2
ANNUAL SALES OF MILK IN RELATION TO ACREAGE
OF CROPS AND GRASS
UNITED KINGDOM AND REPUBLIC OF IRELAND
(April-March years)

Areas	Sales off Farms				Sales per 100 acres crops and grass	
	1967-68		1968-69		1967-68	1968-69
	m.g.*	%	m.g.	%	gallons	gallons
Northern	675.2	21.4	680.2	21.0	11,321	11,514
South and East	364.9	11.5	368.0	11.4	4,607	4,688
Midland	327.2	10.4	327.7	10.1	7,569	7,644
South Western	523.9	16.6	535.6	16.5	14,291	14,697
Wales	249.9	7.9	251.2	7.8	10,305	10,469
England and Wales	2,141.1	67.8	2,162.7	66.8	8,813	8,978
Scotland	246.0	7.8	249.4	7.7	5,733	5,828
Northern Ireland	143.4	4.5	152.1	4.7	6,948	7,366
United Kingdom	2,530.5	80.1	2,564.2	79.2	8,255	8,365
Republic of Ireland†	629.7	19.9	671.8	20.8	5,328	5,660
Total	3,160.2	100.0	3,236.0	100.0	7,440	7,619

* m.g. = million gallons.

† Includes milk consumed by farm households (calendar years 1967 and 1968).

The distribution of the dairy cow population is only one way of illustrating the location and importance of milk production in different areas. Another method is

* The regions included in the areas are as follows:

North—1 & 2. South and East—3, 8 and 11. Midland—4 & 5.

South West—9 & 10. Wales—6 & 7.

based on milk sold off farms and this, when related to the acreage of crops and grass, also provides some indication of the importance of the milk enterprise in the total farm organisation. Milk consumed in farm households and milk manufactured into farmhouse butter figure more prominently in the Republic than elsewhere because of the small size of farm.

Together, England and Wales are responsible for the major part of sales, accounting for about two-thirds of the total. Within these countries, the South West and North areas as well as Wales exhibit a heavy dependence on dairying, measured in terms of gallons of milk sold per 100 acres of crops and grass. This may reflect an absence of alternative uses for land, a factor which is important in the western parts of Great Britain where rainfall restricts the opportunities for cereal production. Apart from South and East England, the lowest milk production per acre of crops and grass was recorded in the Republic. This position in the Republic is due to low yielding dairy cows, low rates of stocking, the dual purpose nature of dairy herds in the country, and the relatively low rates of feeding with purchased concentrates, rather than a preoccupation with other activities. Even so over 20 per cent of the overall total sales in 1968-69 were recorded in the Republic.

A wealth of information is available on the monthly distribution of milk sales. Without exception, this shows that peak supplies in the areas occur in May and June with sales in March, April and July varying in importance according to location. The flush of grass growth in the early part of the season has profound influence on the level of supplies, although other factors, mainly the pattern of milk prices, are also believed to affect the position. The extent of the variation from the peak production months of May and June to the depths of winter in December and January is brought out in Table II.3. In the South and East, the difference in the two periods is at a minimum and can be explained in part by the low summer rainfall experienced there—a condition ideal for the production of cereals but somewhat hazardous for cheap summer milk production. In this area by-products from arable crops become available in the autumn and enable a greater emphasis on winter milk production. The extent to which economic and natural forces determine the seasonal pattern of production cannot easily be assessed but both the level and seasonal pattern of monthly milk prices are probably important factors. Indeed, the greater emphasis on winter production in England and Wales can be attributed, in part, to the high winter prices and wide differentials between winter and summer prices during war-time and subsequently. The differential has narrowed considerably in recent years but, to date, farmers have been reluctant to return to summer production, possibly because winter production is still more profitable and at the same time provides employment for labour when outside chores are difficult. Also, winter milk production still holds out greater possibilities of profitably expanding farm business size by relying on purchased

feeds, an important consideration for the small farmer. If average prices are low, as in the Republic, little money is available to spend on concentrates and winter production suffers.

TABLE II.3
SEASONAL VARIATION IN MILK SALES OFF FARMS
UNITED KINGDOM AND REPUBLIC OF IRELAND
(April–March years)

<i>Areas</i>	<i>December–January as percentage of May–June sales*</i>	
	<i>1967–68</i>	<i>1968–69</i>
Northern	79.1	81.7
South and East	87.4	83.4
Midland	75.7	75.6
South Western	79.2	74.2
Wales	61.2	59.7
England and Wales	77.7	76.4
Scotland	69.0	68.4
Northern Ireland	56.1	58.3
United Kingdom	75.3	74.4
Republic of Ireland	11.3	14.3

* Based on average daily sales off farms.

The greatest emphasis on summer production occurs in Ireland. Here, a price differential in favour of winter milk production operates in Northern Ireland whereas, in the Republic, this occurs only in the case of producers supplying the liquid milk market, which accounts for only a small portion of the total. The majority of producers in the Republic sell their milk for manufacture and are paid a uniform price throughout the year which is considerably below the average United Kingdom level. It is not surprising, therefore, that the Republic shows an extreme pattern of production with the emphasis on summer milk produced almost entirely from grass. Producers in Northern Ireland, despite the differential in favour of winter production, still have a more pronounced peak in the spring months than England, Wales and Scotland. There may be historical reasons for this or it may well be that Northern Ireland is less well suited to arable farming and thus lacks the cheap by-products for winter feeding.

Cost of production data are available but they need careful interpretation because they are not calculated on a similar basis in all countries. During 1965–66, a random

sample of milk producers was costed in England and Wales and the analyses undertaken provide significant data on the average cost of producing milk. In Table II.4 total production costs and other data are quoted for specified areas and countries. The areas in England and Wales used for this purpose differ from those areas defined previously. These were determined by climate, which is considered to have an impact on the level of costs. (Other factors, such as size of farm and herd, yield per cow and the seasonal pattern of production also influence cost levels.)

The average cost of producing milk in England and Wales in 1965-66 was estimated to be nearly 33 pence per gallon. In this particular year, the lowest costs were recorded in the South West and the highest in Wales. The most important single cost item in most areas was purchased feed, followed by labour. The cheapest milk was produced in the Republic and this is largely a consequence of its minimal dependence on purchased foods and relatively low land costs and rents.

Additional data in Table II.4 explain some of the cost variations. The position for the sample in Wales for instance is attributable in part at least to the small size of herd and the relatively low yields per cow. There may also be soil and climatic conditions which make milk production more costly in some parts. The seasonal pattern in Wales reveals a greater dependence on summer milk than in England and Scotland and yet producers rely quite heavily on concentrate feeding.

In all other areas, apart from Ireland, producers showed a greater reliance on winter milk production, the greatest emphasis being in the East where the cows, on average, each received $27\frac{1}{2}$ cwts. of concentrates. It is noticeable that the lowest cost of production was recorded in the Republic of Ireland where the average return for milk was also lowest at just over 2s. 0d. per gallon. There is a strong indication here that producers, faced with low prices for their milk, concentrate on cheap summer production when maximum use can be made of cheap grass. The increasing quantities and proportions of milk utilised for manufacturing highlight the importance of doing so.

Recent Developments

Table II.5 shows that since the mid 50's annual sales off farms have increased quite markedly, the total for the United Kingdom and the Republic of Ireland together having increased by 27 per cent. Some areas, notably South West England, Northern Ireland and the Republic have recorded increases well in excess of this. Greater proportions of milk sales have been manufactured in all areas. In England and Wales, the proportion utilised for manufacturing increased from 22 per cent to 32 per cent. In 1967-69, 52 per cent of the quantity sold in Wales and 46 per cent in the South Western area were used in manufacturing. In both the Republic and Northern Ireland far more milk went into manufacturing than into the liquid

TABLE II.4

SOME CHARACTERISTICS OF HERDS IN MILK COST INVESTIGATIONS

UNITED KINGDOM AND REPUBLIC OF IRELAND, 1965-66

<i>Areas</i>	<i>Total cost per gallon</i>	<i>Return per gallon</i>	<i>Average Herd Size</i>	<i>Yield per cow</i>	<i>Concentrates per cow</i>	<i>Seasonal pattern†</i>	<i>Forage per cow</i>
	<i>pence</i>	<i>pence</i>	<i>number</i>	<i>gallons</i>	<i>cwts</i>	<i>%</i>	<i>acres</i>
North East	33·07	38·74	22	790	23·7	48	1·82
Midlands and North West	32·36	38·25	35	814	24·5	47	1·54
Central and South	32·75	39·92	39	808	22·7	48	1·91
East	34·36	39·48	37	846	27·5	49	1·71
South West	31·17	38·19	31	821	20·5	47	1·84
Wales	35·96	36·96	18	767	21·0	43	1·98
England and Wales	32·87	38·49	29	809	22·8	47	1·79
S.W. Scotland*	35·88	39·43	58	815	23·5	45	1·64
Northern Ireland*	n.a.‡	34·60	20	798	21·9	43	1·60
Republic of Ireland	17·42	24·11	14	555	n.a.	n.a.	n.a.

* 1966-67 data S.W. Scotland April to March; Northern Ireland October to September.

† Winter gallons as percentage of annual total.

‡ Not available on a comparable basis.

TABLE II.5
CHANGES IN MILK PRODUCTION AND UTILISATION
UNITED KINGDOM AND REPUBLIC OF IRELAND
(April-March years)

<i>Areas</i>	<i>Average annual sales off farms</i>		<i>Increase over period</i>	<i>Milk Manufactured</i>		<i>Seasonal Pattern</i>	
	<i>1954-57</i>	<i>1967-69</i>		<i>1954-57</i>	<i>1967-69</i>	<i>1954-57</i>	<i>1967-69</i>
	<i>million gallons</i>		<i>%</i>	<i>% of Total Sales</i>		<i>Oct.-March as % of total</i>	
North	548	678	24	18	28	49	47
South and East	342	367	7	4	7	50	49
Midland	271	327	21	22	26	48	46
South West	360	530	47	40	46	48	47
Wales	191	250	31	30	52	45	42
England and Wales	1,712	2,152	26	22	32	48	47
Scotland	216	247	15	37	45	44	45
Northern Ireland	100	148	48	64	70	43	41
United Kingdom	2,028	2,547	26	25	35	47	46
Republic of Ireland*	488	651	33	53	76	n.a.	29
Total	2,516	3,198	27	33	43	n.a.	43

* The figures for the Republic are not comparable to the United Kingdom sales off farms. Milk for manufacture in the Republic over the period 1957 to 1968 rose from 290 million to 516 million gallons, an increase of 75 per cent.

market. In spite of the increasing importance of manufacturing milk, changes in the seasonal production patterns have been insignificant.

It was mentioned earlier that the tendency to persist with winter milk production, despite the narrowing of the differential in seasonal prices, might in part be a reflection of the scope which it provides for expanding the size of the business by feeding purchased concentrates—an important consideration for the small farmer anxious to expand his herd on limited acreage. Yet the biggest swing towards summer milk production has occurred in Wales which has the highest proportion of small milk selling herds in the United Kingdom. At the same time the country with the most extreme summer production pattern is the Republic where, in 1960, the vast majority of herds had less than 20 cows.

TABLE II.6
DISTRIBUTION OF MILK SELLING HERDS BY SIZE OF HERD
UNITED KINGDOM

Areas	Herd Size (Cows)					
	1955			1965		
	Under 20	20-49	50 and Over	Under 20	20-49	50 and Over
	% of total			% of total		
North	67.6	28.5	3.9	45.1	45.0	9.9
South and East	58.3	34.7	7.0	32.4	45.0	22.6
Midland	64.1	31.7	4.2	39.1	47.2	13.7
South West	70.4	25.3	4.3	45.1	43.0	11.9
Wales	83.8	15.4	0.8	67.3	29.8	2.9
England and Wales*	69.2	26.9	3.9	46.9	42.0	11.1
Scotland†	25.5	58.7	15.8	13.6	54.8	31.6
Northern Ireland‡				86.2	12.5	1.3

* M.M.B. Production Division's National Dairy Herd Census.

† Data relate to 1952 and 1955 and were obtained by the D.A.F.S.

The 1965 figures were collected during the Board's Dairy Farm Census.

‡ The data for Northern Ireland relate to 1967 not 1965.

Of particular interest is perhaps the tendency shown in Table II.6 for a bigger proportion of herds to have more than 50 cows. Changing production techniques and economic pressure to increase stocking rates are the main reason for this. Indeed, in England and Wales over the 10 year period 1955 to 1965 the proportion

of cows in herds of more than fifty has doubled. Tables II.6 and II.7 show the distribution of milk-selling herds and of cows in herds of different sizes.

Some indication of the change in breeds of cows used for milk production can be gleaned from the data set out in Table II.8. The outstanding feature in England and Wales has been the rapidly declining popularity of Shorthorns, and to some extent of Ayrshires, and the rapid rise in the popularity of Friesians. Even in Scotland, where the native Ayrshire is still the dominant breed, Friesians accounted for nearly 18 per cent of dairy cows in 1965. The trend towards Friesians is also apparent in Ireland. In Northern Ireland, in 1968, 64 per cent of the dairy herd was Friesian. This change of breed is an important factor in the increased yields per cow in the United Kingdom.

TABLE II.7
DISTRIBUTION OF COWS IN MILK SELLING HERDS
UNITED KINGDOM

<i>Areas</i>	<i>Herd Size (Cows)</i>					
	<i>1955</i>			<i>1965</i>		
	<i>Under 20</i>	<i>20-49</i>	<i>50 and Over</i>	<i>Under 20</i>	<i>20-49</i>	<i>50 and Over</i>
	<i>% of total</i>			<i>% of total</i>		
Northern	39.5	45.8	14.7	21.0	52.7	26.3
South and East	28.0	48.4	23.6	26.3	33.1	40.6
Midland	35.9	49.1	15.0	15.9	51.1	33.0
SouthWest	40.8	42.1	17.1	19.6	48.4	32.0
Wales	63.5	32.3	4.2	41.5	47.2	11.2
England and Wales	40.2	44.2	15.6	20.7	48.6	30.7
Scotland				4.3	43.6	52.1
Northern Ireland*				61.7	30.2	8.1

* Data relate to 1967 not 1965.

In summary, the interesting features over the past few years in all areas have been (a) the marked increases in sales of milk from farms in all areas except the South and East, (b) the increasing importance of the proportions of milk sales, as well as the actual quantities, utilised in manufacturing, (c) the relatively insignificant swing away from winter milk, (d) increasing herd size, and (e) the dominance of the Friesian breed. Two other features are the fall in the number of milk producers and the increases in yields per cow.

TABLE II.8

**DISTRIBUTION OF COWS IN MILK SELLING HERDS BY BREED
UNITED KINGDOM AND REPUBLIC OF IRELAND**

<i>Areas</i>	<i>1955</i>					<i>1965</i>				
	<i>Shorthorn</i>	<i>Friesian</i>	<i>Ayrshire</i>	<i>C.I.</i>	<i>Others</i>	<i>Shorthorn</i>	<i>Friesian</i>	<i>Ayrshire</i>	<i>C.I.</i>	<i>Others</i>
	<i>% of total</i>					<i>% of total</i>				
North	29.42	40.33	27.58	2.00	0.67	7.09	67.17	19.29	4.09	2.36
South and East	21.25	38.75	18.34	17.87	3.79	5.65	56.06	16.35	19.64	2.30
Midland	22.49	53.47	15.80	5.43	2.81	5.42	70.63	12.99	8.15	2.81
South West	27.60	36.13	13.55	14.08	8.64	6.44	55.00	16.70	14.50	7.36
Wales	28.58	50.17	11.74	3.97	5.54	6.03	77.35	7.17	4.59	4.86
England and Wales	26.37	42.42	19.15	8.21	3.85	6.31	64.19	15.70	9.89	3.91
Scotland	In others	10.80	83.10	1.20	4.90	0.30	17.80	77.80	1.10	3.00
Northern Ireland*	n.a.	n.a.	n.a.	n.a.	n.a.	39.60	49.20	9.70	In others	1.50
Republic of Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	64.10	19.80	In others	In others	16.10

* The distribution for 1967 shows Friesians accounting for 56.7%, Dairy Shorthorns 32.2%, Ayrshires 8.2%, and others 2.9% of the cows in milk selling herds.

In the past decade the overall index of farm prices has remained relatively unchanged whereas costs, and in particular wage rates, have increased markedly. It is not surprising therefore that changes in the character and intensity of production have occurred in an effort to maintain incomes. For very many small dairy farmers, poultry and pigs are the only alternatives to milk production because they are intensive in nature and enable an expansion of the business through the use of purchased feed. On larger farms cereals may not be possible because of climatic and topographical conditions and in such circumstances beef cattle and sheep production may be appropriate. It follows that numerous factors influence the direction of production but trends in prices of agricultural products have a particular impact.

