Centre for Agricultural Strategy

Smallfarmers' Association

Strategies for family-worked farms in the UK

Edited by R B Tranter

CAS Paper 15 December 1983

Tranter, R B (Ed) (1983) *Strategies for family-worked farms in the UK.* CAS Paper 15. Reading: Centre for Agricultural Strategy.

4 Total factor productivity and alternative measures of farm size

A P Power & J M Watson

INTRODUCTION

The average size of agricultural holdings in England and Wales has been increasing for many years. This has a number of policy implications, one of which is the reduced opportunity for entering the industry. This issue, like many others, needs to take account of the effects of economies of size, which is one among a number of factors leading to larger farms. Consideration of economies of size entails measurement of those economies and assessment of their impact – particularly the identification of the range of farm sizes over which they apply. Since measurement requires a yardstick, this paper deals with the awkward fact that different measures may indicate different sizes of farm above which economies are less likely to be obtainable. It provides a preliminary report on research on this aspect of the subject and, in particular, concentrates on the relationship between efficiency and size at the lower end of the farm size spectrum.

A direct link between efficiency (or productivity) and firm size may be expected to exist, with economies of size stemming from effects that are either internal or external to the firm itself. In agriculture, economies of size may be largely internal to the farm although external economies in the form, for example, of enhanced market or bargaining power can be realised. Cooperation and group activity make possible, even for very small farms, the realisation of such external economies as bulk purchasing of inputs or marketing of products at favourable prices.

The internal economies partly derive from the indivisibility, or 'lumpiness', of a number of the inputs used in production, eg buildings, tractors or combine

harvesters and even labour. Some indivisibility problems can be overcome by, for example, renting machinery, hiring casual labour or using contractors. The bigger and more expensive the item the more likely this will be and many farmers will hire a combine harvester or casual labour at periods of peak and very heavy requirement. However, this is by no means a general solution to the problems posed by input lumpiness. Thus when a farmer owns a tractor and hires a fulltime worker he can generally expect to achieve economies if the size of his business increases from a level at which either a tractor or a hired man, or both, are under-employed to the point at which they, and perhaps his own managerial input, are fully employed. In this case the fixed costs represented by management, the tractor and the workman are spread over a greater volume of production and, provided other costs per unit are unaffected, his average unit cost is reduced. Such economies derive from a change in average productivity as a result of altering the proportions of the fixed and variable inputs used. Economies of size include, as a special case, economies of scale which occur when all inputs are increased proportionately and output increases more than in proportion, again resulting in a reduced average unit cost (Vlastuin *et al,* 1982).

RECENT WORK AND CURRENT OBJECTIVE

Recent work in Britain on the size or scale of farms can conveniently be thought of as dating from the report *Scale of enterprise in farming* (Natural Resources (Technical) Committee, 1961). The next major contribution was *Size and efficiency in farming* (Britton & Hill, 1975) followed by *Size and efficiency in Scottish agriculture* (Dellaquaglia, 1978) and *Farm size, efficiency and economies of size* (Lund & Hill, 1979). During this period much work on the subject was undertaken abroad – particularly in India and the USA – and there were also significant contributions to the general literature on the measurement of firm size.

In the recent work on size and efficiency in British agriculture, efficiency was measured by the ratio of the value of total inputs to that of total outputs – henceforth referred to as total factor productivity (TFP) (this is not TFP in the general economic sense, Lund & Hill, 1979) – and farm size either by area or standard man days (smd). However, despite the use of a common concept of efficiency (TFP) in these studies, there are problems in comparing them. These stem from differences in definition and from measurement errors, and it is unclear to what extent the use of different size measures affected the results obtained. So much is evident from the exchange between Lund and Sutherland (Lund, 1983; Sutherland 1983) although both agree that the choice of size measure ultimately depends on the purpose of the study. This agreement serves to underline, rather than resolve, two broad issues; the most acceptable measure of

farm size for general purposes and the extent to which the use of any particular size measure may affect the picture of the TFP/size relationships.

The object of this paper is to weigh the evidence from an examination of the observed associations between TFP and the principle alternative measures of farm size, and to consider the extent to which the use of a particular size measure may change one's perception of the incidence of economies of size in agriculture in England and Wales, particularly among smaller farms. As in recent British studies no attempt is made to infer causal relationships from the observed associations between TFP and size of farm.

