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SOME PROBLEMS IN THE ECONOMICS OF MILK TRANSPORT

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C O N T E N T S

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1. The Background to the Organisation of Milk Transport

Milk is an important food. By its nature it is produced in relatively small quantities and large outputs can only be achieved by assembling together large numbers of animals, usually cows. In the past, and in the present in many countries, the typical dairy herd was small and located near the market. Much of the distribution was direct from producer to consumer, a process in which the producer undertook the marketing function by personally delivering the milk to his customers. In the villages the consumer frequently had to collect milk from the producer's farm. During the industrial revolution in England the needs of the growing urban population were met initially by the building up of dairy herds in or near the towns. The milk had to be produced within easy reach of the market. Hygienic quality was low so that milk could not be kept for long without souring. Knowledge of sterile procedures was lacking and for a long while there was no state intervention to control the market. The farming at Islington, at that time a village some two miles from London is described by Samuel Lewis (4) in 1831 as follows "The land in the neighbourhood is principally occupied by cowkeepers who have very extensive dairies for supplying the inhabitants of the metropolis with milk." A few years earlier a contemporary account of milk production in this neighbourhood(6) reveals that although both largescale production and the letting out of work on the cows by contract were already established, there were many differences from present dairy practice. After describing a herd of between 600 and 700 milch cows kept in Islington, John Nelson says "The quantity of milk yielded by each cow has been averaged at nine quarts per day. The retail dealer generally agrees with the cow-keeper for the produce of a certain number of cows, undertaking to milk them; for this purpose certain persons are employed in the

cow-house, called milkers, who are paid by the retailer. The milk is sold by the cow-keepers of Islington to the retail dealer at about 1s.10d. for eight quarts (which is called a barn gallon); but, in delivering it to the consumer, a vast increase takes place; not only in the price, but also in the quantity, which is greatly adulterated with water; and, as there is reason to suspect, sometimes impregnated with still worse ingredients to hide the cheat.....

"The milk is conveyed from the cow house in tin pails, which are principally carried by strong robust Welsh girls, and Irish women. These are the same that retail the milk about the metropolis.... (They) arrive between 3 and 4.am. with their pails: with these they return loaded to town, and the weight they are thus accustomed to carry on their yokes, for a distance of two or three miles, is sometimes from 100 to 130 pounds..... "

With the advent first of railway transport and later of motorised road transport the market area could be expanded but this brought with it the need for producing milk with better keeping qualities. Increasing knowledge of nutrition and advances in medical science provided strong pressures for government intervention to improve milk quality, particularly when it was realised that in addition to having valuable nutritional properties, milk was an almost ideal medium for the transmission of many diseases. In order to protect the public most advanced countries have developed a complex set of regulations controlling the treatment and handling of milk. The British regulations are among the most stringent in the world, and cover such matters as the licencing of the dairy farm (including suitable buildings and water supply), disease control, the regulation of nomenclature, and so on. All such regulations are a compromise between what is desirable and what is practicable, but any organisation for the handling of milk must work within the established framework of such regulations.

In addition to intervention by the health authorities milk production has been considerably influenced by other activities of the state. The long period of depression between the two wars led to a realisation that farming suffered from particular disabilities that made state intervention desirable. In some countries this was associated with political motivation, usually to secure support by farmers for the governing political parties. In the more recent period such state intervention is very widespread. The Agriculture Act 1947 aims at securing the "proper remuneration of farmers and farm workers." The Treaty of Rome has among its purposes the securing of a fair standard of living for the farming population and the stabilisation of markets for agricultural products within the six countries involved. Other countries have aimed at agricultural welfare in other ways, such as by the provision of specialist education and research, the encouragement of co-operative buying and marketing and by large scale capital investment by the state in irrigation and land reclamation. All these measures have built up a more or less rigid framework of laws, regulations and institutions within which farming and such ancillary activities as milk transport have to be organised.

Nor has state intervention been confined to matters of health or benefit to the farming community. Of particular interest is the reorganisation of milk transport that took place in the United Kingdom during the last war. The prime purpose was to save manpower and materials (petrol, tyres and vehicles) and the reorganisation was successful in keeping the cost of ex-farm milk collection at or below its 1942/3 level for nearly a decade during which period prices generally rose by over 50 per cent. In the U.S.A. alternate day delivery was introduced by Government Order in 1942 and although the order was not enforced for long the effects have been profound. In Germany the effects of cut-throat competition between distributors before the war led to the official zoning of both the collection and distribution of milk, a system

that still continues. In Belgium war-time exingencies led to a compulsory reduction in the number of dairies. In Denmark a similar result was achieved through a licencing system which has been taken, in some towns, to the extreme of granting exclusive delivery rights to a single firm. In the Netherlands direct milk sales from farm to consumer are banned and in Germany they are limited to sales on the farm. (These regulations presumably have their origin in health measures designed to limit the consumption of raw milk). In Vienna Sunday sales of milk are prohibited (with obvious difficulties of supply and demand equalisation) the motivation for which is certainly not to be found within farming. The Austrians have gone very far with a complex system of price controls, complete with import taxes, price subsidies, a transport levy/subsidy system for levelling transport charges and a compensation fund to producers for helping to give producers uniform returns.(1,2,7)

2. The Problem of Milk Distribution in the United Kingdom

The modern problem can be regarded basically as one of making the best use of modern technology within the conditions set by social policy and government regulation. In addition provision needs to be made for technical change, which means that the framework must not be conceived in too rigid terms.

In more detailed terms there appear to be several technical changes which are important for a re-organisation of the milk supply and distribution system.

1) Milk quality, particularly keeping quality has been raised to a level at which quality is no longer an obstacle to long distance transport. This problem was first solved by pasteurisation and cooling at the local depot prior to trans-shipment. The current trend is towards farm cooling so that milk may be sent direct from farm to urban dairy. (This is usually associated with improved labour-saving technology on the farm, particularly milk pipe lines, bulk vat storage and refrigerated cooling of the milk).

2) There has been a rapid evolution of the transport system. Rail transport provided an initial break-through in which farms within a few miles of the railway could send milk to the large towns. At first this was a combination of horse and rail transport. Later trucks and lorries took over while more recently the large tanker has increasingly replaced both lorry and local depot, taking milk from farm to the town distributors' premises.

These two changes have together worked to transform the series of local markets that previously existed into a single national market for milk. It is important to note that relative costs and prices have changed greatly. It is now technically possible to send milk from any part of Britain to any other part without noticable fall in quality. The cost is relatively so much reduced that the economics of regional production have changed. In particular the trend towards specialisation involves a relatively lower transport cost penalty than was the case even a few years ago. We can see this working out in the growth of dairy farming in the west and its decline in the east. The advantages of the west, particularly for the growth of grass, (due to the wetter and milder climate) have to be balanced against the cost of milk transport to the populated areas. But they are also affected by the desire of farmers in the east to specialise, by cutting out milk production. Any local price advantage has been eroded by the cheapening of transport costs. (Although to some producers it appears that they are being unfairly treated by the Milk Marketing Board, we can see that behind the Board's decisions, whether or not they are justified in particular cases, are real changes in cost-price ratios).