Although guaranteed milk prices for the standard quantity in the United Kingdom have risen by 17 per cent over the past 12 years, the milk prices actually received by farmers for all milk have only increased by 6 per cent but they have been relatively attractive compared with prices for all other farm products, except beef. Beef guaranteed prices over the same period increased by over 30 per cent. There have been marked decreases in the guaranteed prices for eggs, a product which holds out particular possibilities for expansion on limited acreage. Higher beef prices have only a restricted attraction for small farmers since the traditional beef enterprise makes extensive use of land whilst barley beef is a high risk activity. The records of the different areas indicate that the expansion in milk production has been less where other alternatives such as cereal production exist. Where there is no attractive alternative, the relatively constant prices for milk and concentrates, together with improved grassland use, have created a situation generally conducive to expansion of milk production.

Future Trends

There are substantial difficulties involved in forecasting production both nationally and regionally. The emphasis on a particular commodity is determined by its own price as well as prices of other alternative commodities. Furthermore, changes in technology can drastically modify cost structures and often nullify the effect of price changes. An example is the development of loose housing systems which have improved labour productivity without sacrificing yields or increasing the incidence of disease. Improvements in animal health, and in particular the elimination of bovine tuberculosis, may have contributed markedly and further success in eradicating brucellosis and mastitis could result in much higher yields and a much lower replacement rate in the dairy herd. The consequent increase in the number of lactations per cow would make possible an expansion in cow numbers and this is technically feasible.

Friesians will undoubtedly continue to oust other dairy breeds. They may also displace pure beef cattle, because they have the dual attraction of yielding milk of

quality acceptable to the liquid consumer and an acceptable beef carcass. Whether it is the breed most likely to satisfy the requirements of the increasingly important milk manufacturing industry is open to debate but it is interesting to note that it is, to a limited extent, replacing the Jersey breed in New Zealand because of its potential contribution to beef supplies. There is scope for an extension of calf rearing within existing buildings on most dairy farms and many dairy farmers supplement their income by undertaking the initial rearing.

Herds will continue to increase in size for a number of reasons, of which the most important is the pressure to maintain profits by increasing stocking rates. The increasing complexity of dairying demands more technical expertise which can only be justified on bigger herds maintained on farms concentrating on milk production. The degree of specialisation may range from the production of milk in particular seasons of the year to providing the minimum feed requirements from the farm itself thereafter relying on feeds purchased from other farms in other regions. All-the-year-round housing may be forced on farmers by the waste involved in traditional methods of cow keeping on high priced land.

An increasing tendency for farmers to specialise in fewer activities will persist, and this could produce a concentration of particular lines of production in different areas. The extent of this will depend largely on (a) the continuation of existing trading arrangements for importing dairy products, (b) the pricing policy for milk and (c) the advantages which different areas may enjoy in the production of milk at different times of the year. Certain parts of the country are undoubtedly well equipped to produce summer milk, but it is doubtful whether the price advantage has swung far enough in its favour. The summer milk experiment of the 60's conducted by the Milk Marketing Board in England and Wales (when participating producers received special prices) showed that if all farmers had reacted as did those in the experiment a shortage of liquid milk would have resulted in the winter. In general, however, milk producers have been remarkably unresponsive to change in the summer-winter price differential. A uniform milk price throughout the year would produce an extreme summer production pattern but with savings in feed and, in the long run, in housing costs in some areas. It would however accentuate peak supplies in summer which might involve manufacturers in some extra costs for plant and equipment as well as labour. In many areas the supply to the liquid market in December-January would be endangered. The best policy will take into account the benefits from cheap summer milk in relation to the costs involved in the highly seasonal manufacturing activity.

III. THE MANUFACTURING INDUSTRY

In the first two sections of this bulletin, developments in the market for milk and dairy products and some features of milk production on British and Irish farms were examined. This section sets out data on the dairy manufacturing sector and illustrates the way its present organisation has been developed.

Size of the Milk Manufacturing Industry

Size can be measured in terms of the employment it provides and the net output (value added) that it produces. In 1968, the milk manufacturing industry* provided employment for 30,000 people, equivalent to 5.3 per cent of the total employed in all food manufacturing industry†. Contribution to net output was £52.8

TABLE III.1

OUTPUT, EMPLOYMENT AND LABOUR PRODUCTIVITY IN THE
FOOD MANUFACTURING INDUSTRIES 1963-68—UNITED KINGDOM
(1958 = 100)

<i>Industry Sector</i>	<i>Measures</i>	1963	1964	1965	1966	1967	1968
Milk products	Output	106.0	103.2	108.9	108.0	16.3	121.3
	Employment	103.9	99.5	101.8	107.1	105.8	99.2
	Productivity	102.0	103.7	107.0	100.8	109.9	122.3
All food manufacturing	Output	111.8	111.9	114.2	116.8	117.6	120.6
	Employment	103.9	103.6	104.3	104.7	103.8	102.2
	Productivity	107.6	108.0	109.5	111.6	113.3	118.0

Output—index of production.

Source: DEA.

Employment—employees in employment, mid-year.

Productivity—output ÷ employment.

million, equivalent to 7.4 per cent of the £709.7 million which was the total net output of all food manufacturing activities. In addition to these measures, information for a six-year period ending in 1968, set out in Table III.1, shows trends in production, labour employed (mid-year readings) and production per employee. These indices show that output in both the milk products and the total food manufacturing sectors increased by over 20 per cent since 1958 during which time the labour force had remained fairly stable. It follows that, in both these sectors, productivity has increased quite substantially—a satisfactory situation provided this has been achieved without too heavy an investment of capital.

* Standard Industrial Classification 211.

† S.I.C. Minimum list headings 211 and 219 inclusive and 229.

In 1963, the milk manufacturing industry of the Republic employed 4,800 people and net output amounted to £5.4 million. In 1967 the respective figures were 5,900 and £10.6 million. These data reveal a marked increase in the output and a rapid rise in the productivity of the industry.

The rise in the output of the milk manufacturing industry is not surprising in view of the marked increases in milk production in the United Kingdom. The position in the Republic of Ireland is similar with steady increases in both production and manufacture being recorded. The overall position depicted in Table III.2 shows that the proportions manufactured in individual countries vary widely from about 32 per cent in England and Wales to 76 per cent in the Republic.

TABLE III.2
IMPORTANCE OF MILK FOR MANUFACTURE
April-March Years (million gallons)

Country	Total Sales		Manufactured		Proportion Manufactured	
	1957-59	1967-69	1957-59	1967-69	1957-59	1967-69
	annual averages				%	
England and Wales	1,822	2,152	476	675	26	32
Scotland	225	247	93	112	41	45
Northern Ireland	106	143	70	100	66	70
United Kingdom	2,153	2,542	639	887	30	35
Republic of Ireland	520	651	294	491	57	76

The liquid market gives a better return and therefore receives priority. Both England and Wales, and to a lesser extent Scotland, are unusual among the main dairying countries of the world because of the dominance of their liquid markets.

Table III.2 shows that, over the last decade, greater quantities of milk have been manufactured. This is the result of milk production increasing at a faster rate than liquid consumption. The greatest percentage increase occurred in the Republic where the growth of the creamery milk industry has been one of the features of the agricultural sector.

Because of the magnitude of the United Kingdom market for dairy products, particularly butter, the increased quantities of manufactured milk are probably fairly easily absorbed and Table III.3 shows that between 1958 and 1968 all countries in the United Kingdom as well as the Republic increased their share of the dairy

products market. In particular, much of the additional output of dairy products in the Republic has been absorbed, and its share of the market has increased from 3.5 per cent to 6.2 per cent over the period. In all cases most of the increases can be attributed to butter.

TABLE III.3
SHARING OF THE UNITED KINGDOM MARKET FOR
DAIRY PRODUCTS
 (in terms of milk equivalent)

<i>Country</i>	<i>Share of the U.K. market</i>	
	<i>1958</i>	<i>1968</i>
	<i>% of total market</i>	
England and Wales	14.8	18.9
Scotland	2.9	3.1
Northern Ireland	2.2	2.9
United Kingdom	19.9	24.9
Republic of Ireland*	3.5	6.2

* Exports of dairy products to the United Kingdom.

Manufactured Products

Many factors influence the relative levels of output of the various dairy products. Naturally producer-organisations wish to sell their milk at the highest possible price, and therefore encourage the development of markets that give the best return, e.g. cream. For such 'high-category' products, market demand is the limiting factor. Since demand is somewhat price inelastic, over-supply has disastrous effects on price. An awareness of this factor has undoubtedly tended to retard the growth of cheese manufacture and milk producers are sensitive about the swamping of this market in recent years with subsidised imports of cheese from non-traditional suppliers. As a result of an anti-dumping application on behalf of the United Kingdom dairy industry, arrangements were eventually reached with overseas suppliers for 'voluntary restrictions' on cheese imports. These arrangements may well be formalised into quotas from 1970 onwards. In effect, market shares, at least for Cheddar cheese, have been stabilised, although there are no formal quota arrangements. A quota system stabilises butter imports into the United Kingdom but inevitably home production of butter fluctuates considerably because this product is used as the 'buffer' or 'sink' product and this

absorbs most of the variations in milk for manufacture. The effect of the British butter quotas has meant that the Republic has had to seek outlets in other markets but the E.E.C. butter surplus makes alternative markets both difficult to find and unremunerative.

TABLE III.4
PRODUCTS MANUFACTURED
(April to March Years)

Country	Butter		Cheese		Whole Milk Powder & Condensed Milk		Cream		Other Products	
	m.g.*	%	m.g.	%	m.g.	%	m.g.	%	m.g.	%
1957-58										
England and Wales	153	29	213	77	127	61	38	76	7	79
Scotland	28	5	47	17	21	10	2	4	—	—
Northern Ireland	33	6	5	2	33	16	4	8	—	—
United Kingdom	214	40	265	98	181	87	44	88	7	79
Republic of Ireland†	325‡	60	6	2	26	13	6	12	2	21
TOTAL	539	100	271	100	207	100	50	100	9	100
1967-68										
England and Wales	150	26	218	65	138	56	130	78	16	54
Scotland	29	5	43	13	28	12	8	5	1	3
Northern Ireland	34	6	19	6	22	9	18	10	7	23
United Kingdom	213	37	280	84	188	77	156	93	24	80
Republic of Ireland†	371‡	63	53	16	56	23	10	7	6	20
TOTAL	584	100	333	100	244	100	166	100	30	100

* m.g. = million gallons.

† Figures for the Republic of Ireland are for the calendar years 1957 and 1967.

‡ Includes farmhouse production.

Table III.4 shows that cheese retains its dominance in the United Kingdom whereas, in the total for all countries, butter absorbs more milk than any other product, largely due to the very high level of production in the Republic. Despite considerable diversification into other products the total gallonage manufactured into butter in the Republic has risen by approximately 14 per cent in 10 years and is likely to go on rising. There has been a considerable reduction in farmhouse

butter production in this period while creamery production has risen by half. Butter also takes precedence over cheese in Northern Ireland but in Scotland the reverse is the case. In 1967-68, considerably more milk was manufactured into cheese than into butter in England and Wales but there have been years in the past when the position was reversed.

TABLE III.5
UTILISATION OF SKIM MILK—1966-67
 April-March, million gallons

Country	Stock feeding	Skim milk powder		Casein	Other
		Roller	Spray		
England and Wales	33.2	28.5	77.2	—	63.6
Scotland	4.9	6.7	5.0	6.7	7.1
Northern Ireland	8.7	6.5	8.1	—	17.1
United Kingdom	46.8	41.7	90.3	6.7	87.8
Republic of Ireland	187.0	60.0		—	n.a.

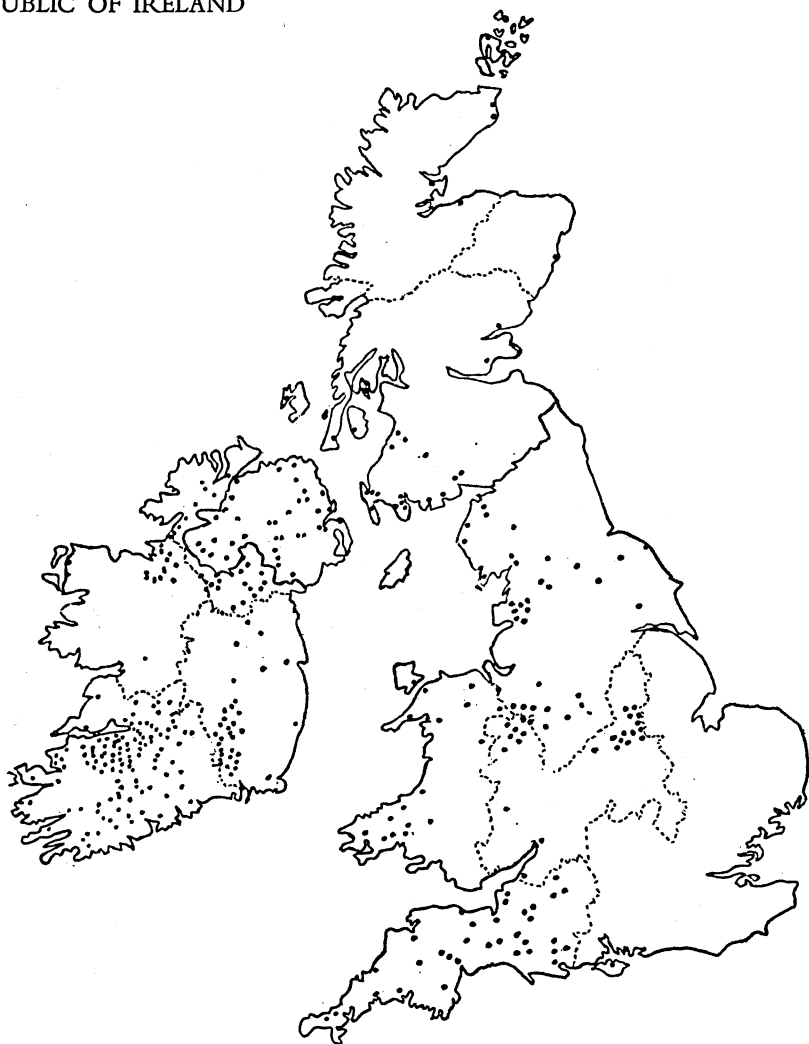
The annual volume of cheese manufactured in both England and Wales and in Scotland has remained fairly constant over the past decade. In Ireland, however, production has mounted steadily; in Northern Ireland there was an increase from 5 to 19 million gallons and in the Republic from 6 to 53 millions. By contrast little variation has occurred in the production of condensed milk and whole milk powder in the United Kingdom, but production in the Republic has doubled over the period. Utilisation of milk for cream has risen spectacularly in the United Kingdom and there has also been a rise in the Republic but the total milk manufactured into cream is still not large. The use of milk for 'other products', such as canned rice puddings, is still very small, but this market has been growing quite strongly.

Skim milk is traditionally considered as a by-product of butter and cream manufacture, but it does retain the majority of the important 'solids-not-fat' fraction of whole milk and is nutritionally of high value. This product has a variety of uses and this is illustrated in Table III.5.