DATA AND SIZE MEASURES

All the recent work on size and efficiency in this country has been based on Farm Management Survey (FMS) data for England and Wales; this paper is no exception. However, the FMS has not remained unchanged and this has meant that the definition of TFP has varied between studies. The Natural Resources (Technical) Committee (1961) and Britton & Hill (1975 & 1978) used gross output per £100 inputs (including farmer and wife labour), whereas Lund & Hill (1979) used total enterprise output per £100 inputs, including farmer and wife labour, but excluding stock appreciation for breeding livestock. Total enterprise output is gross output excluding any profit or loss on the sale of previous years' crops plus the market value of home produced feed (excluding forage) and seed. Out study uses another variant: total enterprise output per £100 inputs (including farmer and wife labour) but with depreciation of machinery, glasshouses and permanent crops calculated at current cost rather than at acquisition cost as in the previous studies. This effects an improvement looked forward to by Lund & Hill (1979). Like the Natural Resources (Technical) Committee (1961) and Britton & Hill (1975 & 1978), but unlike Lund & Hill (1979), we include in output the stock appreciation for breeding livestock. Although in principle it would be preferable to exclude such stock appreciation since it leads to errors in the measurement of output, this has not proved immediately possible; we hope to assess the effect of its exclusion in future work. The limitations of TFP as calculated from FMS data are thoroughly discussed by Lund & Hill (1979) and need not be repeated here.

The Natural Resources (Technical) Committee (1961) used only area as a measure of size, adjusting any rough grazing in sole right to permanent pasture equivalent. Lund & Hill (1979) and Britton & Hill (1975 & 1978) used both area and 1968 smds. However it was Sutherland (1983), rather than Britton & Hill (1975 & 1978), who claimed that 'for the same data from any given sample of farms, efficiency will indeed appear to increase more rapidly with size

measured in smd than with size measured in acres'. He argued this in response to the MAFF evidence to the Northfield Committee (MAFF, 1979) which noted that rankings of individual farms by smd size were not identical with those by area, but nevertheless claimed that broadly similar results would be obtained if area were to substituted for smd. This paper considers this issue as part of a more extensive analysis of the relationship between TFP and size for twelve measures of farm size. These may be grouped as shown below as input based, output based, and, from these standpoints, hybrid, measures of farm size. Some of the measures are physical and others financial in nature; some are generally applicable while others (eg cereal area, number of dairy cows) are specific to particular farm types. The measures conventionally used in TFP/size studies of agriculture are area, smd and now European Size Units (ESU). The twelve measures included in this study are:

total area	Input based
annual labour units	
tenants' capital	
total inputs (including farmer and wife labour)	
total livestock units	
number of dairy cows	
cereal area	
total enterprise output	Output based
turnover	
standard man days (1968)	Hybrid
standard man days (1976)	
European Size Units	

Area is probably the most commonly used measure of farm size, perhaps because it is relatively easy to measure and, therefore, fairly readily available. That does not mean that it is necessarily the best measure of size for all purposes, although it plays a role in some policy decisions and is likely to continue to do so. The definition used in this paper is total area which includes crops, grass, rough grazing (sole right), woodland, buildings, roads, water, etc and corresponds to the measure of total area in the June agricultural census. Cereal area was used as a specific size measure for specialist cereals farms and, by the same token, numbers of dairy cows and numbers of livestock units were included as pertinent measures for specialist dairy farms.

The MAFF introduced smd in the late 1950s (Cracknell & Palca, 1959) as a

means of classifying farms by size and in the early 1960s (Napolitan & Brown, 1963) for classification by both type and size, though earlier use of them for these purposes had been made in Scotland (Scola, 1952). For some time it had been felt that there were drawbacks to area as a measure of the size of business, but it was not until computing services were made available that it became a practical possibility to carry out the enormous number of calculations required to set up an smd typology. Then experiments in classifying and sizing farms using smd, standard outputs and standard gross margins (SGM) were undertaken and smd were adopted as the new basis of classification.

The smd weights were revised on a number of occasions, in particular in 1968, and were intended to be updated every three years. However, by the early 1970s, labour was no longer the major input to most farming enterprises and a reexamination of farm classification was undertaken. This work was suspended on entry to the EC when it became apparent that a harmonised system of farm classification was required for member states. While discussions were in progress a revised set of smd weights was issued in 1976 as a stop gap measure until the new EC system became available. A classification system based on ESU was agreed in 1978; since 1978/79 the FMS has been published using a modified version of this. Some analysis of the June agricultural census has been carried out on the modified system and since 1980 results have been produced by both ESU and 1976 smd. Both 1968 and 1976 smd weights, along with ESU weights, were available for this study.

Total enterprise output (TEO) and total inputs (including farmer and wife labour) (TI) are included as measures of business size. They are the numerator and denominator respectively of the TFP ratio. Both vary as prices change and the former is particularly sensitive to variations in yields. The remaining measures of size considered – turnover, tenant's capital and annual labour units (ALU) – correspond to measures of firm size commonly used in industrial studies (Newbould & Wilson, 1977). It seems that these latter are used more because they are readily available than because they have anything in particular to commend them. However, they may all be useful in particular contexts as is shown by the analysis of firm size by trade classification and turnover size group undertaken by the Business Statistics Office (1981, 1982, 1983) using data for firms on the VAT register.

COVERAGE AND METHOD

Examination of the effect of using different measures of farm size on the TFP/size relationship has been restricted to four farm types, namely, specialist dairy and specialist cereals farms and mainly dairy and general cropping farms.