3) Technological change, and in particular the growth of more scientific agriculture, have made possible the growth of larger units both for production and for distribution. Levy(3) regarded dairying as ideally suited to the small farm on which the cows received the watchful care of the owner. The most recent evidence for England and Wales (5) shows that the smaller herds (e.g.those with less than 20 cows) compare unfavourably with the larger herds

not only in costs but also in the yields per cows obtained. Presumably the skilled cowman employed to manage the large herd is today technically better equipped for his job than the small family farmer. At the point of production economies of scale become possible once the technical problems have been solved. These include economies in purchasing food, labour economies, machinery economies and building economies. Bulk production also reduces the cost of handling and loading milk. The milk in a refrigerated bulk vat requires little loading time and can be transported direct to the milk distributor's dairy, thus reducing transport costs. At the distributors' end centralisation has gone much further. Small dairies have rapidly disappeared, to be taken over by such giants as Unigate. No doubt there are many possibilities of economiesof scale to account for these latter changes, it is not necessary to consider them here.

3. Transport Theory and Agriculture

The original work on the effect of location on agricultural supplies and prices was done by von Thünen in his historic work "The Isolated State." (9) Von Thünen's analysis was based, in the first place, on a single market established in the middle of a uniform agricultural plain. To this market situation he applied data he had collected on his own estate for the costs of production of agricultural products, with the yields obtained and their costs of transport to market, and the ruling market prices. He derived, on this basis, an ideal distribution of land use as a series of concentric rings around the central market, and he was able to calculate the economic rents of the different zones of cultivation. Obviously the actual world is more complex than this and Michael Chisholm has drawn attention to three factors which upset the orderly pattern of zones.(12)

1) Von Thünen included the normal remuneration for a farmer's own labour in the costs of production. In a perfectly adjusted economy this would be a uniform remuneration but in practice we know this is not always so. There is evidence that small upland dairy farms are unprofitable. This implies that such farmers are currently receiving less than normal remuneration, and in von Thünen's terms, by accepting an abnormally low income they create a distortion of the production zones.

2) Variation in the price of inputs will also affect the production zones. Under present-day production patterns this may have rather complex effects depending on sources of supply and transport costs of the many inputs entering into agricultural production. Oil prices are zoned from the major ports. Machinery delivery charges depend on the location of factories. Building costs may depend on competition with industry, and so on.

3) Variations in soil and climate also affect the production pattern as they affect both costs of production and crop yields.

All these factors serve to complicate the pattern without affecting the generality of the original theory. A further complication, which von Thünen developed in the later part of his study, is that transport costs may not be proportional to distance. A river or a motorway can reduce transport costs per mile while a mountain range or river estuary can have the converse effect. It is economic distance, or transport cost incurred, that determines the zone boundary.

It will be noted that the balancing item in drawing up an account for a particular farm is the economic rent. In theory at least the farmer chooses to produce those items which, given his raw materials, and his own particular skills, will maximise his returns on his capital. The rent he can afford to pay will be the difference between this return and the normal income of a farmer with the necessary capital. Given stable economic conditions, and over a period of time, one could reasonably expect that production would steadily move to a regional pattern that minimised costs.

In practice we find that the regional pattern of production is highly complex within the United Kingdom although very broad regional variations are clear enough. Part of the difficulty is that adjustment is slow as a result of a number of inter-connected factors.

1) The production cycle varies from one to several years for different enterprises. As weather conditions vary from year to year the relative merits of alternative enterprises in any location are difficult to assess.

2) There are well known economic advantages in certain combinations of enterprises (crop rotations, crop-stock systems). Alternative systems are not easy to devise, and in any case the economies of an efficient combination of enterprises may for a long time off-set falling returns from a single enterprise in the complex.

3) Conservatism of both farmers and landlords may favour the maintenance of well-tried systems. A farmer may be under considerable social pressure to continue a system which is locally regarded as "good farming".

4) Government policy, and its implementation through price controls, production grants and subsidies may be running against the economic trend. (Such policy is not necessarily bad on that account).

An important aspect of von Thünen's work is that it brought out very clearly the importance of transport costs in the creation of differential rents due to location. For any self-sufficient market the price would be determined by the marginal cost of the product, including transport to the market, from the extensive margin of production. With the growth of the population served by the market one would expect an extension of production both by increased intensity of production and by pushing out the extensive margin. This extension, with its increased transport costs, would determine the new price and the increase would eventually be absorbed into the rents of all farms within the new extensive boundary of production.

It is emphasised that, in equilibrium, the cost of transport is borne by the consumer and included in the market price. All advantages due to location are converted into rents, and accrue to the landlord, not to the farmer. This point requires particular emphasis as there has been a tendency in this country to argue about milk transport from the conditions in the inter-war years when the market for milk was in a chronic state of dis-equilibrium. The rapid growth of road transport at that time resulted in a great extension of the area from which milk for the urban markets could be supplied. Many farmers in these peripheral areas had very low incomes (in itself a sign of dis-equilibrium) from cattle rearing or butter and cheese making. They could increase their profits by switching to liquid milk-selling even though they paid for the transport themselves. No one should have expected these conditions to continue indefinitely. The natural process of establishing a new equilibrium was not allowed to take place because agriculture generally was in an acute state of crisis and, with some two million persons registered unemployed, mainly in the towns, there was little chance of resources being moved out of agriculture even when the market for agricultural products was glutted.

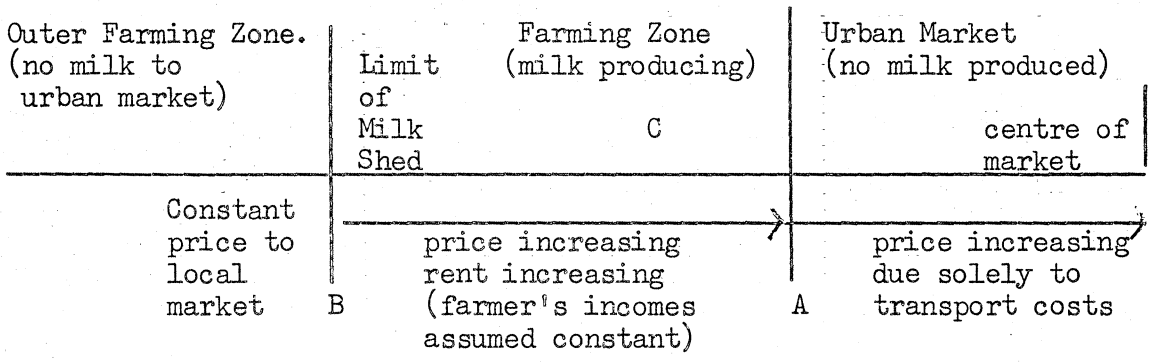
The particular legislation that was used to help dairy farms was the Agricultural Marketing Acts of 1931 and 1933. By 1933 the Milk Marketing Board had been established. In order to satisfy milk producers in all regions of England and Wales the market situation was to some extent "frozen". Regional milk pools were established in which the producers of each region received an average price based on the pooling of the returns for milk sold for liquid consumption and the lower returns for milk sold for manufacture. This was soon modified by a regional compensation fund so that the maximum difference between regional monthly pool prices did not exceed one penny per gallon of milk. Transport prices between farm and wholesaler or retailer were paid by the producer. Where milk was sent by direct contract this was quite straightforward. Where, however, milk went via a collecting depot there were three separate charges:

a collecting charge, covering cost of transport to the depot, a transit risk charge, and a standard freight charge which was a hypothetical charge of the cost of rail transport from the depot to the most distant consuming centre served by the depot. The savings from not sending all the milk this distance were paid over to the Board and credited to the general milk pool.