In the United Kingdom nearly half the skim milk is manufactured into powder. An interesting feature is the diminishing importance of the roller process, whilst the spray process has become more important. 'Other uses' include skim concentrate for ice-cream, condensed sweetened skim milk and an element of wastage. There is finally its use for stock feeding. In the Republic stock feeding is the

MAP 1

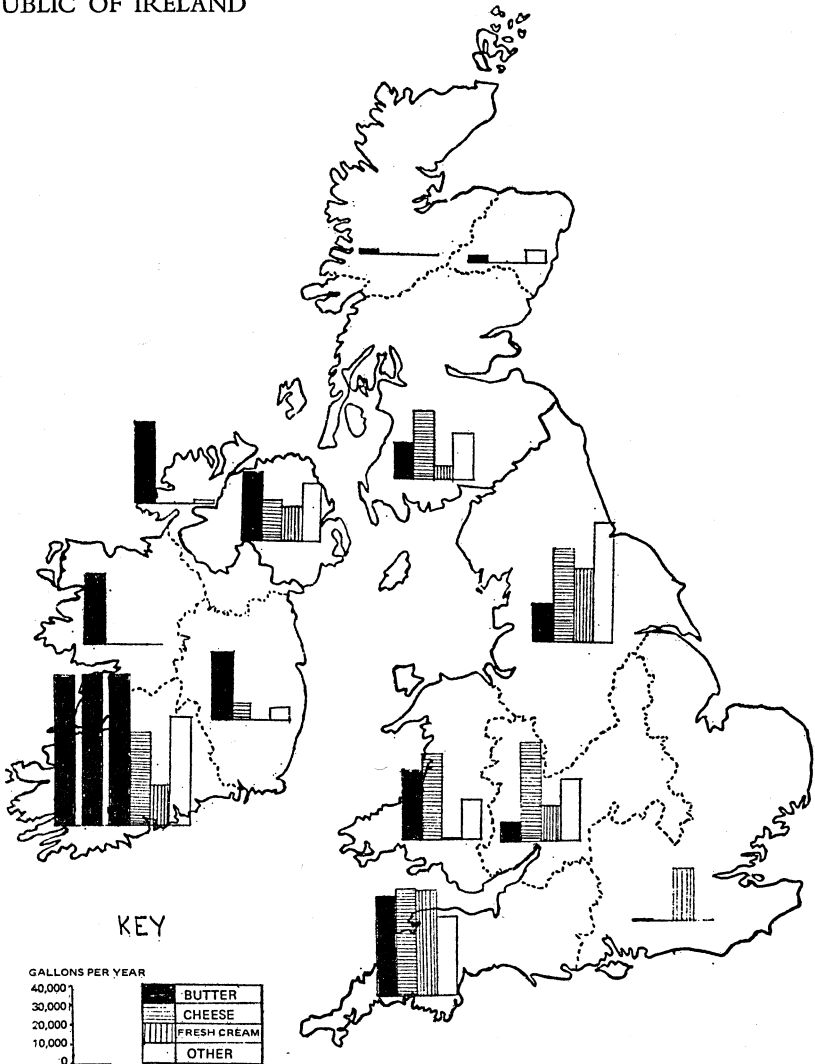
LOCATION OF MANUFACTURING
CREAMERIES IN THE
UNITED KINGDOM AND THE
REPUBLIC OF IRELAND



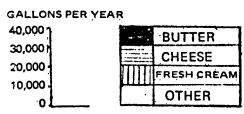
MAP 2

PROVINCIAL DISTRIBUTION OF MILK PRODUCTS IN THE UNITED KINGDOM AND THE REPUBLIC OF IRELAND

Handwritten mark



KEY



dominant use, although efforts are being made to increase the manufacture of milk powder. This is proving difficult because world market prices have declined in recent years, largely due to the build-up of surpluses in the E.E.C. In England and Wales, the Milk Marketing Board is achieving some success in increasing skim sales to stock feeders. At present, the manufacture of casein from skim milk is confined to Scotland.

The Location of Manufacture

The location of the main manufacturing creameries is shown in Map 1 and the regional pattern of manufacture by product, in Map 2. Map 1 does not show the location of dairies which only manufacture fresh cream, but these are fairly evenly distributed, with the cream manufacture often subsidiary to liquid processing. The major manufacturing areas, where high output of milk is coincident with low liquid demand, include South-West Scotland, South-West England and Munster. There are also areas where manufacturing creameries are few and far between because little milk is produced, e.g. North-West Scotland and the majority of the province of Connaught. By contrast, in South-East England there is scarcely any manufacture, apart from fresh cream, because the milk produced in this area is almost all absorbed by the liquid market. Map 2 clearly shows the high concentration of butter manufacture in Ireland, particularly in the province of Munster, which makes over 40 per cent of the combined butter output of the United Kingdom and the Republic. Other important areas of butter manufacture are South Wales and the South-West of England. The main areas for cheese manufacture are the Mid-West and North-West Midland regions of England, North Wales, South-West England and Munster.

In the United Kingdom, the distribution of manufacture is subject to considerable influence from the Boards, which are continually striving to reduce movement of milk to the minimum. To achieve this there should, in theory, be no manufacturing premises (apart perhaps from fresh cream) within the 'Inner Liquid Milk Zone'—that is, the areas around the liquid market. Beyond this 'Inner Zone' should be the 'Outer Liquid Zone', from which milk should be drawn seasonally, at trough periods of milk production, to meet liquid market demand but retained for manufacture during the peak of milk production. The 'near in' manufacturing plant in this zone, therefore, would have to accept a very seasonal pattern of manufacture, and the best product for this purpose is butter, which can readily be stored for long periods. Cheddar cheese manufacture can also stand a fair degree of seasonality and some cheese plant may rationally be located in this zone a little beyond the 'inner ring' of butter plant. Finally, there should be a 'Manufacturing Zone' covering the areas furthest from the main liquid markets, where the majority of the milk produced could be used for manufacture for most of the year. High

category manufacture, requiring a fairly even throughput throughout the year, could be best located in these areas. But to 'back' the high category plant, it is advisable to have a leavening of manufacturing plant in the 'Manufacturing Zone' capable of dealing with the seasonal production peaks, whilst operating at low levels in the trough, and for this purpose butter is again probably the best product. Naturally, the overall national 'mix' of manufacturing plant should conform to the market requirements for the various types of product, taking into account the total availability of milk for manufacture, and product realisations. However, once the ideal 'national mix' is determined, the individual manufacturing plants for the various products should theoretically be located in accordance with the principles outlined above.

The present location of manufacture in the United Kingdom inevitably falls some way short of the ideal. The reasons for this are in part historical, dating back to well before the war, when the patterns of demand, production and distribution were very different from those of today. Capital investment in buildings and fixed equipment on present sites discourages relocation. Nevertheless since 1954 there has been a considerable movement of manufacture to more rational sites. The Milk Marketing Boards can exert a marked influence on the location of manufacture although their powers have to be tempered with expediency. Any manufacturer wishing to commence business at a new site has to obtain a licence for the new premises from the Board concerned, and any wildly irrational proposals could be obviated by refusal to grant a manufacturing licence. There are also fairly frequent discussions between the Milk Marketing Board and the larger manufacturing organisations concerning their capacity and plans for extension, since, in a period of rising production, new capacity has to be made available to match the additional milk available for manufacture when production is at peak. These discussions also help to ensure that there is no wasteful duplication of investment. The Board's objectives are to co-ordinate their own and other manufacturers' plans to ensure that there is sufficient capacity to meet the forecast availability of manufacturing milk, any new plant necessary being located, as far as possible, in accordance with the principles outlined above. For instance, examples of new butter creameries being established in the 'Outer Liquid Zone' to absorb seasonal surpluses are the Glenrothes Creamery in Fife opened by the Scottish Milk Marketing Board in 1958 and the Alfreton Creamery in Derbyshire, built by the England and Wales Board, opened in 1969.

A further means available to the England and Wales Milk Marketing Board to influence the location of manufacture is their power to re-allocate farm supplies from depots and manufacturers to direct market buyers if 'it is in the interests of economic marketing' to do so. Considerable transfers of farm supplies have taken place since 1954 through re-allocation and some 'near in' manufacture has been transferred to the outer zone. The advent of bulk collection has made it possible

to draw milk direct from farms to town dairies over almost any distance, and in the future re-allocation is likely to bring further pressure for the resiting of such irrational 'near in' manufacture as remains, although results will only be gradual. In Scotland there is little scope for re-allocation, but a number of creameries in the South-West of Scotland have been closed because they were not viable units.

Northern Ireland can be divided into two manufacturing zones—the west and the east. The west is predominantly a butter manufacturing area, and this stems from the strong co-operative movement in dairying. At the turn of the century a number of producer co-operative creameries were established and there are still nine of these left, all making butter. To the east are the large dairy plants, manufacturing a wide range of high-category products. This manufacture dates from the second world war period and has tended to follow the pattern of other industries with new plants established near to the ports where the infrastructure is geared for serving the market in Great Britain. Manufacturers do not have to bear the cost of transporting milk to their creameries, and this has, of course, strengthened their desire to site their plant to the east. The Northern Ireland Milk Marketing Board exercises control over the availability of milk supplies and therefore plays an important role in determining, with manufacturers, the siting of new plant. The desire to attract new industry has meant that great attention has been paid to the wishes of manufacturers. Nevertheless it is likely that any further development will be channelled to the west of the country in view of the greater availability of milk (and labour) in these parts.

In the Republic, where most of the milk is produced specifically for manufacturing, the processing units have grown up in the immediate area of production. Connaught and the three counties of Ulster are overwhelmingly concerned with butter manufacture, but Munster, although an enormously important butter manufacturing area, is more diversified, and it is in this province, with a comparatively good infrastructure and access to ports, that there has been most development of dairy manufacturing in the past decade. On the other hand, the pull of the Dublin liquid market is important in Leinster and, in consequence, the number of manufacturing plants in this province tends to be low.

Seasonality of Manufacture

Liquid milk consumption does not vary greatly from month to month, but production is variable, rising to a peak in May and June and falling away to a trough in winter. It follows that milk diverted to manufacturing shows a trend similar to total production but it is more accentuated. Table III.6 shows that, in the United Kingdom and Republic as a whole, manufacture at peak is more than three times the trough level. The pattern for countries within the United Kingdom is similar although Northern Ireland has a somewhat lower and later peak and

also a lower trough. In the Republic, however, the variation between peak and trough is much more marked, with manufacture in June almost twelve times that in January.

TABLE III.6
MONTHLY INDEX OF TOTAL MANUFACTURE*

1968-69	England and Wales	Scotland	Northern Ireland	Republic of Ireland*†	Total
April	124	120	96	95	111
May	156	150	133	165	158
June	147	150	142	188	162
July	112	130	140	178	139
August	108	100	125	158	127
September	94	86	108	135	109
October	87	75	100	105	93
November	73	67	78	58	68
December	69	68	68	20	51
January	72	73	64	16	51
February	72	80	60	24	55
March	83	101	84	52	73

* Based on average daily quantities each month.

† Figures for the Republic of Ireland are based on the calendar year 1967.

The seasonal variations in the quantities of milk manufactured into different dairy products are shown in Table III.7. Butter production shows an extreme seasonal pattern and therefore low capacity utilisation. On the other hand, the high category products, such as full cream powder, usually achieve a much more even throughput. The storage life of the product does, of course, affect the degree of seasonality. For instance, the volume of Cheddar cheese made can be varied seasonally to a much greater extent than a variety such as Lancashire, because Cheddar can be stored much longer without losing quality. Fresh cream is the extreme example of a short-life product, and the level of manufacture varies seasonally and from day to day, but in accordance with market demand rather than the seasonality of milk production.

The degree of seasonal variation in manufacture, and therefore the average percentage utilisation of plant capacity, varies from country to country as well as from product to product, the most extreme fluctuations being in the Republic. The extent to which manufacturing costs rise as plant utilisation declines is not well documented. But it is a question of extreme importance in determining what

would be the optimum seasonal pattern of milk production for manufacturing in various areas, taking both milk production and manufacturing costs into consideration. Until more knowledge is available on this subject, as well as on the seasonal costs of milk production, the issue of whether there should be greater emphasis on summer milk production for manufacture must remain an open question. Savings in production costs could conceivably be outweighed by the

TABLE III.7
MONTHLY INDEX OF MANUFACTURE BY PRODUCT*
UNITED KINGDOM AND REPUBLIC OF IRELAND

1968-69	Butter		Cheese		Milk Powd. (F.C.) and Choc. Crumb		Cream		Other Products		Total	
	U.K.	Rep.	U.K.	Rep.	U.K.	Rep.	U.K.	Rep.	U.K.	Rep.	U.K.	Rep.
1968												
April	126	89	124	105	133	135	98	108	115	24	120	95
May	180	171	155	170	156	146	108	100	144	92	153	165
June	168	196	147	183	146	151	118	116	136	116	147	188
July	130	183	107	177	111	150	122	140	110	212	117	178
August	131	159	96	175	117	143	97	100	97	208	109	158
September	98	129	88	166	120	144	90	100	90	160	95	135
October	82	100	93	126	70	166	92	92	89	132	87	105
November	58	55	81	46	60	81	87	80	84	72	73	58
December	46	19	69	5	59	21	118	140	66	40	69	20
1969												
January	53	17	76	5	72	15	86	64	83	20	71	16
February	53	26	77	8	63	17	90	84	87	16	72	24
March	72	52	85	29	91	73	94	92	100	28	85	52

* Index for each product based on the average daily milk utilisation for each month, with the annual daily average = 100.

rise in manufacturing costs that would inevitably be associated with the installation of extra plant to deal with a higher summer 'flush' of milk production. Conversely, in the Republic, which is an area of high summer production at present, it might perhaps be economic to aim at a more even seasonal pattern of production.

Size of Manufacturing Units

The distribution of manufacturing plants by throughput is set out in Table III.8. An enormous variation is evident in the average annual throughput, but it

must be remembered that the majority of the small manufacturing plants in England and Wales are cream separators sited at processing dairies. The most modern factories tend to be the largest since for many products new dairy technology necessitates a big throughput to achieve maximum benefit and lowest production costs. For instance the throughput required to minimise the costs of manufacturing skim milk powder by means of spray driers is considerably greater than was necessary with the old 'roller' type equipment. Indeed butter and skim powder manufacture are usually associated in the one plant and the most modern of these can handle 100,000 gallons or more of milk each day. In complete contrast there are some very small butter manufacturers particularly in the Republic.

TABLE III.8
DISTRIBUTION OF MANUFACTURING PLANTS BY SIZE
OF ANNUAL THROUGHPUT, 1967

Country	Annual Throughput (million gallons)							Total
	Under 0.5	0.5- 0.99	1.0- 1.99	2.0- 2.99	3.0- 4.99	5.0- 9.99	10.0 & over	
	<i>No. of plants</i>							
England and Wales	204	27	27	17	17	28	15	335
Scotland	79	3	5	5	7	4	1	104
Northern Ireland	18	7	9	3	3	1	4	45
United Kingdom	301	37	41	25	27	33	20	484
Republic of Ireland	24	36	48	13	19	39	—	179

Note: Plants which only manufacture Fresh Cream are included in this analysis.

The manufacture of milk into cheese is generally undertaken in comparatively small units, the majority using less than 10,000 gallons per day. The very largest creameries tend to be the 'dual purpose' units manufacturing more than one product.

Normally, manufacturing plant is only operated at near full capacity over the peak milk production period, and therefore over the year the average daily plant utilisation is comparatively low. Over the years, however, there has been a marked reduction in the number of manufacturers and an increase in the average daily throughput shown in Table III.9. This consolidation of units and the use of larger, automated plant has resulted in considerable cost reductions, and increased labour productivity.

In interpreting the figures in Table III.9 it has to be remembered that the availability of milk for manufacture influences the average throughput per unit,

particularly in the case of butter as the 'sink' product. However, over the years there has been a tendency for throughput to increase for all products. The concentration of manufacture into fewer units is partly responsible for this, particularly in England and Wales where the number of manufacturing depots has declined from 137 in 1958 to 97 in 1968.

Control of Manufacturing Plant

In most of the major dairying countries of the world, control of manufacturing plant is mainly vested in producer co-operatives, e.g. this is true in the Republic of Ireland, where there are also independently owned plants which include some

TABLE III.9
THROUGHPUT OF MILK PER MANUFACTURING UNIT
ENGLAND AND WALES
(Average Daily Gallons)

<i>Year ending September</i>	<i>Butter</i>	<i>Cheese</i>	<i>Condensed Milk</i>	<i>F.C. Milk Powder</i>	<i>Fresh Cream</i>	<i>All Creamery Manu- facture*</i>
1958	9,000	5,400	9,800	4,500	400	8,400
1962	8,100	6,000	10,300	5,300	700	9,700
1966	6,000	6,700	12,400	6,200	1,500	11,100
1967	7,300	7,700	12,700	7,200	1,700	11,900
1968	12,100	7,200	12,100	8,200	1,800	13,500

* Average figures after eliminating spasmodic manufacture at plants mainly concerned with liquid milk processing. Many creameries manufacture more than one product.

of the newest and largest in the country. In the United Kingdom the independent manufacturing companies dominate the situation, particularly in Great Britain where very few manufacturing plants are run by producer co-operatives. This unusual state of affairs may well be due to the introduction of Marketing Boards which are in essence, national (or area) producer co-operatives, albeit compulsory. The obligation laid upon them to purchase all milk of marketable quality removes the need for local producer groups to provide an outlet for their production. The Marketing Boards themselves do, of course, manufacture on quite a large scale to ensure the maximum returns for milk producers and to satisfy the need to act as 'buyers of last resort'.

Allocation of Milk for Manufacture

In the United Kingdom the Milk Marketing Boards endeavour to satisfy fully the demand for liquid milk at all times; they also ensure that milk surplus to liquid requirements gives the best return. The Boards achieve these two objectives by day-to-day control over the milk transferred to the different markets. For instance, in England and Wales the Board exercises this control through a system of marketing allowances and manufacturing rebates. Under the sale contract, milk is technically sold to manufacturers at the liquid market price, with the Board allowing rebates off this price provided the milk is used for approved manufacture. The Board has contractual powers to 'call' milk from any manufacture to the liquid market or from a low category product such as butter to a high category product. If the manufacturer fails to provide milk when called upon to do so, no rebates would be allowed. It would, of course, be quite impossible for any manufacturer to operate profitably without the benefit of the rebates and therefore milk is always released when called for. Similar, but not identical, systems operate in Scotland and Northern Ireland. Priority in the allocation of milk to manufacture is given primarily to fresh cream and then usually to the other high category goods such as chocolate crumb, full cream powder and full cream condensed milk. Territorial cheese is next on the list of priorities, followed by Cheddar Cheese and, finally, butter.