This is because such farms are not likely to have their output, and hence their TFP, too seriously distorted by trading livestock stock appreciation and because the FMS contains fairly large numbers of them. The data for these farm types were extracted from the 1981/82 tapes for England and Wales. These tapes contain the basic data for all the farms in the survey together with aggregates of certain physical and financial items for each farm. They also contain codes allocating each farm to a farm type in each of four systems of farm classification. The four systems, or typologies, are based on smd with 1968 or 1976 weights, SGM used in the EC Farm Accounts Data Network (FADN), and a modified version of the latter. The farm types as defined by the modified FADN typology provide the basis of this study, in contrast with the studies by Britton & Hill (1975 & 1978) and by Lund & Hill (1979) which were based on farm types as defined under the smd (1968) system.

In the previous analyses farms were subdivided into preselected area or smd size categories; the categories chosen were the customary ones used in presenting distributions of farms by area and smd. This procedure is not well suited to our present purpose since these categories are specific to particular measures (ie area or smd) and their use allows no analysis of the effects on the TFP/size relationship of substituting one measure for another. The method followed in this study was to take the farms in the 1981/82 FMS in each of the four farm types considered and rank them in order of increasing size, according to the particular measure being used. The ranked series were then divided into ten subgroups so that the smallest 10% of farms comprised the first subgroup, the next smallest 10% the second subgroup and so on to the largest 10% of farms which formed the tenth subgroup. The mean size and mean TFP were then calculated for each subgroup. Also within each subgroup the farms were ranked in order of increasing TFP and the mean size and mean TFP calculated for the top and bottom 25%.

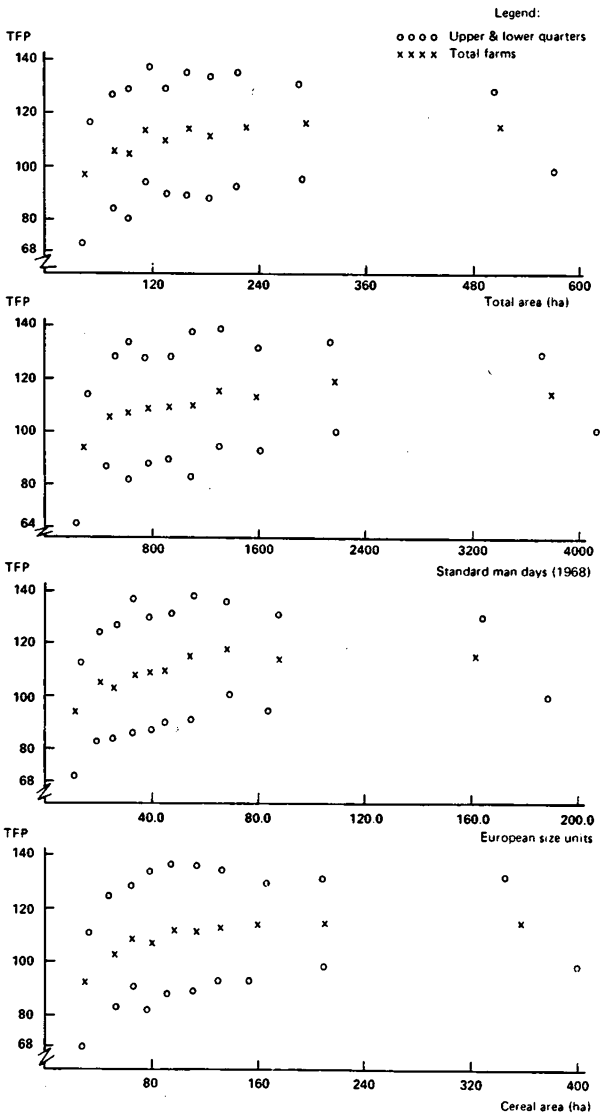
This procedure was repeated for each of the size measures used and means that any observed differences in the TFP/size relationship due to the different size measures are the consequence of some proportion of the farms being classified to different subgroups under alternative size measures. Identification of the frequency and extent of such reclassification lies at the heart of our analysis.

RESULTS

Before moving on to a consideration of the results of the main analysis using the method just outlined, some results are presented for 1981/82 on a similar basis to those provided by previous researchers. Figures 1 and 2 show the relationship between TFP and size for specialist cereals and specialist dairy farms when size is