The principle of producers paying transport costs to the point of first delivery (whether intermediate depot or the dairy of wholesaler or retailer) has remained throughout the history of the Board. War-time difficulties and the changes in both production patterns and transport economics have been reflected in a great simplication of transport charges and in 1962 the Board introduced flat rate transport deductions per gallon of milk sold wholesale for each region. The maximum transport differential was 0.71 pence per gallon, but this was in addition to a price differential with a maximum of 1.00 pence per gallon that also operated between regions.

Since 1962 all differentials have remained the same. With rising costs it is apparent that the transport deductions no longer cover the whole of the delivery costs to the first destination. The most recent figures are that farm collection cost 1.29 pence per gallon in 1967/8 while the average transport deduction was 1.09 pence.(10)

This position is so far removed from "perfect market" conditions that it may be helpful to consider the kind of equilibrium that would be expected under such conditions as between a large urban market and its agricultural interland, a situation typified by much of England and Wales.



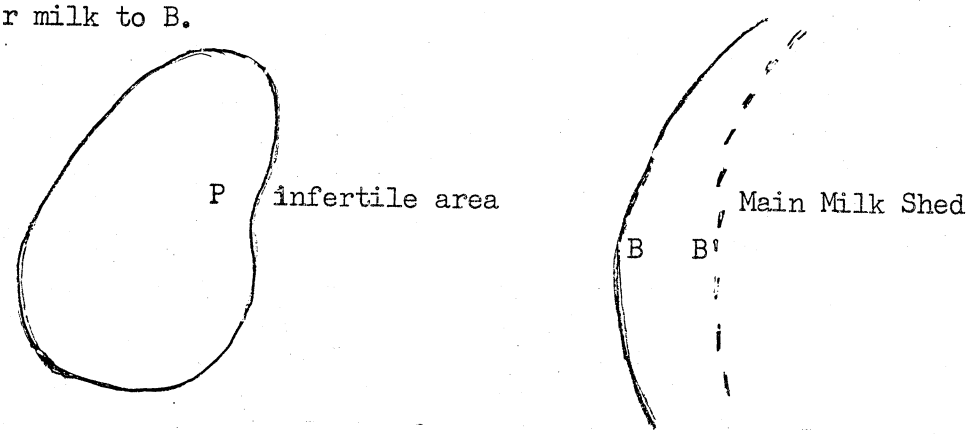
The equilibrium position with a large urban market adjoining a uniform agricultural zone is shown in the diagram. We assume, in order to keep the argument as simple as possible, that the land is uniform and costs are uniform over the farming zone, and that equilibrium has been reached with regards wages and farmers' incomes. (In the modern world we do not assume lower wages or lower farmers' incomes in the areas remote from the towns, although this was formerly the case and may still be a relevant factor elsewhere). It is also assumed that the smallest currency unit is adequate to take account of the price gradient expected.

It is assumed that the current cost-price relationships are such that milk is produced in a zone extending to B in order to satisfy the urban market requirements for milk. Clearly in order to obtain the milk they require dealers in the urban area will have to pay producers a price which gives farmers the normal return on their labour and capital and they will also have to pay, directly or indirectly, for the cost of hauling the milk to the market. From B inwards towards the centre of the urban area there will be a price gradient which will give greater returns to farms near the market than to farms further away. This price advantage will, in turn, lead to differential rents due to location. The situation is not altered by the existence of intermediate zones between the milk-producing zone and the market. (e.g. a market gardening zone at A).

It will be obvious, however, that if zones exist around the market in which production is determined partly by transport costs then a radical change in those costs may result in a complete re-organisation of the zones to meet the new situation. (As we have seen this is in fact happening. Milk and other produce are increasingly being produced in areas of favourable soil and climate and less and less in areas where the main advantage has been proximity to the market).

Even within zones a reduction in transport costs is likely to upset the level of rents, by reducing the value of location.

The effect of introducing variations in soil and climate, in place of a uniform farming zone, into our analysis, is to upset the simple pattern. Economic adjustment would tend towards the most profitable use of each location with all its advantages and disadvantages for a variety of products. Competition for land would result in rents tending towards a level at which the profitableness of farming was equal in all locations and on all soils that could yield this profit.+ In this analysis the price of milk at the point of sale is always sufficient to cover the cost of transport to that point. There is one situation, however in which milk producers appear to bear part of the transport cost directly. We imagine an area 'P' well suited to milk production that is isolated from the urban milk shed by a zone of infertile land. While milk transport costs are high this area may be used for cattle rearing or cheese manufacture. As the cost of transport falls a point may be reached at which it will pay farmers at P to send their milk to B.



+This also assumes that capital was equally available to all farmers.

(If the area P is extensive this new supply of milk may have the effect of reducing the price of milk in the main milk shed. The main milk shed area would then contract to the point B' at which the price of milk from P would be the same as the local price of the milk).

We now have a situation in which the cost of milk transport to the main milk shed is paid directly by the milk producers. However it will be obvious that these producers only produce milk because it is profitable to do so. The price gradient for the net price of milk (i.e. before paying transport costs) will be continuous from P to the urban market and in fact the price paid by consumers will be such as to cover the transport cost and provide a normal level of profit to milk producers at P. As always the land rent will be the balancing cost. Thus the fact that transport costs may actually be paid by milk producers is irrelevant, and only disguises the fact that this cost comes out of the price paid by consumers.

4. The Present Transport Position and Problem:

At the present time milk producers have a transport charge deducted from their milk receipts by the Board which represents a share of the cost of the carriage of milk to the first destination whether this be intermediate depot, wholesaler, or retail depot. There are eleven separate regional transport deductions which are charged at a flat rate per gallon on all the milk sold wholesale within each region. (With the exception that where a farmer arranges his own transport no deduction is made). These deductions meet the approximate total cost of first destination delivery. Subsequent transport is not paid for by producers. Normally the retail price is set sufficiently high to cover retail margins, guaranteed price, intermediate transport and handling allowances, with any surplus paid to the Ministry and a deficit being paid by the Ministry.