The situation in the Republic is rather different, because no central body controls the overall allocation of milk. The supplies of the main liquid markets of Dublin and Cork are regulated by two local Milk Boards, but these are not allowed to manufacture in their own right, and have to sub-sell any surplus to manufacturers. Under agricultural regulations, manufacturing milk can only be bought directly from farmers by co-operatives or by the Dairy Disposal Company—a state sponsored body. They can rely on obtaining all the milk produced on farms normally supplying their plants because 'private' manufacturers have to obtain their milk through some sort of contractual relationship with a co-operative association of suppliers. The diversion of liquid milk surpluses presents problems and for this reason the Dublin Milk Board has sought permission from the Department of Agriculture and Fisheries to establish its own manufacturing facilities.

Transport of Milk for Manufacture

In the United Kingdom most of the manufactured milk passes directly from farms to the plant, but manufacturers are not allowed to retain all the milk they receive unless the needs of the liquid market have been fully met. There is a considerable volume of inter-dairy movement of milk for manufacture particularly in England and Wales. For instance, when normal farm supplies are insufficient, some of the high category manufacturers are 'fed' additional milk from other

dairies to enable them to maintain an agreed manufacturing programme. Conversely, at the peak of production the majority of liquid processors and a few manufacturers receive more milk than they can handle and this has to be diverted to those manufacturers with spare capacity. In 1966-67 (October-September year) about 13 per cent of the milk manufactured in England and Wales was transported to the creameries from other dairies, the remainder being moved direct ex-farm to the manufacturing point. Inter-dairy movements of milk for manufacture also take place in Northern Ireland. Such movements are of much less significance in Scotland, although at peak production some is transferred from England for manufacture.

TABLE III.10
PRIMARY TRANSPORT COSTS 1965-66 AND 1968-69

<i>Country/Area</i>	<i>pence per gallon</i>	
	<i>1965-66</i>	<i>1968-69</i>
England and Wales	1.20	1.37
Scottish M.M.B.	1.39	1.53
Aberdeen and District M.M.B.	1.54	1.88
North of Scotland M.M.B.	1.57	1.83
Northern Ireland	1.61	1.54
Republic of Ireland*	1.73	n.a.

* Cost for churn haulage by contractor to 'first point of delivery' only. Producer delivery cost estimated at 1.62 pence per gallon.

The situation in the Republic is very different. Here in April 1967 there were 154 butter manufacturing creameries. In addition there were 451 cream separating stations taking in milk from farms, skimming it, and shipping the cream to creameries for manufacture into butter. Such 'feeder' plants to the main manufacturing creameries are almost unknown in the United Kingdom, where delivery of whole milk to the final point of manufacture is the usual practice. Another difference is the extent to which producers deliver their own milk in the Republic; an uncommon, but not unknown, practice in the United Kingdom. The existence of the widespread net of cream separating stations means that the average distance from farm to first point of delivery is comparatively short, but even so 'first stage' transport costs are higher on average than in the United Kingdom (see Table III.10).

The comparatively low level of transport costs in the United Kingdom probably results from the overall control over farm transport exercised by the Milk Marketing Boards, which ensure an efficient transport system—one of the benefits of organised marketing. In the Republic, producers have to bear the costs not only of transport from farm to separating stations but also the cost of operating the stations and moving the cream to the central creamery. It is believed that dairy manufacturing costs in the Republic could be greatly reduced by the elimination of many of the separating stations and, indeed, some of the central creameries, to bring throughput to more economic levels. This is one of the main recommendations in a recent report on the 'Irish Dairy Industry Organisation' by Professor H. L. Cook of the University of Wisconsin and Dr. G. W. Sprague, former Economist of the Land O'Lakes Creameries Inc., Minnesota.

Pricing Milk for Manufacture

In the United Kingdom the pricing of milk for manufactured products is negotiated directly between the individual Milk Marketing Boards and the manufacturers. Prices vary according to product but are very much lower than those prices paid by the 'liquid market' dairies. In 1967-68 the differential in average prices received by the Boards for liquid and manufacturing milk was about 32 pence per gallon. This wide differential does not, of course, reflect any important quality differences, and the milk of any producer can be used in the liquid market at any time. There are two main reasons for the differential. Firstly, it has been Government policy to control the price of milk on the liquid market, the selling prices for liquid milk being set at a level sufficient to give producers the income guaranteed on the 'Standard Quantity'. Secondly, milk for manufacture is sold at a price which enables the manufacturers to sell their products in competition with imports of dairy products. The United Kingdom is the major 'free' world market, and imports come either from countries whose dairy industries are geared to produce low cost manufacturing milk, or whose governments subsidise exports of dairy produce, or both. Milk production in the United Kingdom is mainly geared to the needs of the liquid market, in terms both of quality and regularity of supply, and additional milk for manufacture must sell at lower prices in order to compete with these countries.

The producer receives a 'pool' price which is the average of the Guaranteed Price on the Standard Quantity and the manufactured price on the remainder, less administration expenses, etc. As manufacturing realisations are lower than the Guaranteed Price any increase in manufacture reduces the pool price.

In 1967 in the Republic, the average delivered price paid to producers in the Dublin and Cork Milk Marketing Boards' areas was almost 37 pence per gallon compared with 25 pence received by producers of manufacturing milk—a

differential of nearly one shilling. Unlike the United Kingdom the price for manufactured milk is not negotiated centrally between manufacturers and Milk Marketing Boards, but is controlled by 'An Bord Bainne' a dairy produce marketing organisation, established under the Dairy Produce Marketing Act, 1961. This Board has the task of organising the marketing of the Republic's dairy produce and has an export monopoly for most dairy products. It is obliged to purchase at a fixed price all butter of the required quality and this puts a floor to the market. Two-thirds of any losses sustained in the export of butter and other dairy products are met by the Exchequer by way of grant to 'An Bord Bainne' and one-third by way of a Bord Bainne levy on creamery milk producers. In addition, an allowance is paid by the Exchequer to creameries which enables them to pay a higher price to individual producers. At present this allowance is equivalent to ninepence per gallon on the first 7,000 gallons of annual delivery and is on a declining scale thereafter. An additional allowance (twopence per gallon) is paid on creamery milk reaching a specific quality standard, and this is paid on approximately two-thirds of total production. Since receipts are not pooled nationally, the price paid to producers by individual manufacturers varies according to the efficiency of the Creamery and the price that it obtains for its produce.

The present methods of pricing milk for manufacture are as follows:

(a) *Butter*

The price of milk for manufacture into butter in England and Wales is related to the import prices for butter. The 'formula butter price' is fixed each month by reference to the average prices realised for New Zealand butter. The 'formula price' is adjusted to cover manufacturing costs and the value of the skim milk. The skim valuation varies according to its value in different uses, e.g. stockfeeding, roller-skim powder, spray-skim powder and other uses as fresh concentrate. A factor is then applied to convert price per cwt of butter into price per gallon of milk utilised. This conversion factor varies between summer and winter and between Cornish and non-Cornish milk because of differences in the butterfat content. Northern Ireland and Scotland follow more or less the same method but the prices used are related more to Ulster and Scottish butter prices rather than imported prices. The average price realised by the Milk Marketing Boards for milk for butter manufacture (including the value of the skim) was 17.30 pence per gallon in 1966-67. This fell to 16.83 pence in 1967-68 and to 13.45 pence in 1968-69.

In the Republic, the basic price relates not to the milk but to butter. An Bord Bainne pays 469/- per cwt for butter of satisfactory grade packed in 56 lb returnable containers.

The calculation of the net realisation for 1967 is as follows:

	s. d.	s. d.
Price paid by An Bord Baine		469 0
<i>Less Charges for:</i>		
freight	2 6	
cold storage	9 8	
inspection and quality control	2	
manufacturing cost, say	50 0	
	—	62 4
Realisation to producers' co-operative		<u>406 8</u>

From this sum, a levy of threepence per gallon is paid by producers to An Bord Baine so that the net realisation after levy (at 280 gallons of milk per cwt of butter) is 336s. 8d. per cwt. This is equivalent to a realisation of about 15 pence per gallon. If the full export losses had been shouldered by producers the realisation prices would have dropped to less than 12 pence per gallon.

There has been a sharp decline in the use of milk for producing farmhouse butter in the Republic from 73.9 million gallons in 1957 to 29.1 million gallons in 1967. The price received for farmhouse butter is generally lower than that paid by An Bord Baine for creamery butter.

(b) *High Category and Other Products*

In the main, the pricing of milk for high category goods is the same all over the United Kingdom; this involves a set schedule of prices which are lower from April to September and higher from October to March. This seasonal pattern encourages more manufacture when milk is freely available, and restricts manufacture in trough periods when the liquid market absorbs most of the supplies.

Cream 'Special Users' schemes are in operation in the various Board areas of the United Kingdom. These enable food manufacturers, bakers and confectioners to buy cream at a reduced rate provided they use a specified amount each month. The cream manufacturers can then claim special rebates from their Boards on the milk equivalent of the cream going to the special users. The highest manufacturing price realised in the United Kingdom was for fresh cream which averaged 27.34 pence per gallon in 1968-69. In the same year other products, apart from butter, realised between 21.75 and 26.02 pence per gallon.

In the Republic An Bord Baine purchases milk powder and chocolate crumb up to its requirements for export but does not have the obligation, as with butter, to take all that is offered. In effect, the market is controlled by An Bord Baine

agreeing in advance with individual manufacturers the quantity of their products required. Details of realisations are not published but, in terms of milk equivalent, are a little better than for butter. Cream is also exported by An Bord Bainne, but there are no details on realisations.

(c) *Cheese*

In England and Wales the price of milk for manufacture into cheese is calculated according to formulae which take into account the conversion factors of milk into cheese, the manufacturing costs and profit margins. The calculations are made on the basis of the first-hand selling price of cheese some time after manufacture, the time depending on the ripening period for the particular cheese—one month for Cheshire and three months for Cheddar. The milk price is therefore not finalised until some time after the cheese is made but the method gives the manufacturer an assured margin between his raw material price and product realisation.

The methods used in Scotland and Northern Ireland are similar, apart from the fact that in the former the selling price for Scottish cheese and a time lapse of two months in pricing are used, whereas in the latter English cheese prices, adjusted to cover export costs, are used. The prices realised by the Boards for milk manufactured into cheese vary according to variety, Stilton being the most remunerative and Cheddar the least. The overall average price in the United Kingdom was 22.78 pence per gallon in 1968–69.

In the Republic An Bord Bainne only purchases cheese for export up to the quantities required and is under no obligation to purchase more. The milk realisation price is on average probably a little better for cheese than for butter.

Farmhouse Cheesemakers' Scheme

A small farmhouse cheese industry operates in Great Britain. It only accounts for about 8 per cent of the total cheese production in the United Kingdom but is interesting in its organisation.

Farmhouse cheesemakers are milk producers who make cheese on the farm under a special contract with their Board. Comparable schemes are in existence in both England and Scotland so only the details of the system as it operates in England and Wales are given. There are approximately 85 registered farmhouse cheesemakers many of whom have 'co-operators'—farmers who agree to send their milk to the maker for manufacture. With these associated co-operative farmers included there are about 200 farms in all engaged in the industry.

The two main areas of cheesemaking in England are the West Country and the North-West. In the former—mainly Somerset—Cheddar is the main product but some Caerphilly and other territorial cheeses are made under approved private

contract arrangements. In the North-West, Cheshire and Lancashire cheese is made. All these cheeses are graded and marketed by Board agents on behalf of the producers.

Payment to farmhouse cheesemakers takes into account their dual role of milk producers and manufacturers. As producers they receive the basic regional milk price (related to milk of 12·1 per cent total solids) with the gallonage based on the weight of the cheese made. In addition a supplementary payment is made to cover the difference between the estimated average total solids and 12·1 per cent, less one farthing (this deduction is made because farmhouse cheesemakers are not allowed to benefit from the farthing injected by the Government into the Guaranteed Price to improve the quality of milk for liquid consumption). As cheese manufacturers they receive an advance equivalent to threepence per gallon to cover manufacturing costs. Finally an adjustment is made depending on the actual realisation price of the cheese, the amount due being calculated on the basis of a formula which deducts storage, grading and marketing expenses, and the Board's rebated selling price for milk for factory cheese manufacture, from the actual market realisation. This gives the maker approximately the same basic returns as a creamery cheesemaker plus any premium which the farmhouse product earns in the market.

In 1968-69 (April-March), farmhouse cheesemakers in England and Wales manufactured approximately 23 million gallons of milk into almost 10,000 tons of cheese—just over 10 per cent of the total produced in England and Wales. In Scotland, about a million gallons were used by farmhouse cheesemakers. When cheese is not made on the farm, the milk is diverted to the liquid or manufacturing market.

IV. DAIRY MANUFACTURING TECHNOLOGY

This section considers the problems facing the dairy product manufacturer and examines in detail developments in major processes. Historically, the dairy manufacturing industry has tended to be traditional in both its methods and products. In an industry dominated in Great Britain by the liquid milk market the manufacturing side has played a subsidiary, albeit a seasonally useful, role. However, there is a growing awareness that too great a reliance on the liquid market may not, in the long term, be good for the health of the whole dairy industry. Some rationalisation of manufacturing facilities has already taken place and many of the smallest and least economic units have closed. This is probably a main cause of the increase in productivity. In some instances the advent and growth of bulk collection has eased this process, since this technique has enabled enlarged plants to be serviced with greater quantities of milk without the expense of extending churn reception facilities. Technical advances in manufacturing methods and plant, per se, have probably not at this stage played a very significant part in this movement towards larger units, but the rate of technological progress is undoubtedly accelerating in the industry and future developments must take very much more account of this factor.

The largest and most complex units of plant in the manufacturing industry are those used for processing by-products, such as skim milk and whey. The manufacture of the traditional dairy products still involves a considerable measure of manual work although developments in mechanisation are reducing this. The manufacturing operation also requires an abundant supply of water, both potable and non-potable, and provision for the discharge of large quantities of effluent. These are often the critical factors in determining not only the location but also the capacity of the manufacturing unit.

Large scale plant in full operation makes for economies in operating costs, particularly if it also results in a substantial reduction in labour, often scarce in the countryside. Certainly, major breakdowns become more significant and maintenance and other service costs increase. Nevertheless, the economic advantages remain provided that the utilisation of the plant is adequate. Here the seasonality of dairy manufacturing presents a major problem and undoubtedly a more stable pattern of milk production would be advantageous. It is a question of whether or not the savings in manufacturing costs are outweighed by additional costs incurred on the farm to achieve this stable pattern involving a fairly high level of output in winter. Another approach, however, is to consider the dairy manufacturing industry in the wider context of the food industry. Other products, not dependent on fresh milk supplies, might be processed on the under-utilised dairy manufacturing plants during winter. This presents a challenge to the research and development facilities of the industry.

Now, a more significant emphasis is being placed on modern development and marketing techniques to exploit products, not merely for the utilisation of by-products but as acceptable products in their own right. This leads naturally to the development of multi-product manufacturing units, requiring a greater degree of flexibility of planning. The substantial increase in the overhead costs of multi-product factories must be offset by greater throughput.

In the quest for economies in operating large-scale manufacturing plant, it is easy to lose sight of the possible diseconomies resulting from having to transport very large gallonage of milk to one central point. Costs of collection rise considerably as the size of milk fields increases and savings in manufacturing costs could be more than outweighed by rises in transport costs. This is particularly the case if the density of milk production in an area is not very great. In England and Wales, it is doubtful if there is much to be achieved by going above a plant capacity of 100,000 gallons per day maximum throughput—even in the areas of dense milk production—if the plant is expected to rely on milk from its local area. Rather different considerations apply if a plant is being designed to handle seasonal surpluses from the liquid market for a short period of the year only.

Separating and Butter-Making

All the butter produced in the United Kingdom and the vast majority of the production in the Republic of Ireland is made by the 'Sweet Cream' process. Commonwealth butter is also of this type but imported butters from Denmark and some other continental countries are made by the 'Ripened Cream' process which gives a distinctive flavour, colour and texture. This process is a little more complicated as the butter cream has to be cultured and ripened before churning. It also suffers from the disadvantage that the butter cannot be stored so readily for long periods without deterioration. It follows that it is the 'Sweet Cream' process which fits the needs of a seasonal manufacturing butter industry rather than the continental process. It is, however, possible that in the Republic manufacture of 'Ripened Cream' butter might be developed in an attempt to increase the market share in the United Kingdom.