Figure 1

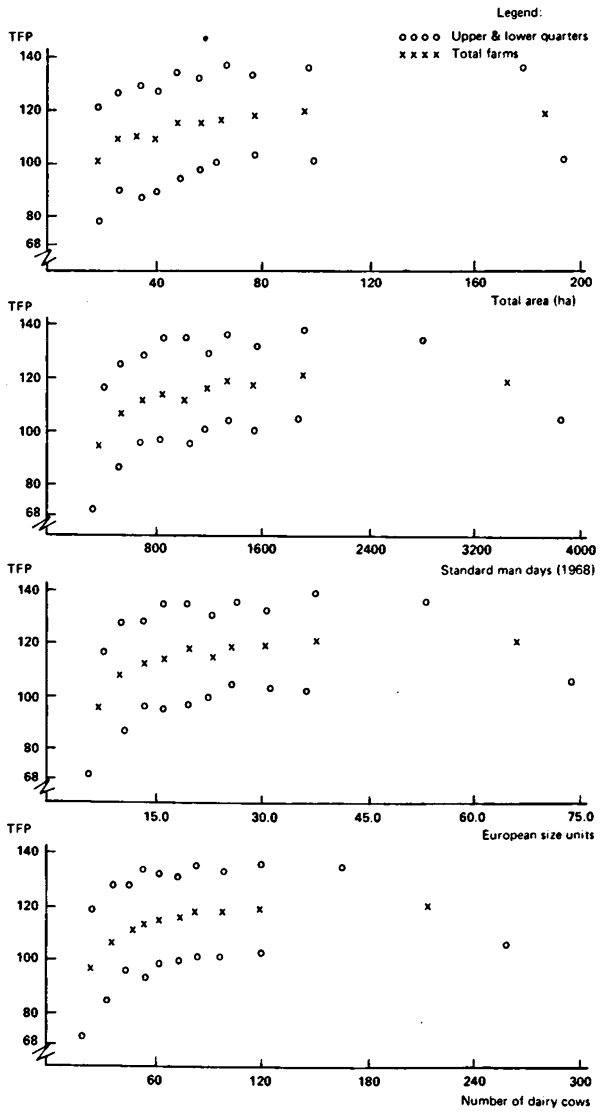
Specialist cereals farms: graphs of mean total factor productivity against various measures of mean size, 1981/82.



Source: Derived from 1981/82 Farm Management Survey data.

Figure 2

Specialist dairy farms: graphs of mean total factor productivity against various measures of mean size, 1981/82.



Source: Derived from 1981/82 Farm Management Survey data.

measured for both farm types by total area, 1968 smd and ESU, and by cereal area and number of dairy cows for the specialist cereals and the specialist dairy farms respectively. They show the familiar pattern at the means for all farms and for the top and bottom 25% of farms in each farm type. This pattern is one of marked positive association between TFP and size among the smaller farms with the relationship either less pronounced or absent among the larger farms. There is also a tendency, among the largest 10% of farms, for the average size of the 25% less efficient farms to be larger than that of the 25% most efficient farms, under all size measures.

A general summary of the main results is given in Figures 3 to 6. This type of presentation cannot be used to illustrate the precise differences introduced into the TFP/size relationship by the various size measures employed, but it does serve admirably to identify, or confirm, three major matters of general and quite fundamental interest. These are that:

(i) the positive association between TFP and size is marked among the smaller farm subgroups for all four farm types;

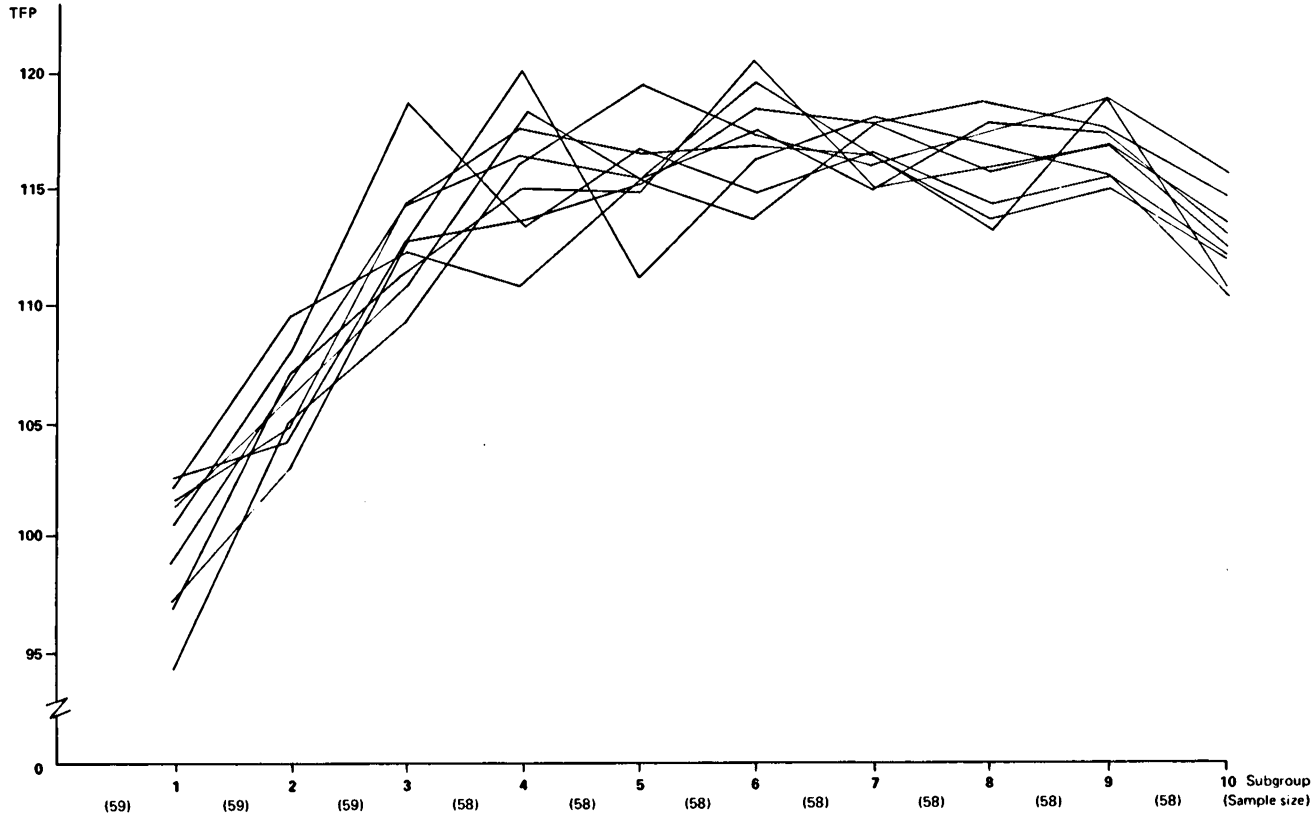
(ii) some of the size measures produce more variable and erratic, sometimes even conflicting, results than others.