There are several anomalies in these arrangements. Perhaps the most important is the lack of direct incentives to anyone to use the most efficient organisation of transport. The recent development of bulk collection+ of milk from the farms has brought many more farms within the area within which direct transport from farm to urban dairy is feasible. The overall saving of cost can be very great as a lot of handling is saved and the milk makes only one journey instead of two. However the dairies and distributors of milk will lose some of their handling charges (on which they may make a profit). More seriously the producers costs may actually increase. They pay transport to the first destination and if a local depot is closed down their transport costs can increase. The Ministry of Agriculture is the main beneficiary of such a re-organisation.

Despite the difficulties the Board has pressed forward with re-organisation so we may assume that they have found ways, by re-siting depots and making a more rational distribution of milk, of obtaining at least some of the benefits of re-organisation for producers.

The second problem is concerned with regional prices and charges. The Board operates a price differential between regions in the price paid for wholesale milk amounting to a maximum of 1.00 pence per gallon in the monthly pool prices between the lowest and highest priced regions. In addition a transport

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+ Bulk collection involves the farmer installing a bulk vat and cooling plant. The cold milk is collected by tanker, the milk being pumped direct from vat to tanker. The elimination of churns gives a big saving in labour in handling milk both on the farm and subsequently.

deduction is made at a flat rate per gallon in each region, ranging from 0.66 pence to 1.37 pence per gallon. Together these represent a price differential whose original justification has gone. In the nineteen thirties the different regional pools reflected the composition of the regional markets, and in particular the proportion of the milk that was sold at a low price for manufacture. The reduction of the differentials before and during the war and their subsequent freezing through a period of inflation mean that they have little relation to original or current needs.

The arguments in favour of a price differential in prices paid to milk producers are broadly based on the satisfactory nature of a self-regulating market system (such as von Thünen described) in which an optimum allocation of resources is achieved. Any changes from this are alleged to increase costs to the consumer since they lead to a sub-optimal allocation of resources.

It is important to keep this argument within realistic proportions. Within any of the Milk Board's regions it probably has little validity. The savings that are potentially available are small and, on the other hand, the difficulties of assessing realistically the true costs of milk haulage for single farms are enormous. The quantity of milk collected from each farm varies from day to day and it is advantageous for hauliers to be able to make frequent adjustments to collection routes in order to make the best use of their vehicles and manpower. Under these circumstances it would be unrealistic to try to make a separate cost assessment on the transport of milk from each farm. The present system has the advantage that hauliers have every encouragement to do their job efficiently and provides some competition between them to keep costs down.

When we consider the different regions, however, the argument has greater validity. In general terms it appears quite obvious that if milk is produced at an unnecessary distance from the market then this will lead to additional transport costs and the using up of physical resources that might otherwise be available for other uses. When we consider the actual situation this argument loses some of its simple appeal. In order to keep the liquid milk market supplied every day of the year regardless of the effects of droughts, snow drifts and other hazards a certain surplus must be produced. The total size of this surplus is influenced by the natural cycle of milk production and in particular the May-June peak of output which cannot be removed without risking a shortage at other times. It is this need for a surplus at all times, and which has been found by experience to require an overall yearly surplus of at least 20 per cent that lies behind the agreed "standard quantity" to which the milk price guarantee applies. Now that it is government policy to expand milk production still more in order to raise the output of calves for beef the question of where to produce the extra milk acquires a new importance. It may be better to encourage this extra milk production in the remoter areas as for most of the year it will not be wanted for the liquid market. The cost of transport will be high for the few weeks when such milk is diverted to liquid use but for the rest of the year it will carry little transport cost and can be taken direct from farm to manufacturing creamery. There are clear economic advantages in producing this surplus milk in the remoter areas as this will enable farmers to make good use of the better grassland of such regions.

A further problem in milk pricing comes from the structure of the pricing system. With a central Board dealing with large numbers of producers there are obvious advantages in keeping charges steady over a period of time. Producers know where they are and the Board has its task simplified. Despite the fact

that in recent years transport costs have gone up there is evidence that the transport revolution is far from being over. With the change over from churns to tankers and the growth of motorways, costs per gallon may well come down in the next decade and there would be little gain in raising charges, only to reduce them within a short period.

There is also a rather difficult problem of public relations as between the Board and the farmers who produce the milk. The levying of a hypothetical charge for transport could cause a lot of misunderstanding and a lack of confidence. In the long run rents and land values will adjust to any radical changes in the pricing system. One must assume that they are at present fairly well adjusted to the price-transport differentials that have changed little since the end of the war. A sudden change of any magnitude would benefit some farmers and bring disadvantages to others. Over the years these benefits would be lost as rents became adjusted to the new conditions. One would like to see a quantitative analysis of these effects, and of the advantages to be gained before any radical change is made.

5. A Simple Model of Milk Transport

In order to establish some basic relationships from which it might be possible to draw rational conclusions about the organisation of milk transport a simple model of the national market was devised.

The model is based on the geographical counties of England and Wales each of which is regarded as a single production unit. Counties are also regarded as consumption units and in this case London has been amalgamated with Middlesex. For each county the production of liquid milk for 1962/3 was taken as the basis for the calculation. Consumption was calculated from the 1961 Census Returns for population and the Milk Marketing Board's regional figures for per capita consumption of liquid milk.

It is, of course, necessary to supply liquid markets with a surplus to cover fluctuations in both supply and demand, and the requirement for liquid milk of each county was calculated as 20 per cent above its estimated liquid milk consumption. From these figures the counties could be divided into three classes: surplus counties, self-sufficient counties, and those with a deficit in liquid milk supplies.

A further assumption was made that all milk would be collected from farms and delivered either to a local dairy for retail delivery or to a depot prior to being taken to a market outside the county boundary. Milk for consumption within the county of origin would only bear a single transport charge. Milk for shipment to ex-county markets would bear two charges, the local collection charge and a further transport charge between depot and urban dairy. Milk for manufacture would only require a single haul from farm to manufacturing depot which would be within the county.

It was also assumed that the Regional Transport Deductions represented a reasonable assessment of the transport costs from farm to the point of first delivery and could be used for the costs of transport to first destination under the simplified plan envisaged.

The costs and routes for inter-county transport were then assessed and analysed by the linear programming routine available on the Leeds University computer. Only milk surplus to county requirements was treated as available for supplying other counties. Milk deficits were calculated for the counties short of milk as the difference between production and the estimated requirements.

Single figures were used for inter-county transport costs, based on the distances between the approximate mid-points of the counties. The mileages were estimated and the costs calculated from the Board's contract rates for medium tankers. (see Appendix) As a further refinement it was assumed that milk would not be sent to Sussex, Surrey or Kent from across London or the Thames estuary. The optimum program is shown in table 1. However the general pattern is easier to see from the two maps. In Map 1 are shown the deficit counties (i.e. those whose total production of liquid milk was less than 20 per cent above liquid requirements over the year). In addition the counties whose milk would all be manufactured under the plan are indicated by the letter M and those where part would be manufactured by the letter P. Manufacturing is concentrated in Devon and Cornwall, West Wales and Cumberland. Map 2 shows the routes for milk transport in the optimum plan.