In the United Kingdom, most of the cream used for butter manufacture is separated at the factory where it is to be churned but it was noted earlier that in the Republic large numbers of small cream separating stations still consign the cream to a central factory for churning. Until recent years, conventional churning has been almost universal—generally in metal churns of various types and sizes although a few wooden churns still survive. In the larger creameries, cylindrical metal churns are normally used with sufficient capacities to fill 50 to 130 56 lb butter boxes in a single churning.

Churning is still the predominant method of manufacture but the continuous

method of butter making is becoming more popular despite some teething troubles in the early installations. These troubles seem to have been overcome and it is likely that most new installations will be of this type. There are at least ten continuous butter-makers operating in Great Britain and two in Northern Ireland.

Considerable economies are claimed with this method, provided the machines are installed in factories with a very large throughput—the capacity of these machines varies from $1\frac{1}{2}$ to 3 tons per hour, equivalent to more than double the normal rate of conventional churning. The initial problem of lack of consistency in the quality of the butter produced has now been largely overcome but the manufacturing process requires a more precise approach to the treatment of the cream prior to churning.

With conventional churning, costs of manufacture (including milk reception, separation, churning, bulk packing but excluding storage) probably range at the majority of creameries from less than two pence to more than four pence per gallon over the year. The higher costs are usually associated with small size of operation. There is, of course, considerable variation seasonally in both level of throughput and costs.

Considerable work has been carried out in the U.S.A. and more recently in the Republic of Ireland on the economies of size in traditional dairy manufacturing activities. The work done in the Republic of Ireland is quoted by H. L. Cook and G. W. Sprague in their report on the Irish Dairy Industry, and shows that butter-making costs fall from 7.75 pence per lb at 50 tons per annum to 1.91 pence at 2,400 tons per annum, and separating costs from 0.42 pence per gallon at 150,000 gallons to 0.09 pence at 1,050,000 gallons per annum. Their investigations showed that if all butter in the Republic of Ireland were manufactured in 25 plants of 2,400 ton capacity then £8,900,000 in direct manufacturing costs would be saved in 10 years, more than enough to pay for the capital costs involved. The effect on milk transport costs, however, was not calculated. Continuous butter-making would provide even greater economies, with plant capacities of up to 414,000 gallons a day, using 2 shifts of 4 men to operate two continuous butter-makers linked to a packing machine.

Milk Powder, Chocolate Crumb, Condensed and Evaporated Milk

There are still a large number of traditional roller-drying plants in operation but the newer spray-drying process has been gaining ground quite rapidly in recent years and all new installations have been of this type. The spray process produces a powder which, because of its improved solubility and versatility in product formulation, is in general more acceptable to the consumer than roller-dried powder. Roller-drying involves very severe heat treatment of the milk which results in a cooked flavour in the powder with severe denaturation of the

protein and destruction of the fat globule structure. Reconstitution is comparatively poor. These faults are less evident in spray-dried powder. The one main advantage of the roller-drying process is that the bacteriological quality of the powder is inherently very good due to the high temperature required during the drying process. For this reason roller-dried powder is still considerably used for the manufacture of baby food. The characteristics of spray powder can be varied according to the precise method of manufacture and in particular the degree of heat treatment used. Increasingly, the practice is to produce 'tailor-made' powders for particular purposes, since the ideal requirements for a powder used in, for example, ice-cream manufacture may differ from a powder designed for use in confectionery. A notable recent advance has been the introduction of 'instant' skim milk powder. Powder produced by the spray process is subjected to a further process known as the re-wet or agglomeration method which, if properly carried out, should result in a dust-free powder with very good solubility and dispersibility characteristics. Much work has been undertaken in attempts to produce an instant whole milk powder but so far without any real success. Work at the Hannah Dairy Research Institute in Scotland indicates that this lack of success is partly due to the formation of free fat in the re-wet process which causes flavour deterioration of the powder during re-drying and subsequent storage. This indicates that the re-wet process is inherently unsuitable for use with whole milk powder and there is no other really satisfactory method of instantising. A further problem with whole milk powder is that reconstitution is bound to be very slow if the temperature of the water is lower than the melting point of the fat. The same problem occurs with cold reconstitution of 'filled' milk powders (skimmed milk powder combined with vegetable fat).

There are a number of creameries solely concerned with the manufacture of whole milk powder but the majority of installations are at butter creameries and are primarily used for drying skim milk. Because of their high capital cost, spray dryers need a large throughput to be economic. It is not uncommon now to install drying plants capable of handling 5,000 to 6,000 gallons of milk per hour. The swing to spray-drying is, therefore, another factor tending to increase the size of manufacturing units.

Chocolate crumb manufacture is a specialised form of milk drying and only a few plants operate in this field. Considerable technical improvement in manufacturing techniques has taken place.

It is general practice to pre-condense milk before drying by the use of evaporators. These are, of course, also used in the production of evaporated and condensed milk. There has been considerable technical development over the last fifteen years in the evaporators used. The natural circulation unit used to be the standard type of evaporator but this is being rapidly replaced by film evaporators,

originally of the climbing film type but latterly using falling film. The objective of these technical developments can be classed under three headings:

- (a) Reduction of capital cost
- (b) Reduction of operating costs
- (c) Reduction in material denaturation.

Large-scale plant may achieve these three objectives, triple effect evaporators being a case in point.

Conventional evaporators of all types require large quantities of steam and cooling water and have in fact the highest energy requirements of any plant in a modern dairy factory. In the future, a new type of evaporator making use of the heat pump cycle, working with a closed circuit filled with a suitable refrigerant, offers considerable scope for economy and improved operation.

Looking ahead, new techniques such as freeze crystallisation, involving the centrifugal separation of ice crystals from the product, offer great improvements, not only in retention of product nutritive values and flavour but also of cost—only 80 calories per gram of water are required against 550 for a single effect evaporator. As extraction of individual milk constituents becomes possible all techniques which preserve product characteristics will need more attention. These will include freeze crystallisation, reverse osmosis, and vacuum spraying.

Several of the techniques referred to above have neither been investigated thoroughly nor widely used by the dairy industry. The possibility of competition from non-dairy firms in the food industry, at home and abroad, may force the industry to invest much more in testing and evaluating new evaporating techniques. This is important particularly where these techniques are designed to deal with many products and especially in view of the variable composition of milk. Apart from reducing capital and steam costs, a larger plant can be operated by one man as easily as a smaller plant. In fact, with the development of instrumentation techniques one man can easily monitor several evaporating and drying plants. What is frequently not taken into account is the work involved in cleaning and other operations. Frequently plant which requires one man for operation involves several men cleaning for short periods leading to under-utilisation of staff at other times. There are also problems involved in the maintenance of sophisticated control systems.

With the increasing use of evaporating and drying plant the industry may need to take the initiative in encouraging manufacturers, not only to use the techniques of value analysis and apply sound ergonomic principles in design but also to establish the work involved in the necessary operations. This entails the production of detailed step-by-step, commission and test, start-up, run, close-down and clean procedures to which would be added initial planned maintenance procedures.

Application of this work at the design stage would save an enormous amount of duplicated work in terms of work measurement and manual writing by operating companies. The analogy here should be drawn from computer manufacturers and their increasing attention to 'software'. Perhaps a joint forum for exchange of information between manufacturers and users should be set up under the auspices of a government department or some other suitable organisation.

Milk powder manufacturing costs are not readily available, but it is probable that they range from one penny to four pence per gallon. In a study of economics of size in skim milk powder production O'Dwyer* (An Foras Taluntais Rural Economy Division) quotes theoretical costs, excluding management staff, water and the cost of sacks for packaging the final product, ranging from approximately 1½ pence for plants with a throughput of 6½ million gallons a year to just over a penny for plants with a throughput of 32 million gallons a year.

Cheese Making and Whey Products

The vast majority of the cheese made in the United Kingdom and the Republic of Ireland is of the hard pressed variety with Cheddar predominating. In all factories, the curd is produced in vats. The size of vats has increased over the last decade and the older vats of 500 gallons capacity are being replaced by larger ones of up to 2,500 gallons capacity. The size and wrapping of the cheese has also been changing and there has been a very considerable swing away from the old fabric finish to film wrapping and from large traditional 56 lb cheeses to block cheeses in 40 lb units. Some automation of the process has taken place but production still remains a batch rather than a continuous process.

In comparison with butter-making and evaporating and drying, cheesemaking is fairly labour-intensive. Much progress has been made in the last ten years in reducing the variable factors by better control of starters, better hygiene and the use of scientific measuring techniques such as titration and pH readings to the point where cheese is almost made 'by the clock'. Better utilisation of vats and easier control have been achieved with the introduction of 'coolers' following scalding. Larger vats and in-place cleaning have reduced the amount of capital involved and also reduced labour and cleaning costs. More recently, the application of work study, particularly in the milling, salting, resting and moulding stages, has considerably reduced labour costs by the use of automatic salting, vibratory conveyors and automatic tared weighing. Machines have also been developed for wrapping, although the handling of the moulds into and out of press remains as a manual operation.

* T. O'Dwyer. Economics of Size in Skim-Milk Powder Production. *Ir. J. Agric. Econ. Rur. Sociol.* Vol. 1, No. 3, 1968.

In Australia, progress towards mechanisation has been very much faster, particularly at the cheddaring stage which is the most labour-intensive operation and is still carried out manually in this country. In some cases, possible controversy has been avoided by seeking to carry out by mechanical means exactly what is done by hand. This was the case with the cheddaring system, using conveyors and turning and piling positions initiated by Launder and developed by Czulak. Another system places less emphasis on the need for 'flow and spread' to develop the 'chicken-breasted' texture of Cheddar by piling curd in large coolers on a conveyor band, allowing settling or applying pressure, and then cutting. Systems developed by Jongia and Tebel mechanise the stages of curd consolidation and cutting, and either ignore flow or can be used with subsequent traditional cheddaring.

It is vital when considering mechanisation, to establish scientifically what is going on in the process, so that any changes introduced do not result in loss of quality—the rate of flow of product at different stages of the process is a critical factor. In the past, small batches provided a reasonably continuous flow of work throughout with a consistent utilisation of labour. The development of large batches has led in some cases to a very irregular work flow, particularly at the cheddaring stage, where the labour requirement can fluctuate from, say, two to fourteen men. One instance of this occurred where 2,800 gallon vats, originally intended for stirred curd production, were used for producing Cheddar with the Bell Siro system which provides no buffer stock between milling and moulding and runs at 8,000 lb per hour. The rate of 3.2 moulds per minute is satisfactory so far as the work content on moulding and subsequent operations is concerned but it allows 18.8 minutes for the milling and salting of a 2,800 gallon vat, and this must be related to the uniformity required in the final product. All in all, the development of continuous curd production should be assessed more in terms of its labour-saving potential from the cheddaring stage onwards than in the actual 'vat' stage.

A revolutionary development abroad has been the development of continuous curd manufacturing machines, of which perhaps the most promising is the Hutin-Stenne process developed in France. Continuous curd machines use concentrated milk and, therefore, have to be linked to evaporators. Much effort has been devoted to produce a curd with these machines comparable with Cheddar but so far it has not proved possible. However, very acceptable full fat cheeses of, for instance, the 'Saint Paulin' type can be made with such a machine and there would seem to be great scope for the development of new varieties in this country using this system.

If this new process could be developed successfully in the United Kingdom or the Republic of Ireland it would undoubtedly lead to greater concentration of cheese manufacture. However, with present methods, the economies to be gained

from further concentration of manufacture are rather limited—in many cases the result would be that where there was one vat before there would be two now. Such small savings in scale of operation would, therefore, very likely be cancelled out by the costs of transporting a larger labour force to the expanded site and the additional costs of bringing milk in from an expanded collection field.

Previously, there has been relatively little manufacture of full fat or soft cheese, largely because with conventional methods the labour requirements for these types of cheese are very high and only small batches can be made at a time. In view of the restricted amount of milk available for manufacture, the policy of concentrating on the traditional hard pressed varieties has probably been correct. However, the new continuous curd processes do offer the opportunity of manufacturing soft cheeses without encountering the labour problems of traditional methods and this is an area which is now being exploited. The manufacture of these products is covered in more detail subsequently.

Manufacturing costs are again not readily available but for Cheddar are probably in the range of three pence to six pence per gallon, including milk reception but not storage and maturation.

The major by-product of cheese manufacture is whey and the economic utilisation and disposal of this product presents both a challenge and an opportunity to the industry. The traditional use for whey is feeding to pigs and, indeed, farm-house cheesemaking enterprises are almost always combined with pig farming. Transport costs make this a less attractive solution for creameries that produce cheese on a factory scale and seasonal problems of disposal would, of course, also be likely to arise. Most cheese creameries in Britain either spray or roller dry their whey to produce whey powder, for which the main utilisation is in animal foodstuffs. However, this is really a very uneconomic way of utilising what is a very valuable foodstuff from the nutritional standpoint. The recovery of the nutritional value of the whey, when the animals to which it is fed are eventually used for human food consumption, can only be expected to be of the order of 20 per cent.

Cheese whey powder should, in fact, be considered as a potentially valuable source of food for direct human consumption. It has a comparable calorific value to skim milk powder, although it is not directly equivalent. Whey powder has a very high lactose content and contains 6–15 per cent protein compared with some 33–38 per cent protein in skim milk powder. A developing use for whey powder is the baking industry and the product helps to give a golden brown colour to the crust. It improves the shelf-life of dry mixes of pancakes, soups, puddings and cakes and may also be used to improve the whipping quality of instant dried potatoes. Whey powder might also be used in ice-cream manufacture and in the manufacture of some sweetmeats, while another possible use is as an additive to sausage fillers. One disadvantage of whey powder is its fairly high mineral

content which is considered disadvantageous by some parts of the food industry. Whey can be de-salted by electrodialysis but the process is expensive. However, recent experimental work indicates a good prospect for removing the mineral salts economically by the reverse osmosis process. If this can be satisfactorily developed, powder from whey treated in this manner could be used for the manufacture of infant and medical foods, e.g. for diabetics.

Lactose may be manufactured from whey and there are tentative proposals to manufacture it in the Republic of Ireland, in the Limerick Junction area. Lactose is separated from whey by crystallisation. This is an expensive process involving the evaporation of whey to 30 per cent solids, agitating the concentrate in stainless steel vats or tanks, and then centrifuging to separate the lactose crystals which are washed clean in cold water. Further processing may be required if very pure lactose is required. It is widely used in food manufacture and compared with sugar it has a relatively low sweetness value—while at the same time adding considerable flavour to foods. It is also used in the pharmaceutical industry as a pill coating because it readily absorbs dyes. Very few costs on lactose production are available but the Irish venture expects to be able to pay for whey at about a farthing per gallon collected which, together with the profits of the enterprise, is expected to provide a net return of a halfpenny per gallon. These figures again indicate the undervaluation of the solids-not-fat content of milk in comparison with butterfat.

Whey is popular as a base for flavoured drinks in some Eastern European countries—particularly Russia—but so far no similar development has taken place in the United Kingdom and the Republic. Carbonated flavoured whey could be a very wholesome and attractive product, and undoubtedly there are considerable opportunities here for an enterprising firm, backed with a good marketing and distribution network. The production of whey butter has also become one of the most important single uses of whey in the Republic in recent years.

Other Products

The nature and pricing structure of the dairy industry has led to the development of products which utilise by-products in a more economical and profitable manner. The best example of this is provided by yogurt, the presentation of which has been transformed in the last few years.

Yogurt is a product of Balkan origin dating back to biblical times. Essentially it consisted of milk (not necessarily cow's milk) which was cultured from day to day by a residue of the previous make. The modern product, whilst basically the same, is very much more sophisticated, and is usually made from milk, partially separated milk, or separated milk, with or without added milk solids. For many years the so-called 'classic' or set-curd type of yogurt was the order of the day.

This was either 'natural' or flavoured, in which case it also contained sugar. Incubation took place in the container and usually resulted in a characteristically light, 'fluffy' curd.

In the past five years, the popularity of yogurt containing real fruit has increased dramatically, requiring a revision in manufacturing techniques. This product is usually incubated in bulk, cooled, and the fruit mixed into the yogurt prior to filling. Despite the variations in spelling and in pronunciation, most of the products sold in the United Kingdom today are basically the same. They are made from a base of skim milk, with or without added milk solids and cream, are inoculated with a culture of *Lactobacillus Bulgaricus* and *Streptococcus Thermophilus*, incubated under controlled conditions to a desired level of acidity, and subsequently chilled to arrest the incubation process. There are differences in scale of production, which varies from a small subsidiary operation to single-product yogurt plants on a substantial scale.