(iii) a fairly distinctive pattern of TFP/size relationship is observable for each farm type. Thus for general cropping farms (Figure 3) the overall picture is one of a steep rise in TFP as farm size increases, with a levelling off at about the fourth to fifth subgroup and some suggestion of a decline in productivity in the largest subgroup. With specialist cereals farms (Figure 4), on the other hand, the impression gained is one of continuous improvement of TFP over virtually the whole range of subgroups. Like the general cropping farms there is a more pronounced positive association between TFP and size at the lower end of the farm size spectrum. There is also an indication of a flattening out or even a reversal of the relationship in the largest subgroup of farms. Specialist dairy farms (Figure 5) display an overall pattern which is akin to that for the specialist cereals type except that the positive TFP/size association is more marked for the first two subgroups, perhaps a little less marked subsequently and there is no suggestion of a negative relationship in the largest subgroup of farms. Finally, the picture for mainly dairy farms (Figure 6) differs in one major respect from all the others: having shown the expected positive relationship for the smaller subgroups, there is a general tendency for TFP to be negatively related to size from the fourth to fifth subgroups onwards.

Figures 7 and 8 provide a closer examination of some of the more conventional size measures. Average TFP is plotted against average size for each subgroup of the size distributions of all four farm types. The graphs show TFP increasing with farm size up to some limit in each case. However, the large range of TFP

Figure 3

General cropping farms: synopsis of the relationships between mean total factor productivity and mean farm size for 9 measures of size, 1981/82.