The basic pattern may be summarised as follows:

Consumed in county of origin	2051 million gallons
Transferred to other counties	674 million gallons
Manufacture in county of origin	303 million gallons

but this is subject to the disposal also of the excess milk that has been allocated to the liquid market to cover day to day fluctuations in supplies and in local demands. This excess will be referred to later.

Table 1 and Map 2 show that relatively little milk is required to travel long distances. Only 61 million gallons is taken more than 125 miles and none more than 150 miles. The calculated mean cost of all inter-county transport is only 1.72 pence per gallon, with a total cost of £4,832,000. This may be compared with the actual transport deduction, covering transport from farm to first destination (dairy or depot) of all milk, of £8,688,000 in 1962/63.

TABLE 1.

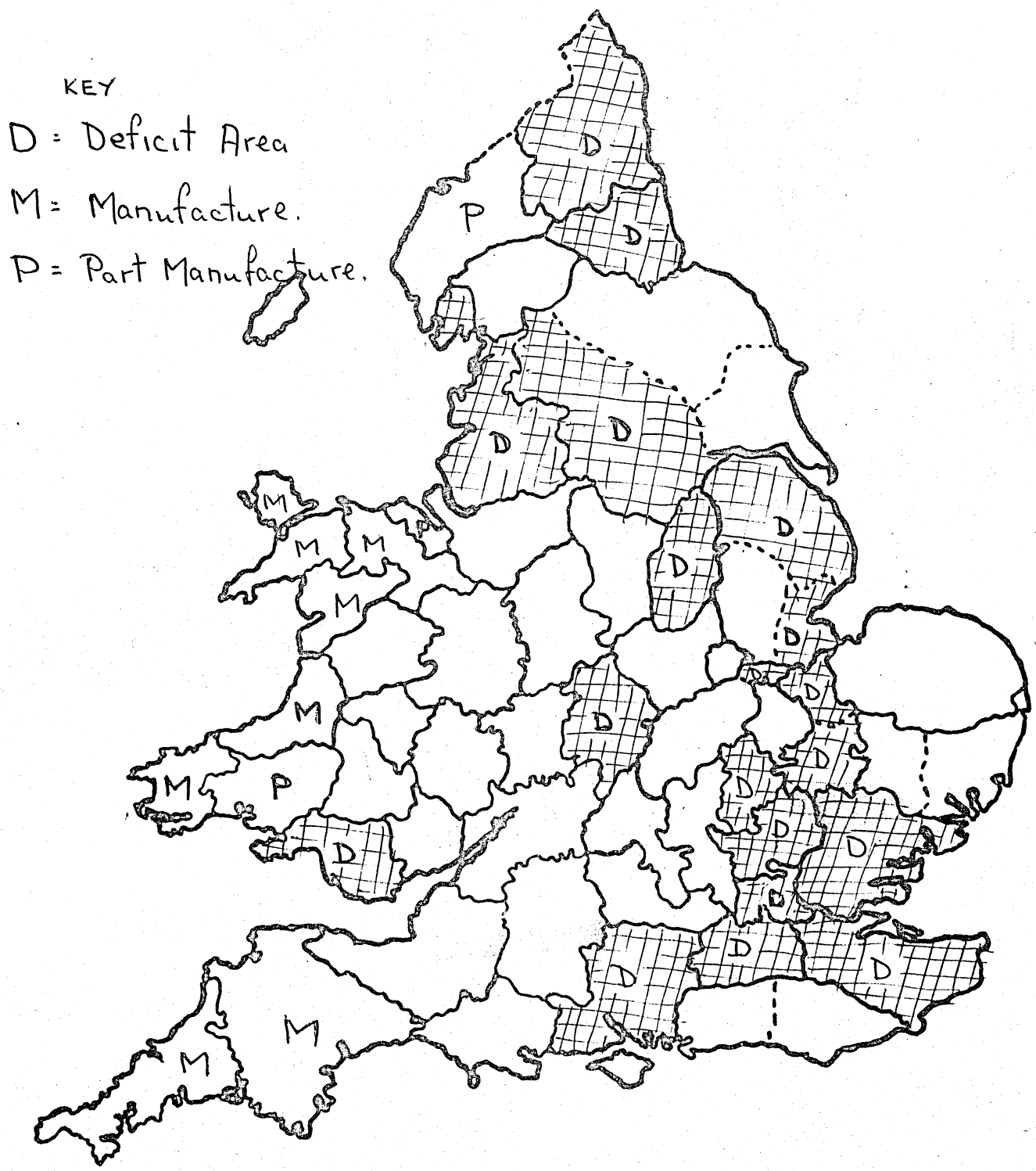
PROGRAMMED TRANSPORT OF LIQUID MILK

Source	Destination	Flow (100,000 galls)	Cost per Unit Flow £	Total Cost £
Berkshire	Surrey	33	512	16896
Buckinghamshire	London	34	429	14586
Cheshire	Lancashire	673	512	344576
Cheshire	London	3	1000	3000
Cornwall	Manufacture	508	0	0
Cumberland	Northumberland	115	683	78545
Cumberland	Manufacture	409	0	0
Derbyshire	Bedfordshire	32	771	24672
Derbyshire	Cambridgeshire	37	771	28527
Derbyshire	Lincs.Holland	17	704	11968
Derbyshire	Lincs.Lindsey	14	683	9562
Derbyshire	Nottinghamshire	140	429	60060
Derbyshire	Yorks.West Riding	124	512	63488
Devonshire	Manufacture	774	0	0
Dorset	Kent	153	1000	153000
Dorset	Surrey	428	771	329988
Gloucestershire	London	206	771	158826
Isle of Wight	Hampshire	41	429	17589
Herefordshire	Bedfordshire	23	771	17733
Herefordshire	London	114	917	104538
Huntingdonshire	Isle of Ely	8	321	2568
Leicestershire	Essex	91	771	70161
Leicestershire	Soke of Peterboro.	17	512	8704
Lincs.Kesteven	Lincs.Holland	5	321	4815
Norfolk	Essex	180	704	126720
Northamptonshire	Bedfordshire	31	429	13299
Oxfordshire	London	75	575	43125
Shropshire	Essex	263	1000	263000
Shropshire	Hertfordshire	23	917	21091

TABLE 1. (Continued)

Source	Destination	Flow (100,000 galls)	Cost per Unit Flow £	Total Cost £
Shropshire	Warwickshire	448	575	257600
Somerset	Hampshire	2	704	1408
Somerset	London	1083	917	993111
Staffordshire	Isle of Ely	13	771	10023
Staffordshire	London	313	917	287021
Staffordshire	Warwickshire	3	512	1536
Suffolk	Essex	107	512	54784
East Sussex	Kent	71	512	36352
West Sussex	Surrey	82	429	35178
Westmorland	Durham(County)	233	512	119296
Wiltshire	Kent	212	917	194404
Wiltshire	London	414	704	291456
Yorks.East Riding	Lincs.Lindsey	22	575	12650
Yorks.North Riding	Durham(County)	45	512	23040
Yorks.North Riding	Yorks.West Riding	268	575	154100
Anglesey	Manufacture	70	0	0
Brecon	Glamorgan	33	429	14157
Caernarvon	Manufacture	61	0	0
Cardigan	Manufacture	247	0	0
Carmarthen	Glamorgan	240	512	122880
Carmarthen	Manufacture	275	0	0
Denbigh	Manufacture	314	0	0
Flint	Lancashire	52	575	29900
Flint	Manufacture	100	0	0
Merioneth	Manufacture	29	0	0
Monmouth	London	10	917	9170
Montgomery	Hertfordshire	188	1000	188000
Pembroke	Manufacture	346	0	0
Radnor	London	5	1000	5000