Cottage cheese is another product which is increasing in importance in this country, although total production is only a fraction of that of the United States. The original Dutch cottage cheese was made by allowing milk to stand until it coagulated by the ordinary process of souring. The curd was put into cotton bags to drain, and after all free whey had escaped, the curd was salted. It was then pressed into the form of balls, and was ready for immediate consumption.

The two types of cottage cheese made at the present time are the European, which is a homogeneous pâté type of product, and the American type, with small particles of skim milk curd blended with cream. In this country it is the American style cottage cheese which is increasing in popularity. The long set (12 hours) method of production was first favoured by small operations but the economies associated with size have encouraged the short set system (4-5 hours). The curd is produced from skim milk coagulated with a starter and scalded and washed with water. It is then blended with a low fat cream and salt.

In view of the high cost of labour and the problems associated with the production of starters, a process whereby curd can be produced continuously and without a starter has been developed in the United States. The process consists of adding hydrochloric acid to skim milk at low temperature (37°-40°F) without coagulating the casein. Warming the skim milk without agitation produces a curd which is cut, cooked and washed in the normal fashion, although in this process it is done automatically and continuously.

The cost of manufacturing cottage cheese naturally varies according to the size and efficiency of the operation. The direct and indirect costs of seven plants in the U.S.A. were investigated by Rippen and McBride for a two year period, and are quoted by Reidy and Hedrick of Michigan State University*. The average cost was 19.7 pence per lb (at current exchange rate), with a range from 15.7

* Dairy Industries, Vol. 33, No. 9, September 1968, pp. 617-623.

pence to 27·6 pence per lb. The average cost of ingredients and manufacturing was 14·8 pence per lb. These costs are believed to be higher than those in the United Kingdom, possibly due to the higher price for skim milk in the protected U.S. market. Reidy and Hedrick indicate that the manufacture of cottage cheese in the United States will continue to be concentrated in fewer plants of larger capacity, with the trend towards greater mechanisation and automatic control, although complete automation is unlikely within the next decade.

Under new regulations both soft and cream cheeses are classified according to their butterfat content and subsequently bear the prefix high, medium or low fat. Control is also exercised in respect of moisture content. The terms soft cheese and cream cheese are becoming synonymous whereas traditional soft cheese used to refer to varieties such as Colwick, Coulommier and Cambridge.

Soft cheese is the soft, smooth, unripened product made by clotting the casein in the skim milk or cream mixture by encouraging acidity and adding rennet extract. The whey is removed from the curd by draining and pressing the curd in muslin bags. The traditional methods of manufacture were extremely labour intensive but these are being ousted by new methods of manufacture, and it is this development which has brought the confusion in terminology. The new methods, although changing the product slightly, have greatly extended its shelf-life.

Perhaps the most important single achievement in the processing of soft cheese, was the development of the centrifugal separator. This continuously removes whey from the hot soft cheese mix, and concentrates the curd to the correct composition for immediate packaging while hot.

Soft cheese is also produced by a cold pack method. This product has superior flavour and body characteristics compared with the hot pack procedures. However, the shelf-life of the product, even under ideal conditions, is limited to a maximum of about 20 days so that the number of plants that make cold pack cream cheese is small but at the present time alternative methods of manufacture are making this a viable enterprise. An important factor in the growth of this type of cheese has been the introduction of flavours.

Since the development of U.H.T. milk, a logical successor has been U.H.T. cream. This process does overcome the big problem of short shelf-life and the extremely variable demand for the fresh product. Another dairy-based U.H.T. product is Swiss Dessert and a ready-made custard has also been marketed. Packaging is one of the main problems with U.H.T. products which must be maintained in a sterile condition. At present the only possible forms of packaging which ensure this are the Tetra Pak and the can. Consumers find the former awkward to handle, whilst the latter is comparatively costly. The packaging industry could have a big influence on the development of U.H.T. products by producing the right size and shape of pack for each commodity. The U.H.T. method is now

used for products such as single cream, whipping cream, enriched milks and flavoured milks. The other main problem is the physio-chemical changes which take place during its long shelf-life.

There are several other minor products. Cultured buttermilk, a cultured skim milk, is a pleasant drink and heat treatment, plus the effect of the lactic acid, makes the protein easily digestible. Sour cream is cultured single cream (18 per cent) which enhances the flavour of other foods. Another product which has recently come on the market is 'Dairy Dessert', a fruit and fresh cream product. This appeals to the convenience shopper and it might have as bright a future as yogurt.

V. FUTURE TRENDS

The factual information presented in the previous sections of this bulletin sets the scene for the next two sections which are forward looking and therefore somewhat speculative. The complex inter-relationships between different events and policies make predictions difficult and it is preferable to consider a range of alternatives. To do this, future trends in demand and production, in location and seasonality, as well as developments in manufacturing are reiterated briefly and it is assumed that existing policies will continue.

Demand and Supply

The projections of demand in the United Kingdom for milk and dairy products in 1975 quoted in Section I indicate a rise in consumption of about 400 million gallons of milk equivalent over the 1968 level; i.e. to some 5,700 million gallons. Projections by Strauss* indicate a higher level of approximately 5,900 million gallons. The Demand Working Group of the Economic Development Committee for Agriculture† calculated a demand of 5,490 million gallons by 1972: continued increase at this rate would result in a demand of some 5,800 million gallons in 1975.

Projection of data on milk production suggests a level of total production in the United Kingdom in 1975 of 2,700 million gallons. This corresponds with the lower of two projections averaged by Strauss, the higher being approximately 2,900 million gallons. The E.D.C. projection of production for 1972-73 was 2,780 million gallons: continued expansion at this rate would result in the production of some 2,900 million gallons in 1975.

These projected rates of increase in demand and supply are in broad general agreement, but there are variations according to the nature of the assumptions made. They indicate an increase in demand of from 400 to 600 million gallons by 1975 and an increase in production of from 200 to 400 million gallons.

It should be borne in mind that the projections assume a rate of growth of demand and supply based on past experience. They take no account of possible technical developments, political influence on prices and other largely unpredictable factors. It is, however, important to discuss some factors relevant to future developments even though their influence cannot be measured.

Liquid milk consumption is obviously an important part of the total market for milk and dairy produce. To date, the whole of the liquid market has been supplied by home producers. The main threat to this market lies in the substitution of preserved forms of milk on the grounds of convenience or lower-cost.

* E. Strauss. *The Future of the Dairy Industry. Some Economic Aspects*. J. Soc. Dairy Technology, Vol. 20.1.1968.

† Economic Development Committee for Agriculture. *Agriculture's Import Saving Role*.

The increased use of skim milk powder in institutional catering has been mentioned and domestic use of 'instant' skim powder is increasing though so far it does not account for a large share of the market. If an easily soluble whole-milk powder is developed this might present a more serious challenge both in the possible sale of imported supplies and the economies resulting from easy storage. 'Filled' and synthetic milks have as yet made little impact in the United Kingdom and in the United States of America sales have been below expected levels. However, with lower prices and good keeping quality such products could compete with liquid milk sales in the future. Larger profit margins may eventually influence their adoption by the distributive trade but at present distributors are determined to maintain sale of liquid milk by regular household delivery. The changes in the school and welfare milk schemes have resulted in lower sales and milk drinking habits may become less well established. On the other hand, development of more acceptable milk based soft drinks may help to increase consumption.

A further factor is the effect of the eventual adoption of metric measures. If the standard size of retail container is changed from the pint (568 ml) to the half litre (500 ml) to accord with the practice of E.E.C. countries the likely effect is a drop in liquid sales of up to 10 per cent. This is because it is fairly certain, from experience in countries that have changed, that most housewives would continue to purchase the same number of bottles as before, making do with a little less milk. Conversely, an increase in the standard size of bottle to say 600 ml could well result in a sales increase. But at present the dairy trade is believed to be opposed to any change from the pint, and it is likely that it will be some years before any change takes place, although in the long term it is scarcely conceivable that the dairy industry would be allowed to remain the odd man out in a 'metric' world.

With regard to the demand for dairy products, butter sales may increase with the growth of population and with rising incomes but, if some form of international control resulted in the removal of surplus supplies from world markets and prices rose, sales might well fall. The decreasing consumption of bread, and competition from margarine are also factors which could reduce butter consumption. Voluntary limitation of fat intake for dietary reasons is another factor. Cheese consumption per head in the United Kingdom is lower than in most European countries and the trend to higher consumption in recent years may well be accelerated. Sales of fresh cream have risen rapidly in recent years and are expected to continue to rise. Synthetics are obviously competitive especially in the confectionery trade but recent trends have been away from synthetics to fresh cream. Sales of yogurt, which is mainly produced from skimmed milk, have increased very rapidly over recent years and now account for two million gallons annually of liquid milk plus a large quantity of skim milk. This product and other items such as canned puddings and custard may well continue to increase in importance but their contribution will remain relatively small for some years.

It may be of significance that many of the innovations in dairy manufacturing have been developed by firms with interests primarily in food manufacturing rather than in dairy manufacture. Consequently there is the obvious possibility of further substitution of non-dairy for dairy ingredients, e.g. ice cream which in the United Kingdom is largely produced by 'food' firms and has a minimal content of dairy produce.

In making the projections on milk production, no adjustments have been made to take account of possible changes in the relative prices and production costs of milk and alternative products, nor of technical advances which might accelerate the existing trends for herd size to increase and yields per cow to rise.

There has been a marked and continuing decrease in the number of milk producers in all areas especially in the South and East. Least changes occurred in South Wales where profitable alternatives are few. Dairy cow numbers have also declined markedly in the South and East and to a lesser extent in the Midlands and Wales, but have risen in the South-West and North areas. Total numbers increased in England, Wales and Northern Ireland but decreased in Scotland, the overall trend for the United Kingdom in recent years being a decrease of 0.7 per cent annually. Projection to 1975 indicates a dairy cow population of 2,696,000 in England and Wales and 3,181,000 in the United Kingdom.

Projection of yields per cow achieved over the past decade suggests that average yield will reach some 820 gallons per cow per year by 1975. Past increases have been most marked in the South-West with an annual increase of 8.3 gallons per cow. There is some correspondence between regional variations in average annual yield per cow and the proportion of Friesian cows in herds. The highest sales of milk per cow were recorded in the Midlands where Friesians account for over 70 per cent of the dairy cows. In the South-West the proportion of Friesians increased by 28 per cent, to 55 per cent, between 1960 and 1965.

Projections of milk sales off farms in 1974-75 by regions are given in Table V.1.

For the Republic of Ireland, Cook and Sprague* estimate total milk production in 1975 at 930 million gallons, of which 114 million would be used for farm butter and livestock feeding and 816 million gallons sold off farms. The results obtained by Colman and Leech† using Markov chain analysis are of interest. They predict a fall in the number of producers of 32.7 per cent between 1966-67 and 1975-76 to 62,600 in England and Wales, with the highest rates of decline in the Northern, Eastern, East Midlands and Southern regions (M.M.B.) and the lowest rate in the North Western region.

* H. L. Cook and F. W. Sprague. Irish Dairy Industry Organisation, Department of Agriculture & Fisheries. Dublin 1968.

† D. Colman and D. Leech. Structural Changes in the Dairy Industry in England and Wales. *Journal of Agricultural Economics*, Vol. XXI, No. 2, May 1970.

The general conclusion to be drawn from the discussions of projected future demand for and supply of milk and dairy products is that if the population increases as predicted, if the consumption per head of liquid milk remains static and if the price relationships remain at their current level then there will be scope for expansion of milk production. However, the major problem facing the industry is that while imported supplies of dairy produce are available at low prices, either from countries with a natural comparative advantage in milk production or from those which subsidise exports, any increase in production not matched by an increase in liquid consumption can under the present pricing system only result in a lower price. Obviously there remains a large manufacturing milk market open to the home producer but only at lower realisation prices than for the liquid market.

TABLE V.1

PROJECTED SALES OF MILK OFF FARMS BY AREAS, 1974-75

	<i>Sales 1967-68*</i> <i>m. galls.</i>	<i>Sales 1974-75</i> <i>m. galls.</i>
North	675	741
South and East	365	358
Midland	327	352
South West	524	585
Wales	250	267
England and Wales	2,141	2,303
Scotland	246	252
Northern Ireland	143	164
United Kingdom	2,530	2,719
Republic of Ireland†	741	812

* Sales for some regions in this year were adversely affected by the consequences of the outbreak of foot and mouth disease.

† All milk excluding milk to calves.

Location

The principles governing the future siting of new manufacturing plant have been discussed in Section III. There might be exceptions if standardisation of milk were introduced, because then some facilities might be needed in the Liquid Zone to manufacture surplus cream into butter. The amount of new capacity necessary would of course depend mainly on the trends in the volume and pattern of production, although the rate of replacement of equipment would also be important, particularly in areas where manufacture is badly sited. There would undoubtedly

be savings in transport costs if the milk now manufactured in the theoretical 'Liquid Zone' was used in the liquid market because then 'replacement milk' would not have to be brought in from further afield. The justification for any change would depend on the transport savings in relation to the cost of resiting existing manufacturing plants. Neither factor is easily quantifiable. The probable outcome is that new investment would be largely channelled into the outer manufacturing areas, particularly if these were in 'Development Areas', where high rates of investment grant could be obtained. It seems likely then that a gradual run down of ill-sited manufacture will take place and new equipment will be resited in more suitable locations when existing facilities run down or become technologically outdated.

Seasonality

Once established, seasonal patterns of production cannot be modified quickly without great efforts. It is true that in England and Wales there has been an observable trend over a period of many years for the winter trough in production to deepen and to come later in the year, but this is only occurring very slowly. Although this trend is likely to continue, its effect on the pattern of manufacture will be comparatively insignificant.

It is interesting to speculate whether, as deliberate policy, effective efforts will be made to alter seasonality patterns of production. Expansion of summer production would accentuate the seasonal variation of manufacture—particularly of butter—in the United Kingdom. However, producers will not consider adapting their production schedules in this way unless there is a prospect of economic advantage to them. This might occur if a pricing schedule were introduced with less differential between summer and winter prices than at present. This was done to a certain degree in the England and Wales Milk Marketing Board's Summer Milk Experiment, but the summer weighting was insufficient to attract many producers.

Revised price schedules must satisfy two criteria. Firstly, they must ensure that winter producers changing over to an extreme summer-type production do not incur a fall in average annual milk prices in excess of the savings of production costs. Secondly, the savings in average prices paid to producers under the new price schedule compared with the old should be more than adequate to offset any additional manufacturing costs involved in providing more manufacturing capacity (per million gallons manufactured per annum) to cope with the higher volume of milk at peak production.

Although it seems possible that these conditions could be met in the United Kingdom if milk production were expanding, it is by no means a certainty, and more research on both manufacturing and production costs related to seasonality

appears to be needed. An expansion of milk production might be regarded as a prerequisite for introducing 'summer price schedules' in selected manufacturing areas for, at present production levels, at least in England and Wales, there is insufficient margin at trough for it to be safe to introduce policies that would deliberately accentuate seasonality.

The situation in the Republic of Ireland is the reverse of the United Kingdom, for there the problem is thought to be too great a seasonality of production, rather than too little. Again, more research seems indicated before voicing an opinion on the most economic pattern of seasonality to aim for, taking account of the costs of both the production and the manufacturing sides of the industry.

Future Trends in Manufacturing

If current trends of rising milk production and comparatively static liquid consumption continue, this will result in a substantial increase in the surplus of milk for manufacture over the next few years. However, the possibility of changes in the pricing structure of the industry and in the attitude of the government towards imports of dairy products introduce considerable uncertainty. Furthermore the possible effect of our joining the European Community adds to this uncertainty. Although the increase in bulk farm collection will lead to further rationalisation, it is unlikely that any economies in transportation costs which occur will significantly increase the current optimum size of the manufacturing plant. There will undoubtedly be some specialised plants with greatly increased capacity, but the main trend will probably be towards the large multi-purpose plant.

It is possible that the technical difficulties of producing a satisfactory instant full-cream milk powder will be overcome. This could have a considerable impact on the domestic liquid market, and if a marked degree of substitution took place a greater proportion of the milk produced in the United Kingdom would have to be manufactured, provided that farm prices were maintained and that the government did not deliberately aim to run down milk production. However, the technical difficulties have not yet been overcome, and the effect on the liquid market is very difficult to judge.