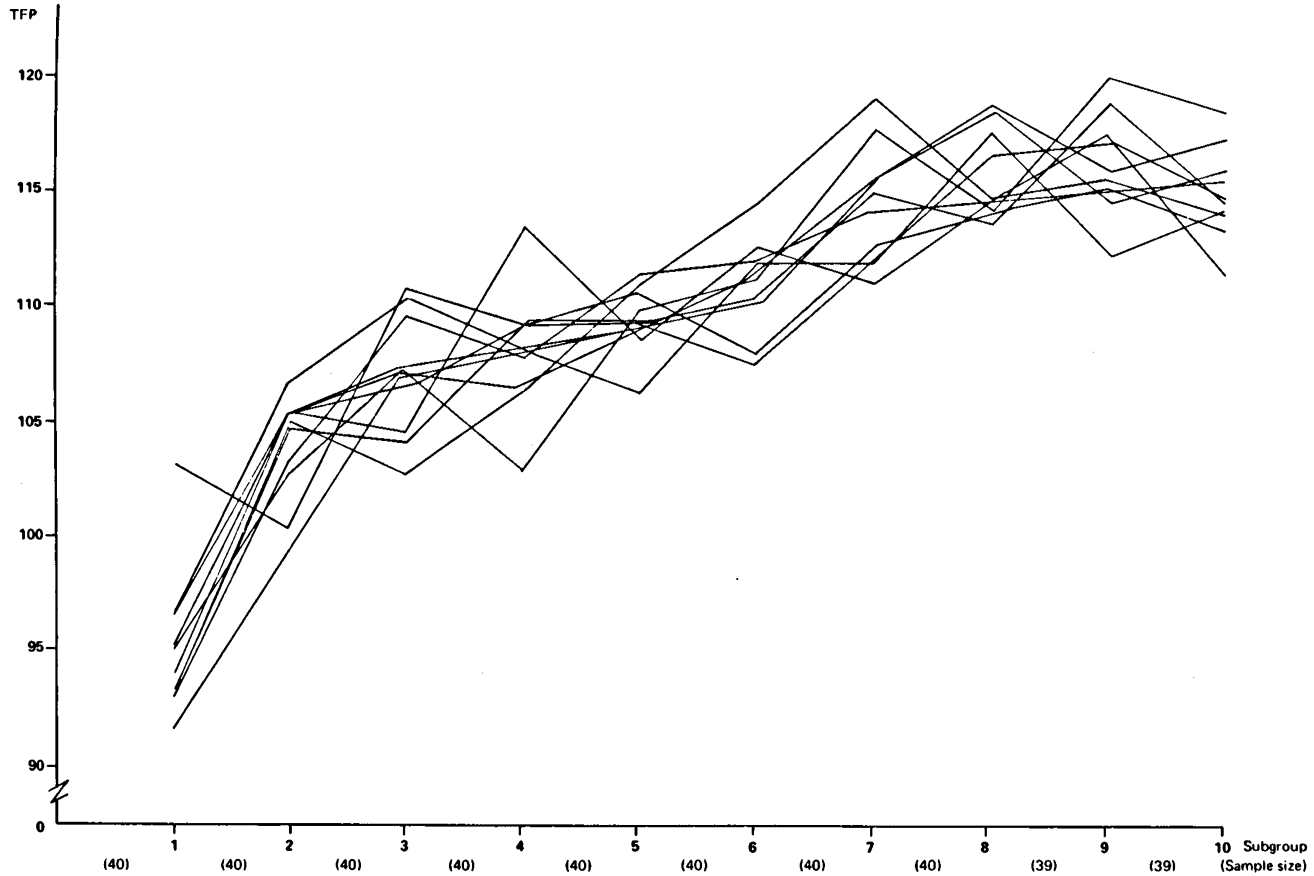


Source: Derived from 1981/82 Farm Management Survey data.

Figure 4

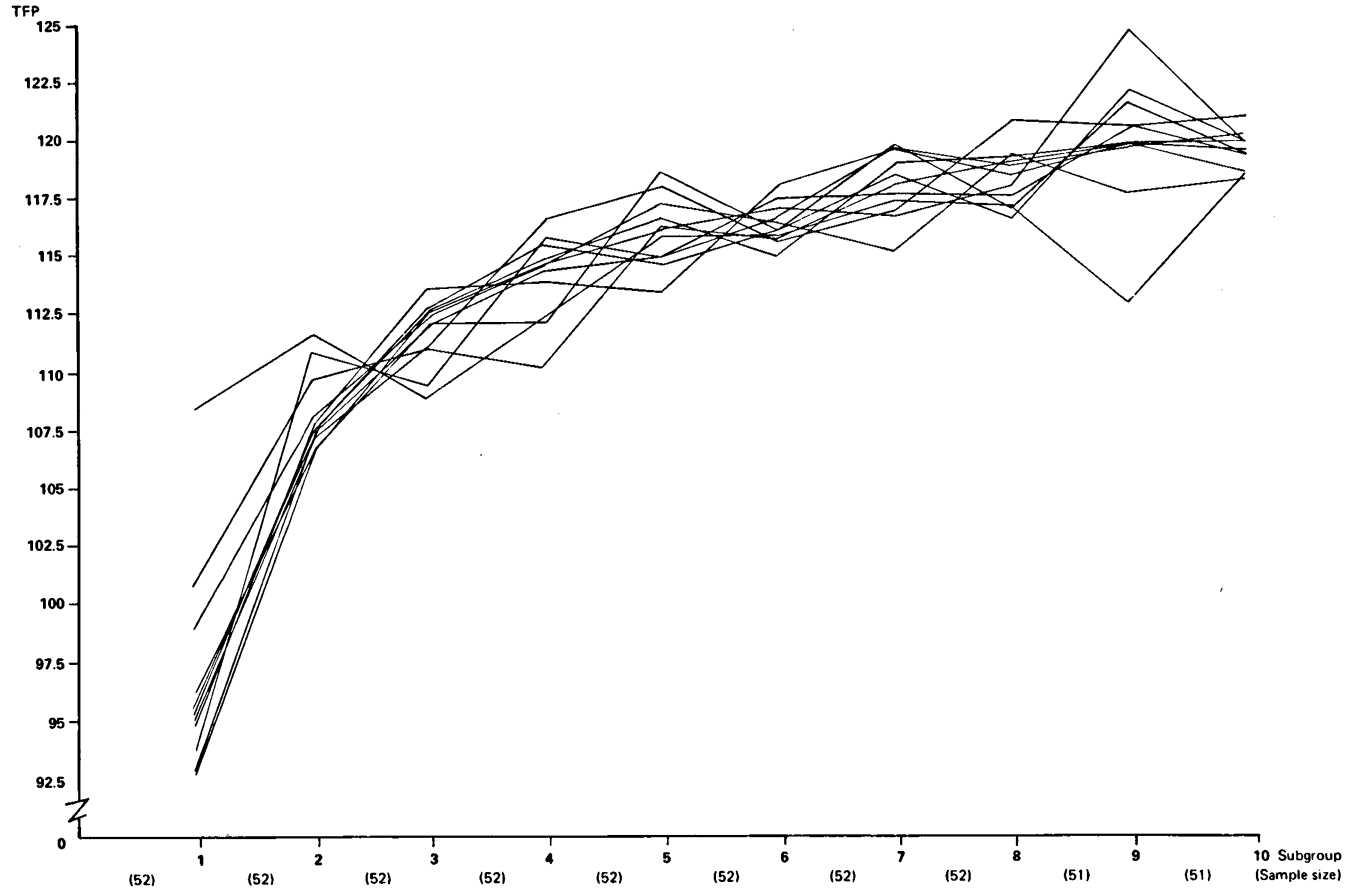
Figure 4

Specialist cereals farms: synopsis of the relationships between mean total factor productivity and mean farm size for 10 measures of size, 1981/82.