MAP 1



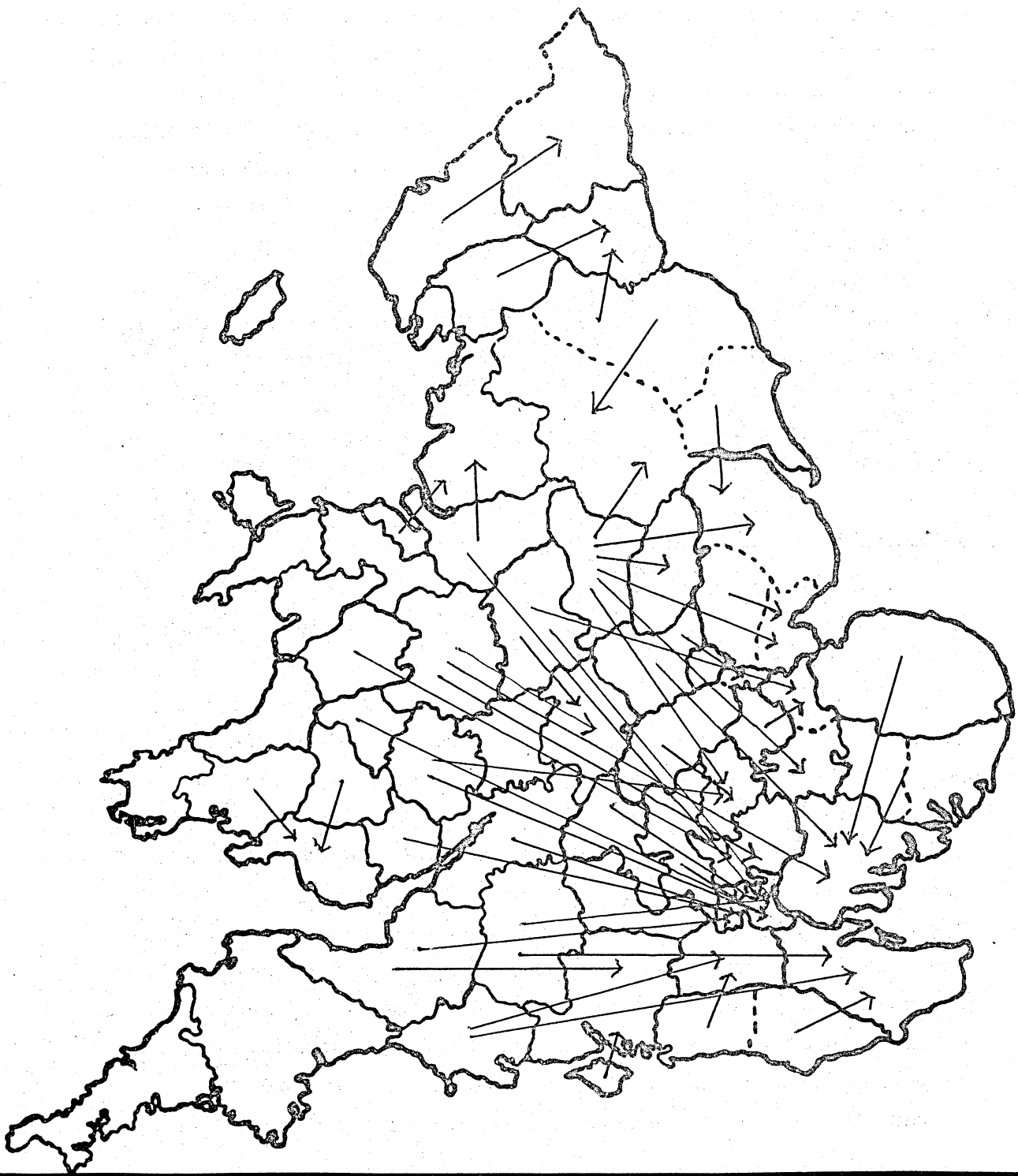
Probably the most important conclusion to be drawn from these figures is that transport costs are a relatively minor problem and that the location of milk production is unlikely to be seriously affected by any realistic assessment of costs. The second conclusion, which comes directly from Map 1, is that no simple arrangements of transport charges based, for example, on distance from London, would commend itself as equitable. One cannot easily argue that producers in any of the deficit counties should bear costs beyond what is necessary to transport milk within their own county. A further point is that the pattern of surplus and deficit counties cuts across the Board's Regional pattern of organisation. The problem of charging transport costs is complicated by the situation in which the Board has to operate, and reform may require amendment to the whole marketing scheme and to the structure of the distributors prices. Some of these questions are beyond the scope of this report. Other aspects of charging transport costs are dealt with in the next section.

6. Problems of Charging for Milk Transport

Before considering practical problems it is desirable to look at some questions affecting the validity of the analysis carried out so far.

One of these questions involves the final disposal of the extra milk supplied to all consumer markets. An allowance of 20 per cent above liquid demand has been made, and it is obvious that, on average, this amount will have to be disposed of in some way. The argument is simply that extra supplies are needed because daily supplies from each farm vary from day to day, and there are also both random and seasonal fluctuations in consumer demand. To equate the two, within the complex of collection routes, depots, dairies, wholesalers and retailers, a fairly large margin is needed. However if this quantity of surplus milk is to be left in the hands of the dairies and distributors, and if the quantity varies considerably from day to day (and it would not

MAP 2 OPTIMUM MILK ROUTES



otherwise be needed!) then it must either be manufactured by them into a product that can be handled in varying amounts or it must be sent to a suitable centre for manufacture. In practice it should be possible to satisfy liquid markets with a lesser margin so that some saving in transport might be available to cover possible third stage transport. It seems likely that butter would be the most suitable product for this milk. The only problem is that it amounts to some 290 million gallons - nearly half the total milk used for manufacture in 1962/63. However the trend towards very large distributive organisations (Unigate, Northern Dairies, Co-operatives) should make it possible for other products to be manufactured without excessive recourse to third stage transport. The organisation at this level is essentially a practical problem in the light of local distributive organisation and plant available. Economies of transport may have to be balanced against economies in plant utilisation.

A further problem concerns whether the regional transport deductions are sufficiently near to actual costs to be used in a valid analysis. For 1962/63 the total transport deduction was very near to the total cost of ex-farm transport, and when the analysis was made it was assumed that regional deductions were also realistic. Some correction of the results may be desirable if more realistic regional or county costs become available.