One further development could be the standardisation of milk. This has been common practice in the majority of the main dairying countries for many years and might have to be legalised in these countries if we join the E.E.C. Gauging the effect of standardisation on the home market is difficult. The seasonal fluctuation in compositional quality, and the high proportion of supplies going to the liquid market in England and Wales in particular, mean that all milk for liquid consumption throughout the year would have to be standardised to average below the present level achieved but there could be a range of grades. This would probably decrease the amount of butterfat consumed in liquid milk, a development

which producers might regard as retrograde in view of the mounting world butter surplus. It is possible that the industry could increase profits by offering a wide range of specially formulated milks. It is doubtful if such a development would increase liquid milk sales, but it might provide the industry with an enhanced return for the same volume of sales. In a period of rising prosperity this would help to maintain the percentage of income spent by consumers on dairy products. In any event, it does seem highly probable that standardisation will be introduced if these countries join the E.E.C., and the result will be an increase in the amount of butterfat available for manufacture. For instance, the United Kingdom butter production in 1968-69 of 52 thousand tons would have more than doubled if all liquid sales had been standardised at 3 per cent butterfat, and the excess butterfat used for butter production.

There will undoubtedly be a drive to develop new lines, with increasing emphasis on 'mixed' rather than 'straight' dairy products. The influence of the 'non dairy' food manufacturers is almost certain to increase, and milk and its constituent parts will become more and more regarded as ingredients of a product rather than a complete product to which nothing should be added and nothing taken away. The development of the U.H.T. process, which enables dairy based products to be stored for long periods without refrigeration, will undoubtedly encourage such a trend. The traditional and purist approach, which has sought to preserve milk and its distribution in established forms, has already led to firms from outside the dairy industry reaping the benefits of new developments. Now there is a growing appreciation that milk can be broken down or combined in a number of different ways, and that it is an ideal raw material for developing new food products. If the dairy manufacturing industry is to reap the most profitable rewards for its basic material, then its constituent companies will have to make a considerable investment in process and product development within the wider context of the food industry. If the return on such investment is to be optimised then this development work must be supported by modern marketing techniques and integrated into long range planning policy of companies in the industry.

In no area is the scope for the dairy manufacturing industry more apparent than in the exploitation of its by-products. Convenience-type foods of the low-fat, low-calorie, high-protein type will increase in number to make use of such products as the calcium co-precipitates of milk proteins, a combination of casein and whey proteins which recovers 96 per cent of the protein in skim milk, and for which a continuous process has been developed. Great strides are certainly being made in the manufacture and marketing of skim-utilisation by-products such as yogurt and cottage cheese, and dairy technology is now advancing at a greater rate in this area inside, as well as outside, the dairy manufacturing industry.

Despite the accent on the development of new products, undoubtedly there will be considerable advances in the production of the traditional dairy products. In

the Republic of Ireland butter produced on a continuous buttermaker and subsequently canned has been shown to preserve the characteristic flavour of fresh butter better than present methods and to give better physical and microbiological results. Work has also been carried out on the de-aeration of butter to reduce bulk. Powdered butter and cheese have already been produced in Australia. The development work being carried out on continuous cheese production will proceed until a satisfactory product is made. It may be that the cheese produced on a continuous system will lack some of the body and flavour characteristics of conventional cheese, but will open up a market by virtue of its good bacteriological quality and competitive price. It is therefore reasonable to expect a switch to the continuous methods of butter and cheese manufacture, because of the productivity benefits that they promise, and in the case of cheese manufacture this might lead to the development of entirely new varieties of cheese of the 'full fat' type. A considerable expansion of cottage cheese production also seems a likely possibility.

It was indicated earlier that future trends will probably be more marked in the direction of multi-purpose plant, since this provides a means of overcoming the seasonal fluctuations of milk production and producing a better return on capital, and increased investment in both the technological and commercial aspects of such developments will be essential. But there will also be a move towards larger-scale continuous capacity plants for certain products, and a word of warning is necessary here. The advance of mechanisation and automation has a particular attraction, and the economics of the situation are not always adequately examined. On a number of projects in the past subsequent work study investigations have shown that the greater part of the savings achieved could have been gained by the improvement of existing methods with relatively little expenditure of capital. This is not an argument against technical progress, but one in favour of proper project feasibility studies and the best use of capital resources.

There will be an increase in the application of computers in the dairy manufacturing industry, both in formulation and process control. The application in respect of formulation will be mainly in terms of the use of dairy products and by-products in the production of convenience foods, animal feeds, etc., and such applications will be particularly important where multi-purpose plant is involved. Experience in the biscuit industry has shown that the balancing of flexibility and efficiency of production with minimum investment in plant is best achieved with the use of a computer. Analogue computers will also be used to simulate changes in product or treatment without carrying out actual production runs. Already such computers are being used to simulate production runs in order to establish the restraints on increasing throughput of a plant at various levels. A recent application revealed that the removal of a series of restraints, as costed by work study, in terms of labour, and by engineering feasibility studies, could produce an increase in plant capacity of 300 per cent for an increase in capital investment of

7 per cent. Although this is an extreme example, it shows what can sometimes be done.

Individual companies will intensify their research and development effort, but there also seems to be a clear need for one central Product Development Research Association for the dairy industry itself working closely with, or within the orbit of, the Food Manufacturers Research Association. Such an organisation would be mainly concerned with developing projects to the commercial marketing stage, and would therefore supplement the basic research work now undertaken by the National Institute for Research in Dairying. One possibility would be to build on the nucleus provided by the Technical Division of the England and Wales Milk Marketing Board, which already aims to undertake product development work which could be taken up by any suitable dairy firm, and is not solely confined to research on behalf of the Board's own creamery organisation. If a central development organisation was instituted, under whatever auspices, there would be the need to avoid some of the basic problems that so often occur in this sort of work. In some cases the Research Associations have difficulty in interesting their members in their developments; and in other cases so many organisations adopt the new technique that the market is flooded and all operate uneconomically until some eventually drop out. On the basis that something paid for and competed for is valued more highly, there may well be a case for putting Research Association developments out to tender. The highest bidder could then pay a royalty, which would provide the Association with funds to carry out further work and purchase better equipment, and would also provide encouragement and motivation for their staff. An aspect of research and development work which will require more specialist attention in the future is concerned with the problems associated with distribution especially in the field of packaging.

As for the whole of British agriculture the future holds a great number of imponderables for the dairy industry and the inevitable changes will greatly affect the manufacturing side of the industry. This is now harnessing some of the fruits of modern process technology and management techniques in order to meet the challenge that lies ahead. It will be interesting to see how far the dairy industry retains its individuality.

VI. POLICY CONSIDERATIONS FOR THE FUTURE

The information on possible future trends, contained in the preceding section, indicates that the market for liquid milk may expand more slowly than milk production thus leaving more milk for manufacturing. Under current arrangements, this would mean some reduction in the average realisation price per gallon of milk. It may prove impracticable to increase the realisation price by raising the liquid milk price since the quantity of liquid milk purchased by consumers is likely to fall if its price increases and this would add still further to the manufacturing quantity.

Faced with this situation, there are various alternative policies and policy elements which could be employed, the final choice being influenced by a range of interests and not merely by economic considerations. For example, the incomes of dairy farmers are affected not only by the price of milk but also by unit costs and scale of enterprise. Policy towards their incomes is influenced by the relative importance of the sector and the number of people dependent upon it for a livelihood. Milk Marketing Boards are an integral part of the dairy industry and policy would need to take account of the role they are expected to play and the powers they would require. Similarly, the requirements of the growing manufacturing industry need to be taken into account. Last, but by no means least, the interests of consumers must be considered.

This complex of interests has to be borne in mind by the Government and a responsible government has to fit dairy policy into its agricultural policy, which in turn must conform to its overall national policy on production and resource use. In doing so it has to consider the international aspects: the benefits accruing from trade and the contractual obligations of the United Kingdom within various international agreements. In such a situation it may be useful to indicate some of the likely effects of alternatives and to discuss possible advantages and disadvantages of different policies. The remainder of this section attempts to do this in relation to some of the more relevant factors.

The Current Situation

U.K. Government policy has until recently been based on the maintenance of the dairy industry at a level providing for the demand for liquid milk consumption with an appropriate safety margin. The development of a manufacturing industry as such has not been encouraged, mainly because of the ample supplies of dairy products available at low prices from Commonwealth and other countries and also trade obligations. This is to some extent reflected in the limitation of guarantees to the industry by means of the standard quantity mechanism which was established in 1954. In recent years it has been argued that, as the dairy herd is the major source of beef animals, expansion of beef production can be achieved by enlarging the

national dairy herd but this involves an increase in milk available for manufacturing. The current government objective is, therefore, to have a national dairy herd at a level providing liquid milk supplies and a larger number of beef animals but keeping to a minimum the dilution effect of low manufacturing milk prices on the pool price paid to producers.

These policies may be judged successful in that liquid milk supplies have met demand at retail prices which, when allowance is made for the service element in the United Kingdom, compare favourably with those in Western Europe. The pool price received by milk producers in the United Kingdom fell during the years following decontrol in 1954 subsequently rising to a level some seven per cent higher in 1968 while in other dairying countries they increased to a much greater extent. As a result of increased efficiency, however, milk production has remained a relatively profitable enterprise to farmers. On the other hand, many farmers feel that higher prices would be necessary to give them adequate returns. Consideration of such issues is beyond the scope of this bulletin. The average retail price of milk rose by 2s. 9d. per gallon (63 per cent) between 1954 and 1969: 50 per cent of this increase is attributable to increase in distribution costs, 22 per cent to elimination of the Government subsidy while the remaining 28 per cent accrued to producers.

Stocks of dairy produce in the United Kingdom are at relatively high levels and these are largely of imported origin. Stocks have fallen to some extent following Government action in reducing butter quotas and restricting cheese imports. The availability of imported produce at low prices however, continues to affect prices for manufacturing milk and, mainly as a result of the fall in the price of milk used for butter, the average realisation price for manufacturing milk in 1968-69 was the lowest for five years.

Efficiency in the production, manufacturing and distribution of milk has improved continuously over recent years. The average size of herd in the United Kingdom has increased by 50 per cent during the sixties to 29 in 1968 while average yields per cow have increased by over 5 per cent to 815 gal. These developments have been accompanied by changes in breeds, the use of artificial insemination and improved feeding. In addition, labour costs have been reduced by improvements in buildings, layout and milking techniques. Also during the sixties the number of registered milk producers has declined by about 30 per cent to 105,981 in 1969. In the manufacturing industry there has also been a substantial decrease in the number of plants and an increase in the capacity of those remaining. In distribution, the development of bulk ex-farm collection makes it possible for transport vehicles to collect each day at least twice as much milk as previously and to travel longer distances and thereby bypass country depots. The weight of bottles has also been reduced and plastic crates have been introduced, thus enabling

roundsmen to carry more milk on their delivery vehicles and increasing the average size of rounds from 89 to 94 gallons between 1966 and 1968.

Imports

The proportions of the U.K. market supplied by imports in 1968 were:

	<i>per cent</i>		<i>per cent</i>
Butter	90	Milk powder	25
Cheese	60	Cream: Fresh	4
Condensed milk	—	Sterilised	37
Chocolate crumb	29		

Imports are brought in under a variety of bilateral and multilateral agreements, both formal and informal. Specific agreements include the Anglo-Irish Free Trade Agreements, agreements within the European Free Trade Association, Anglo-Australian and Anglo-New Zealand agreements. At the wider level, there are the butter quota system and cheese import restraint agreement in addition to such general concepts as the General Agreement on Tariffs and Trade. In a number of instances dairy imports have been dumped or subsidised by exporting governments and only one of the main suppliers has undoubtedly been trading without support. In the circumstances it is difficult to decide what the 'free competitive' price would have been.

The main point to bear in mind, when discussing alternative policies, is the fact that, in addition to specific international agreements, general assurances have been given to traditional suppliers such as New Zealand. These give an undertaking that there will be no massive expansion of dairy product manufacture in the United Kingdom at the expense of their exports. Such policies can be reversed and in any case the brunt of any import substitution could be directed at non-traditional suppliers. There is of course the risk of retaliation or reciprocal trade losses but these are difficult to estimate. Within the U.K. these agreements concern not only the dairy manufacturing interests but also affect consumers directly and other British industrial and trading sectors indirectly. It would be unreasonable to expect major changes in U.K. trading policy solely in order to accommodate the interests of those affected by one particular and relatively small sector of our domestic industry.

Within the present framework of agreements, a degree of stability has been achieved with butter and cheese, but the domestic market in milk powder and skimmed milk products has not been subject to agreement and has been relatively unprofitable.

Milk Allocation

In decisions regarding the allocation of milk to manufacturers, the marketing boards have freedom to act only within certain constraints. Thus the cheese import restraint agreement cannot be disregarded and the volume of milk going for this purpose is therefore affected. Conversely, with butter manufacture, the residual nature of this use means that existing plants cannot be guaranteed continuity of supplies to maintain a regular level of throughput. It could be argued that these limitations on action are restricting the level of competition between manufacturers and, to some extent, hindering the search for a better allocation. On the other hand, there is the argument for stability, which would assert that such competition would be anarchic and damage the prospects for rising efficiency based on known regularity of supply. There is of course competition for milk between products because the Boards try to fulfil the requirements of high-category products in preference to others. Within the restrictions imposed by implementing government policies and trying to maintain stability in the industry, the marketing boards would claim that they attempt to encourage the development of new products and seek to obtain the best returns possible for producers.

Under present U.K. conditions, it is inappropriate to consider manufactured milk separately from fresh milk because farm production is identical for both and has to attain 'liquid market' standards. The economics of the industry, both at farm and factory level is complex, with a wide range of possibilities in production and utilisation of milk which involve problems of location, scale and seasonality. Simple resolution of the issues facing the industry is therefore unlikely.

Pricing of Farm Milk

In discussing prices, one possibility is to maintain the present policy. This involves having a high guaranteed price for a standard quantity (adequate to meet the liquid market with some safety margin), and low realisation prices for manufactured items, generating a pool price with appropriate quality, seasonal and regional variations. Given the likely expansion of production this would lead to a gradual fall in the pool price. The disadvantage of this, from the farmers' point of view, is that gross margins per cow are reduced, although increasing herd-size may enable farm income to be maintained. The marginal value of milk is not reflected by the price which farmers receive for their increased output so that uneconomic production can occur without producers being aware.

It is sometimes suggested that the expansion of production by individual producers should be discouraged because the marginal costs of producing the extra milk exceed the low manufacturing realisation that it earns for the price 'pool'. But in fact it is not possible to make a simple judgement of what is economically 'right' because the realisation prices themselves are not left to the free determination

of 'pure' economic forces. Theoretically, in a system of completely free competition, the differential in prices between manufacturing and liquid market milk would be slight and if supplies increased because some producers expanded output to reduce their unit costs realisation prices would fall to the extent that some high cost producers would be forced out of production thus contracting supply and bringing the market back into equilibrium. In passing, it must be mentioned that a 'free' system of this sort would probably lead to great price instability which might well reduce efficiency to the detriment of both producers and consumers. Producers expanding production would not be forced out of business unless their expansion resulted in their becoming high cost producers whereas usually the effect of expansion is to reduce average unit costs. The economic case for restraining expansion by individual producers is therefore not entirely sound, but nevertheless the problem of expanding output tending to reduce average returns per gallon has to be faced. Purely from the standpoint of efficiency there is a case for allowing high cost producers to be squeezed out to encourage low cost production. However, against the efficiency argument has to be balanced the social consequences particularly the effect on the less favoured areas of the country which might be faced with extensive depopulation.

A variation on present policy would be to increase the standard quantity to include all or a large part of the manufacturing milk. While this more open-ended guarantee would benefit farmers' incomes it would be at the cost of a subsidy from the taxpayer or higher retail prices for the consumer. Moreover this would not solve the problem of unprofitable marginal milk—indeed it would be likely to increase the problem by stimulating additional production with all the implications this has for import saving and the balance of trade.

The taxing of incoming dairy produce would constitute a radical departure from present policy. This could be achieved by means of variable levies, as in the Common Market system, or by minimum import prices, as envisaged in the Conservative Agricultural Policy. These devices would enable all home-produced milk to be sold at practically the same price, regardless of its utilisation. Some variations might be retained to cover the costs of producing milk for the liquid market since this might involve high quality standards as well as a high level of winter supplies. In the European Economic Community (E.E.C.) at the moment, variations in milk prices according to utilisation are believed to be below sixpence per gallon. Without the adoption of E.E.C. policies and prices, it seems unlikely that the British Government would impose threshold prices on imported dairy products at a level which would allow all home produced milk to be sold at more or less uniform prices and at the same time maintain the present level of 'pool' prices. To do so would result in very much higher dairy product prices to consumers, although as taxpayers they could be correspondingly better off if the

proceeds of levies were retained in this country. Within E.E.C. of course such levies would not be retained.