Source: Derived from 1981/82 Farm Management Survey data.

Figure 5
Specialist dairy farms: synopsis of the relationships between mean total factor productivity and mean farm size for 11 measures of size, 1981/82.



Source: Derived from 1981/82 Farm Management Survey data.

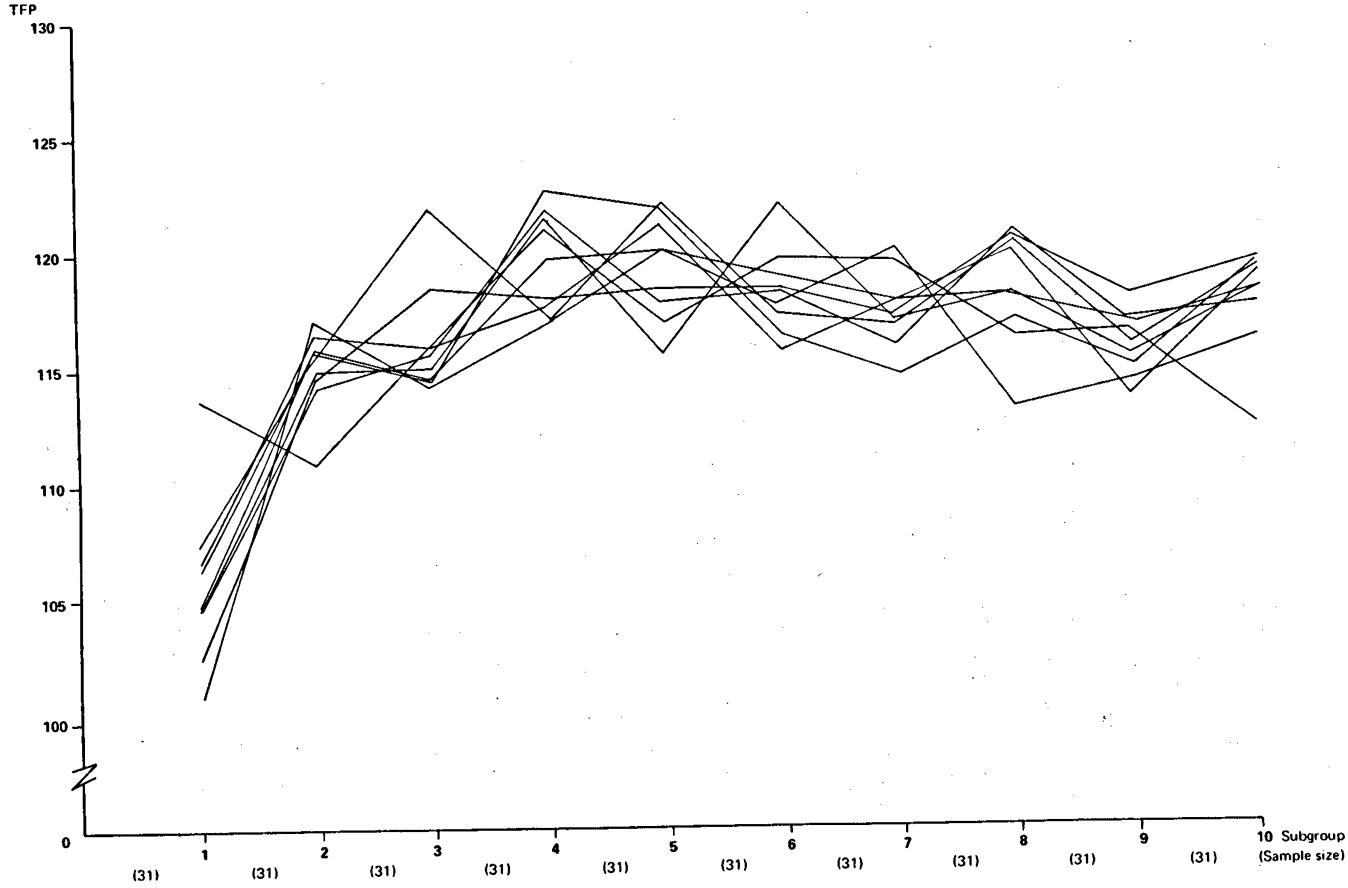
Figure 6

(52) (52) (52) (52) (52) (52) (52) (52) (51) (51) (Sample size)

Source: Derived from 1981/82 Farm Management Survey data.