The question of who pays for transport may also be important. In other spheres of economic life the pattern is very varied. Prices for petrol are zoned by distance from the ports used by the importers, so that buyers pay pooled transport costs. While buyers also pay carriage on many other items there is also a range of goods for which transport costs are averaged over the whole national market, so that the consumer pays the same price in London, Buxton or Wick.

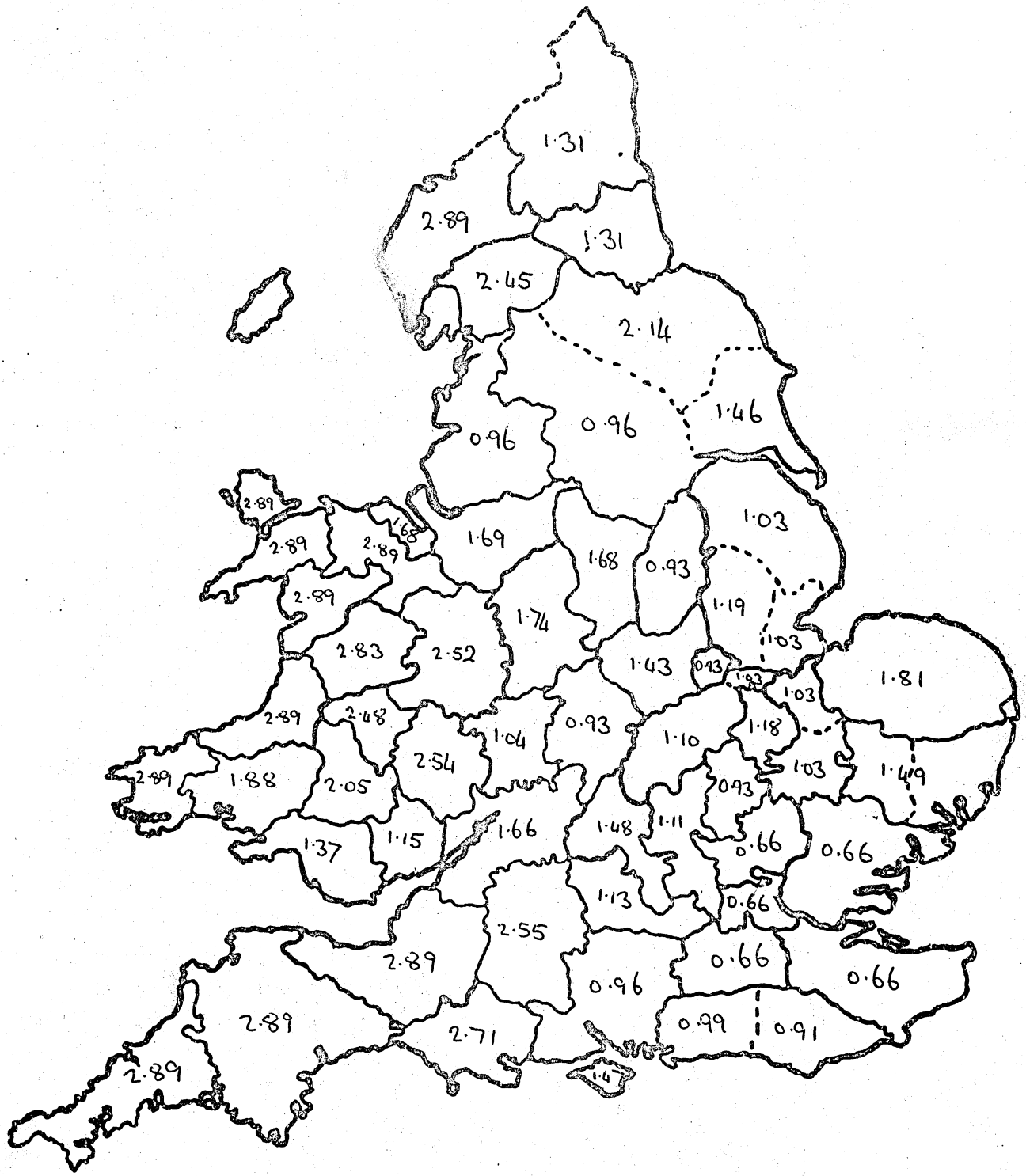
Once a system has been established it tends to be taken for granted and to become institutionalised. We have seen, however, that the milk transport charge system is illogical and is combined with an obsolete price differential and it may therefore be profitable to analyse the situation in more detail before suggesting alternatives.

The first step is to see what transport costs would be charged if producers bore the whole cost of sending milk to the urban markets. (Defined as in the previous section). For this analysis all counties with a milk deficit, as shown on MAP 1, have been charged with their regional transport deduction. Counties with a surplus have also been charged with the programmed cost of sending the surplus to the chosen deficit areas as shown in table 1. Those counties where surplus milk would be manufactured have been charged the highest rate found in the previous section in order to maintain a cost gradient. The results are shown on MAP 3. Not unexpectedly the pattern is complex, and there are some marked differences between counties within the same Milk Marketing Board regions. An interesting point is that the maximum regional differential, between North Wales and the South East, is only 1.8 pence per gallon, very close to the actual current differential of 1.75 pence between the South East and North Wales. (10).

One question that arises directly is whether if this type of charging is accepted counties that are short of milk or very nearly self-sufficient should share the transport costs of their neighbours. In one sense, of course, they have an interest in doing so. If milk transport is not rationally organised then the alternative may be a flood into the nearer markets. Warwickshire farmers have an interest in sending milk from Shropshire or Gloucestershire to the deficit areas of the South-east. This is perhaps the strongest argument for broadly drawn regional rates in which a price gradient is preserved between surplus and deficit areas.

An alternative plan would be to make consumers pay the whole of the transport costs, from farm to destination. This can be considered as a quite separate question from whether a differential price should be paid for milk from different sources, and corresponds with the practice with other commodities. It is a method that has recently received partial recognition from the Prices and Incomes Board (8) in their suggestion that the price of milk in London should be raised to cover the cost of getting it there.