The implementation of the E.E.C. type policy is unlikely in the U.K. unless she becomes a member but the introduction of a modified policy which would narrow the price gap between liquid and manufacturing milk is a possibility. Such a policy would have far reaching implications for both consumers and producers. For consumers, the price of liquid milk might fall a little but this would be far outweighed by increases in dairy product prices. The former might give some fillip to liquid milk sales, but the latter would be likely to reduce the sales of dairy products unless the levies on imports were used to subsidise the needy or to reduce taxation. For producers, prices of individual products could be adjusted so that the existing average price would be achieved at the outset, but in the longer term, if production expanded producers would be protected against the 'dilution' effect experienced with the current system. Such a policy would generate confidence, and create a climate within which productivity should increase and unit costs decrease. Its impact on level of production is difficult to forecast because it is often considered that a gentle squeeze on prices is the most effective way of encouraging greater production. Its effect on self sufficiency in dairy products is more predictable—imports should decrease in the short run because of a price-induced contraction of the market, and in the long run because of expansion in home production in excess of the difference between expanded liquid sales and contracted manufacturing sales.

It seems then, that a policy of increasing final product prices has limitations. Any increase in the liquid milk price is likely to reduce the volume of sales: an increase in the price of milk products has a similar effect and can only be accomplished by limiting imports involving amendments to existing agreements. Apart from considerations of international trade, this raises the whole issue of consumer versus producer and possible conflicts between the concepts of equity and economic efficiency.

Another aspect of pricing arises when considering the farmers' choice of enterprises. At present, the dairy herd is by far the most profitable grassland enterprise. A typical gross margin per acre of lowland devoted to dairying is £60, while similar figures for beef or lamb are £25 or £20 respectively. If the likely future problem is diagnosed as supply pressure, it could be relieved by making other enterprises on the farm relatively more attractive, either by increasing beef and lamb prices or by reducing milk prices, or by some combination. A further point arises when considering the beef-milk relationship in the national dairy herd. If more beef is required relative to milk, this could be achieved through lower yields per lactation. In so far as yield is determined by the level of concentrate feeding, a reduction in the relative price of milk to concentrates could bring this about.

The possibility of putting the whole of U.K. milk production on a quota system has been examined. This has been summarised in a document circulated to milk producers in England and Wales in 1966.* The schemes considered were all based on specific allocation of a quantity to individual producers and on multiple prices. Under fixed base quota schemes a basic gallonage is laid down for a given period, a formula for determining the higher price proportion is established and the high-tier and low-tier prices are determined. The fixed-base non-transferable quota is the most simple form but also the most rigid, acting as an obstacle to expansion and being difficult to adjust to changing market requirements. Moving-base schemes are more flexible and less restrictive though their effectiveness is less predictable.

The arguments for and against quota schemes are finely balanced. On the one hand the adoption of some form of quota scheme would guarantee each producer a known share of the liquid market returns. A lower price for production 'above quota' would ensure that production was not expanded unless the cost of doing so was less than the low-tier price. This would seem likely to channel any expansion into low cost summer production. On the other hand the effect of introducing quotas would be to give existing producers a new 'asset' which would almost certainly have to be made saleable. This would increase the capital requirement for the new entrant to dairy farming. Quotas are also the antithesis of a free economic system since unless the quotas are saleable they make it difficult for the efficient to expand and mitigate the forces which would compel the inefficient to leave milk production.

Finally, there is the possibility of having separate contracts for producing liquid milk and manufacturing milk. Several countries already employ such policies. Fresh milk suppliers could be on some type of saleable quotas, linked to a requirement to produce all-the-year-round regular supplies. Manufacturing milk suppliers, who might be able to operate with lower usage of capital, could be located where climatic advantage favoured grass-only summer milk production. This idea has been mooted many times in the past. There are administrative and technical problems involved and the comparative advantage of the various regions of the U.K. would be radically altered.

The possibility of producing milk specially for the manufacturing market presents a tremendous challenge. It is doubtful whether this could be done profitably even in the most highly favoured grassland areas, without adjustments in prices and production methods and changes in the milk and dairies regulations. Prices could be adjusted upwards by control of imported products or by a subsidy transfer from the 'liquid' milk producer to the producer of milk for manufacture. A change in methods to a cheap, extreme summer type of production would reduce feed costs in the short run and housing costs in the long run. The relaxation

* N.F.U. and M.M.B. A study of Alternative Payment Systems for Milk. April 1966.

of various standards so essential in producing milk for liquid consumption could also reduce labour costs. These cost reductions would have to compensate for lower realisation prices and at the same time outweigh the additional costs of manufacturing highly seasonal supplies of milk, but the position needs to be examined carefully because there may be advantages in separating the two markets, particularly if there is a further expansion of milk production.

In the Republic of Ireland, the problems of the rapid increase in the costs of supporting milk prices, even at levels which are low by European standards, have been of major importance in official policies towards milk production. The increases in costs of milk production have tended to be felt more strongly by the small and medium scale producers than by the large ones. The recent change in the rates of milk price support are designed to ensure that the benefit of the additional Exchequer support which can be made available for milk is applied where it is most needed, i.e. to the smaller farmer. The larger producers have advantages of scale which lead to substantially lower costs per gallon than those of the smaller farmer. In the particular circumstances of the Irish economy, the maintenance of farm employment opportunities is of special concern and this means that the opportunities for a reasonable income from milk production on smaller farms is a major part of the government's agricultural policy.

The problem of maintaining incomes of milk producers, especially those of small or medium size, is a particularly formidable one in the face of the very low returns of the world market for dairy products. Inducements to farmers to develop alternative enterprises, particularly beef, have been offered by the Government in the form of a Beef Incentive Scheme. At the same time entry, with the U.K., into the E.E.C. would bring substantial opportunities for the dairy farmer in the Republic, who can compete effectively with producers in any other European country. In these circumstances the restriction of output in the Republic of Ireland, as mentioned by the E.E.C. Commission in its report on the enlargement of the Community, to just that which can be sold at home or on higher priced quota markets abroad would limit the potential gains to be achieved in the event of E.E.C. membership.

Pricing Policies for the Manufacturing Industry

Retail prices of dairy products are determined by the interplay of market forces, in which imports play a major part, and with the marketing boards controlling the allocation of domestic milk supply. The present policy of negotiating milk manufacturing prices, is likely to remain as an integral part of the institutional arrangements. This process involves an examination of manufacturing operation costs and a review of the international prices of dairy products. Two areas in which change could be envisaged are in the field of dairy regulations, both statutory and

administrative on the one hand, and the distribution system on the other. Under present law, the degree to which milk and dairy products can be 'tailored' to market requirements is limited. For instance, the standardisation of milk practised in most countries cannot be undertaken here. Indeed in the United Kingdom, the basic legal directive still ensures that nothing is added and nothing is taken away from the milk as it comes from the cow.

At present milk distribution costs are relatively high due to the daily delivery system. Any change in such a system, while possibly of benefit to distributors, would prejudice consumption and thereby the incomes of milk producers. The development of new milk products is perhaps one of the most promising ways of stimulating the market. However, it is most unlikely that, in milk volume terms, the new products will rival traditional products in the near future. Furthermore, new product development is not likely to provide an immediate and complete panacea for the industry, but this should not be regarded as an excuse for inactivity.

Throughout the foregoing paragraphs no consideration has been given to the possibility of any change in the functions of the marketing boards. In both the U.K. and the E.E.C., product marketing organisations have been the subject of thought and enquiry, but such speculation has been outside the terms of reference of this study. Nevertheless, mention should be made of the Board's widening range of activities which include advertising, sales promotion, new product development, dairy husbandry services such as artificial insemination, national milk records and advisory work, in addition to their main tasks of organising milk distribution and paying producers.

The major development in the Republic of Ireland is the reorganisation of the manufacturing industry so as to reduce the number of manufacturers in order to create large scale units capable of producing a range of dairy products. The prospects of reducing unit manufacturing costs and of developing more flexible manufacturing policies to meet current market demands has been the stimulus to a trend towards rationalising the manufacturing industry. This trend has been generally accepted but its implementation has been a relatively slow process. Even though the creameries are owned by farmer co-operatives and a state sponsored undertaking, the social and other problems present very complex difficulties in developing a more rational industrial structure.

It seems likely that slow but fairly steady progress will be made towards a rationalised manufacturing industry. According to the Third Programme—Economic and Social Development 1969-72.

'With the increasing pressure on world prices for dairy products, the necessity to effect the utmost economy both in production and manufacturing becomes more important. In this connection the Government consider it essential for the creamery and milk processing industry to derive the operating and marketing

advantages that are to be gained from economies of scale and diversification of production. In 1967 the Minister for Agriculture and Fisheries, on the recommendation of the National Agricultural Council, engaged two consultants from the United States to examine the organisation of the creamery and milk processing industry and make recommendations as to the type of reorganisation best calculated to meet the needs of the future. The consultants' report was received by the Minister in July 1968 and has since been under consideration by him and the various interests concerned. The report endorses the need for reorganisation of the industry. This will involve the delineation of different areas which should constitute separate rationalised groupings. The aim is that in each such area there would eventually be centralised churning and facilities for the manufacture of one or more diversified dairy product. State aid by way of capital grants, long-term loans and other forms of assistance will continue to be available for the reorganisation of the creamery industry on the same basis as for industry generally. In the rationalisation process, due consideration must, of course, be given to the social factors. It is intended that the Dairy Disposal Company should be associated in a development capacity with co-operative creamery societies which may be unable from their own resources immediately to undertake the rationalisation of the industry and the provision of processing facilities. In connection with the establishment of new premises in any part of the country for the manufacture of diversified products it will, of course, be necessary to have regard to export prospects of the commodity proposed to be produced.'

The Common Market

As with many other sectors of British industry, dairying and dairy manufacturing could be profoundly affected by entry into the European Economic Community (E.E.C.) and operating under the Common Agricultural Policy (C.A.P.). The difficulty of determining the implications of joining E.E.C. is that the C.A.P. itself has proved unworkable in its present form and is in a state of flux, particularly with regard to dairying. Furthermore, the addition of four more countries, two of which are exporters and one a major importer of dairy products, would be likely to change policy even more.

The problems of membership would be exacerbated by the E.E.C. level of butter prices which would induce, in the U.K., a major shift in demand from butter to margarine. Therefore the requirements of butter by the U.K. market under such a regime would be greatly diminished. Here a brief statement is made concerning dairying in the E.E.C. at the moment, present problems and proposals to overcome them but clearly this may become out of date in weeks rather than years.

The European Economic Community's common policy on milk and dairy produce covers in principle virtually all fresh and manufactured forms of milk

but in practice, fresh milk and cream have been excluded from the regulations. The policy is based on a system of levies applied to trade both within and outside the Community, guaranteed prices and market intervention.

The common target price of \$10.30 per 100 kg equivalent to 48.2 pence per gallon for milk of 3.7 per cent fat content corresponding on average to 45.6 pence per gallon at the farm gate, has operated since the unification of the market in July 1968 following a transitional period during which national target prices were aligned to the common target price.

Import levies are determined for a pilot product in each of thirteen groups, the amount being the difference between the threshold price and the exporter's free-at-frontier price with a standard deduction in intra-Community trade giving a measure of preference.

Threshold prices are based on reference prices, derived from 1963 ex-factory prices and representative transport costs, for each group of products. Intervention prices are determined for butter, and intervention agencies are obliged to buy at these prices any fresh domestically produced first quality butter which cannot be disposed of at a higher price. At the transitional stage, the regulations provided only for support for butter but at the final stage it was decided to include also skim milk powder together with a special support scheme for cheese in Italy. A number of subsidiary measures provide limited support for certain products in specified situations.

To enable dairy produce to be exported at world market prices, the difference between these prices and the threshold price (plus transport costs) may be met by an export subsidy.

It is intended that intervention prices should be fixed for each year to enable average receipts from all milk sales to correspond with the common target price.

The Council of Ministers has declared that equalisation arrangements between the liquid and manufacturing milk markets are incompatible with the common policy and that retail prices should be fixed so that returns on fresh milk are not more than \$0.50 per 100 kg higher than those from manufacturing milk.

Proposals for the organisation of the liquid market are expected to be adopted and to be in force in 1970.

Expenditure for the Guarantee and Guidance Fund on the common dairy products policy in 1968-69 was estimated at \$800 million (£330 m.) comprising aid to skimmed milk fed to animals \$223 m., support buying of butter \$30 m., disposal of butter surpluses \$250 m., casein and Parmesan cheese aids \$37 m. and export subsidies \$250 m.

Surplus butter stocks were estimated to total some 428,000 tons in July 1969, 83,000 tons more than in 1968 and 184,000 tons more than in 1967. Outlets for these stocks are limited even at the current low prices on world markets.

By 1968 the appearance of surpluses was a convincing demonstration that market and price policies alone were no longer sufficient to deal with the imbalance and that structural and social measures over a wider field were necessary. In December 1968, the Commission put forward its proposals in a memorandum 'Agriculture 1980' outlining suggestions for development of agriculture in the Community over a ten-year period. In introducing the memorandum Dr. Mansholt, Vice-President of the E.E.C. Commission, pointed out that revised projections of supplies indicated the likelihood of even larger surpluses than so far had been expected. Butter production in 1969-70 was assessed to exceed normal outlets by 210,000 tons with likely surpluses of 280,000 tons and 320,000 tons in the two succeeding years. In July 1968, the Council of Ministers had approved special sales of butter to manufacturers, sales to the public of melted butter, special sales to old people and the armed forces, the use of butterfat in feedingstuffs, and for food aid to developing countries. Such measures were expected to find outlets for some 80,000 tons a year (though previous expectations were for 140,000 to 160,000 tons). Outlets for a further 180,000 tons annually would be found by reducing intervention prices for butter. Such remedies were insufficient to solve the problem of surplus production and the new plan envisages a reduction in cow numbers from 22 million to 19 million over a four year period. A slaughter subsidy would be paid, to offset the resulting loss of income in the first two years. The Commission proposed no change in the milk target price since milk prices were a factor in the income of many farmers. The proposed reduction in cow numbers might result in a drop in butter production of 30,000 tons per year, and surpluses would be diverted from butter by a 36 per cent reduction in the butter intervention price and a rise in intervention prices for cheese and skimmed milk powder together with higher direct aid for skimmed milk.

In November 1969, in order to implement the price cuts, the Commission proposed that the intervention price for fresh butter be reduced from \$173.50 per 100 kg to \$142.25, a reduction of 18 per cent, and that existing stocks of butter be sold off at the lower price. If full compensation was offered to butter producers for this reduction, it would correspond to a \$15 per 100 kg increase in the intervention price for powdered skimmed milk. In order that producers should bear some of the burden, the Commission proposed that the intervention price for powdered skimmed milk should be increased by only \$9.50 to \$50.75 per 100 kg.

Proposals for marketing reform in the memorandum include the encouragement of producer-groups and the setting up at European level, of councils for products or groups of products. The function of the councils would include the operation of permanent information systems, determination of methods of fixing price quotations on agricultural markets, checking quality of goods when marketed, the examination annually of prevailing conditions and the arrangements to be

enforced in the light of market prospects, mounting sales promotion campaigns for individual products and organising publicity campaigns. They would also assist individual and associated groupings of producers to develop contacts with purchasing agencies, processing industries and the wholesale trade and organise appropriate contractual arrangements.

The Commission intends to introduce rules governing product councils. These rules envisage handing over wider responsibilities to the Councils as the Common Agricultural Policy develops.

The possibility of changes in the system, as a result of pressures from both within the present Community and from without to accommodate British entry, means that an assessment of its impact on the United Kingdom Dairy Industry is of limited value. However, if the present pricing system is applied to the United Kingdom it would largely eliminate variations in realisation prices for milk in different uses. Dairy product prices would increase and consumption levels would fall, whilst slightly lower prices for liquid milk should lead to a modest expansion of demand. With full membership of the Common Market, such an expansion would be in the national interest since it would allow greater production of dairy products at home. This would reduce imports of expensive dairy products from within the E.E.C. as well as the levies charged on cheap products from outside and which would have to be paid to the Common Fund. Superficially, there would therefore be attractions in producing as much as possible at home. However, the Commission proposals regarding enlargement of the Community include the possibility of national production quotas. In the face of this choice of possible policies, it is difficult to predict the outcome and the implications for the dairy industries of the United Kingdom and Ireland.

Conclusions

The dairy industry is at an interesting stage of transition in the U.K. Technology, both in production and manufacturing, has been changing rapidly. Consequently, although current policies have generally served the U.K. well in the past, it may be sensible to consider new possibilities. Views on what constitutes the best solution will vary, depending on whether one is a producer, manufacturer or a consumer and taxpayer. This bulletin has summarised the issues involved and the forces at work. It has also indicated in very general terms some of the possible lines of action and some of their implications. No attempt has been made to find a unique prescription. The objective was to give a firmer basis for the debate which is taking place between those interested in and connected with dairying in the U.K.

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