MAP 3 Transport Costs charged to Producers.
(county pools - pence per gallon)

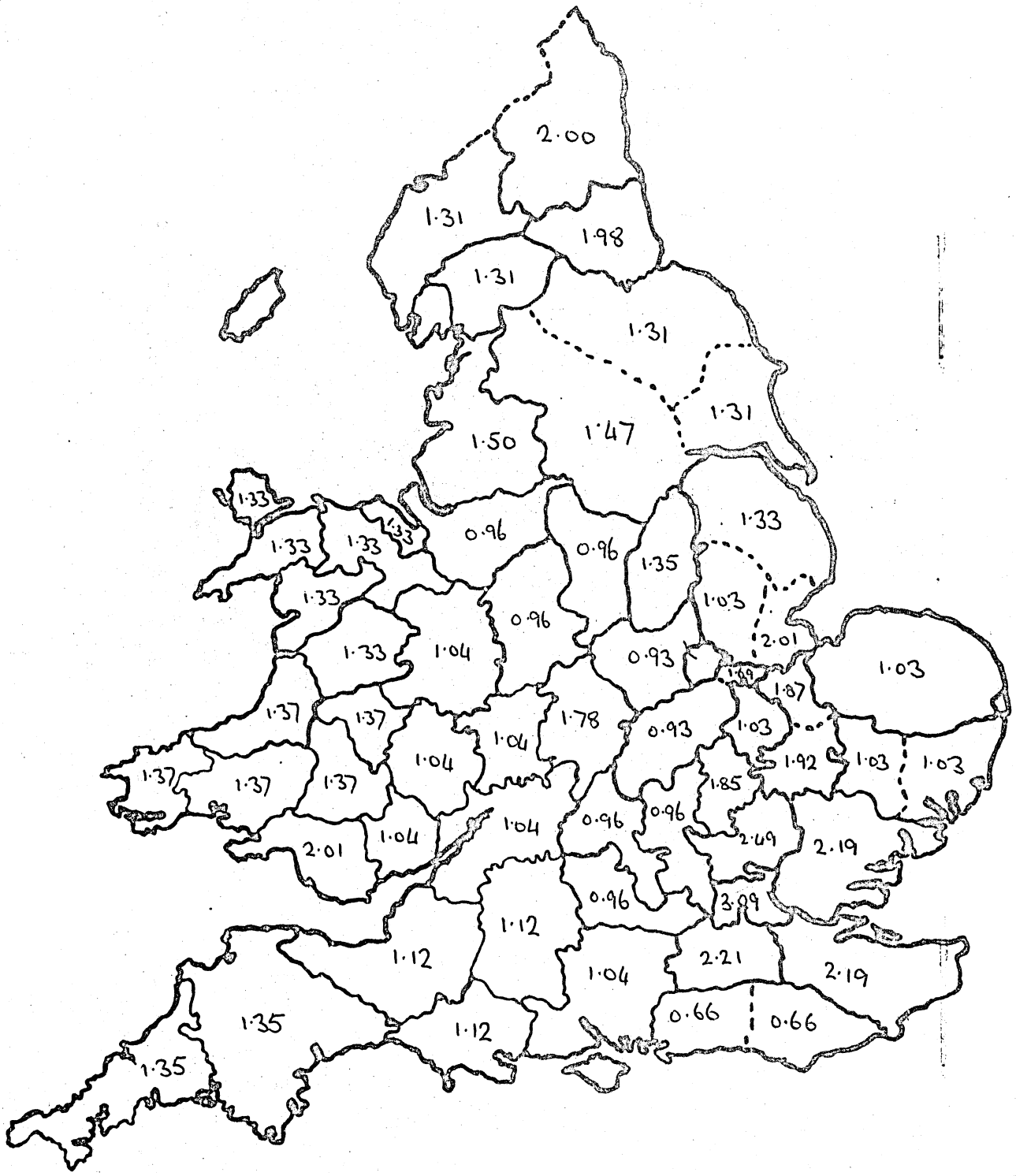


The previous analysis again serves as a basis. Milk consumed within the county of origin bears only the regional transport deduction. All milk transported further bears the programmed cost. But the costs are now aggregated according to the destination of the milk. The analysis has been done by counties and the results shown on MAP 4. London and Middlesex have to carry a cost of 3.09 pence per gallon while Sussex has only 0.66 pence per gallon to pay.

Although the principle of this method of charging may appear to be sound there are difficulties about using units as small as counties as the basis of the charges. Reference to table 1 and MAP 2 will suggest (what can be confirmed by actual calculation) that alterations in the supply schedule could alter the relative cost of milk transport to London, Essex and Hertford quite considerably with very little effect on the aggregate cost. The grouping of counties (not necessarily on the present regional pattern) might be done in a way that would reflect costs adequately and yet not be unacceptable on grounds of equity. Such a grouping would also reduce the range of costs. If both London and Sussex were included in wider areas the total transport charge between the highest and lowest area costs would probably not exceed 1.5 pence per gallon.

The question of how to charge transport costs is not a new one. It was fairly thoroughly investigated by the Cutforth Commission (11) which came out in favour of producer liability for transport costs. Although the Commission considered the possibility of distributors paying for the transport of milk, with a consequent higher retail price in markets which had to draw milk from distant producers, they rejected this largely on the grounds of difficulties of administration. (At that time there were large numbers of distributors, each buying milk direct from farmers). The Commission's main concern in this field was to reduce transport costs and they emphasis their interest in restoring proximity values to milk-producing farms near the main markets. Conditions have changed greatly since those days.

MAP 4. Transport Costs charged to Consumers (county pooling - pence per gallon)



The importance of transport costs as a proportion of total costs is greatly diminished. The Board is the sole buyer of milk (apart from the declining amount sold by producer retailers) and the number of distributors is now relatively few. There are therefore no serious practical difficulties about a reappraisal of the whole question of transport organisation and finance although some solutions might require legislative sanction.

The analysis in this report is not intended to provide any such solutions. The main aim is to show some of the complexities of the situation and to suggest directions in which progress might be made.

It is important that the problems of the dairy industry should be viewed in a wider context of farming in the United Kingdom. Within the confines of dairy farming it may appear desirable to minimise transport costs and to encourage production near the markets. However when we consider the national needs for greater cereal and meat production the picture is different. A new equilibrium needs to be established between the different geographical regions. The national economy may gain more from concentrating milk production in the wetter regions than from continuing the present distribution of milk production. If this is true one may blame the conservatism of farmers in the east and midlands for any excess of milk.

Finally any solution should also look well into the future. Technical methods are changing, not only on the farms but also in the dairies and in the transport industry. We already have pipe lines on the farms. Gas, oil, water and some other materials are sent much longer distances in pipes and milk may soon join the list. The question of delays through traffic congestion may mean that quite different routing than those suggested in this report would be more economic. Probably the whole of the analysis will appear naïve to transport managers concerned with the day to day optimisation of transport routes, the satisfying of changing market demands for milk, and making the most profitable use of the Ministry's various handling and transport allowances. However little has been published about these problems and the broader approach to the national position may have some merit in high-lighting some of the problems of milk transport.

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APPENDIX

(a) Regional Transport Deductions 1962 onwards.

M.M.B.Region	Charge per gallon (pence)
Northern	1.31
North western	0.96
Eastern	1.03
East midlands	0.93
West midlands	1.04
North Wales	1.33
South Wales	1.37
Southern	0.96
Mid western	1.12
Far western	1.35
South eastern	0.66

(b) Bulk Transport Charges 1962/63 Medium tankers

Distance(miles)	Pence per gallon
Up to 5	0.31
Over 5 up to 15	0.62
15 20	0.77
20 30	1.03
30 40	1.23
40 50	1.38
50 60	1.64
60 75	1.69
75 100	1.85
100 125	2.20
125 150	2.40
150 160	2.56