Figure 6

Mainly dairy farms: synopsis of the relationships between mean total factor productivity and mean farm size for 9 measures of size, 1981/82.



Source: Derived from 1981/82 Farm Management Survey data.

within each subgroup is indicated by the standard deviations of the overall means shown in Tables 1 to 4 and implies that the relationship between size and TFP is generally weak and that TFP would have to be accounted for by many factors other than size.

Figure 7 compares the effects for the four farm types of using total area, ALU and smd as size measures. In all cases (except for ALU when measuring specialist cereals, specialist dairy and mainly dairy farms) the marked positive relationship between TFP and size for the smaller farms is evident. However, the point beyond which economies of size become less marked varies with the measure and also by farm type. For example, this point occurs in general cropping farms at the third subgroup with ALU as the size measure, at the fourth with 1968 smd as the yardstick and possibly as high as the sixth with total area. In specialist dairy farms there seems to be a strong positive TFP/size relationship for smd up to and including the fourth subgroup that is less apparent with the other measures. For the mainly dairy group, TFP peaks at the fourth subgroup with smd and ALU and at the fifth with total area. The most notable feature of the specialist cereals farms is the generally continuous increase in TFP with smd size over the first nine tenths of the size range.

Figure 8 shows the TFP/size relationship using TI and TEO as size measures. Both these show TFP steeply rising with size up to and including the third subgroup of specialist cereals farms. There is a less marked, but still generally positive relationship thereafter, peaking at the eighth and ninth subgroups with TI and TEO respectively. By comparison economies of size are exhausted relatively rapidly in the case of mainly dairy farms. With TEO as the measure specialist dairy farms continue to exhibit modest increases in TFP after about the fourth subgroup.

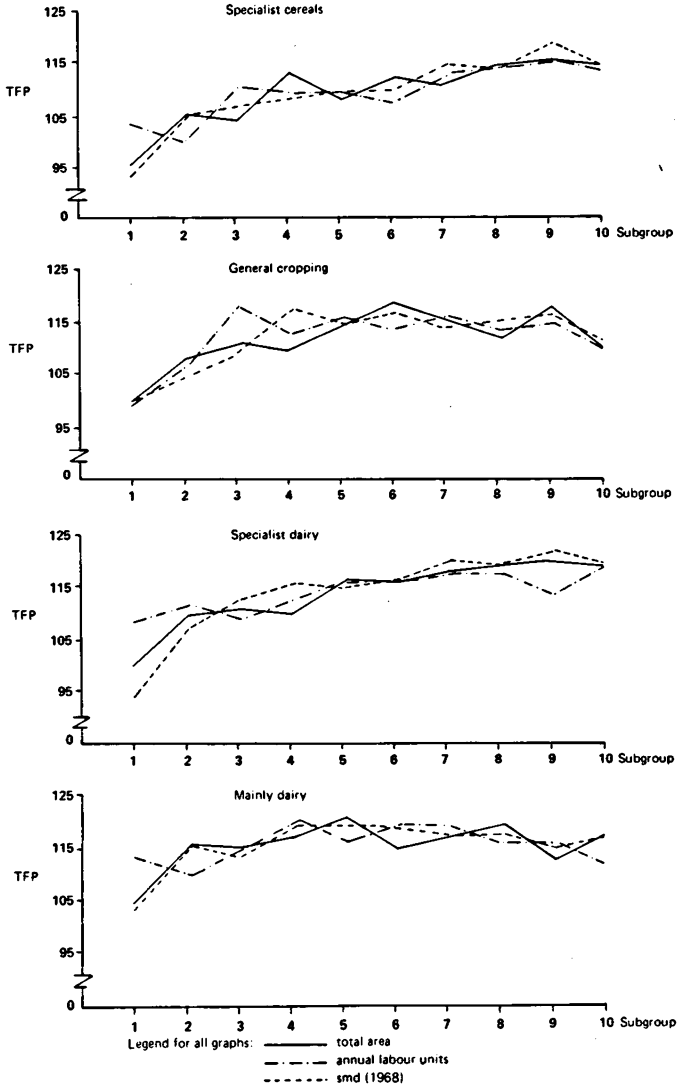
Figures 7 and 8 also provide information on two points discussed by Lund (1983) and Sutherland (1983) in their exchange. Figure 7 shows that, for a given group of farms, TFP does appear to increase more rapidly when their size is measured in smd rather than in area; however, the effect is quite small. The evidence in Figure 8 demonstrates the fact that a ratio will tend to be more positively related to its numerator than to its denominator, but again the effect is not very pronounced.

The main feature of the group of measures in Figure 9 is the reasonably close similarity of the TFP/size relationship they portray, despite their different conceptual bases. Once again all these measures show a marked positive association between TFP and size among the smaller farms in all farm types.

The underlying reason why different size measures show different patterns of economies of size for the same group of farms is because farms change their rank as the measure is changed. Naturally some reordering of farms will take place

Figure 7

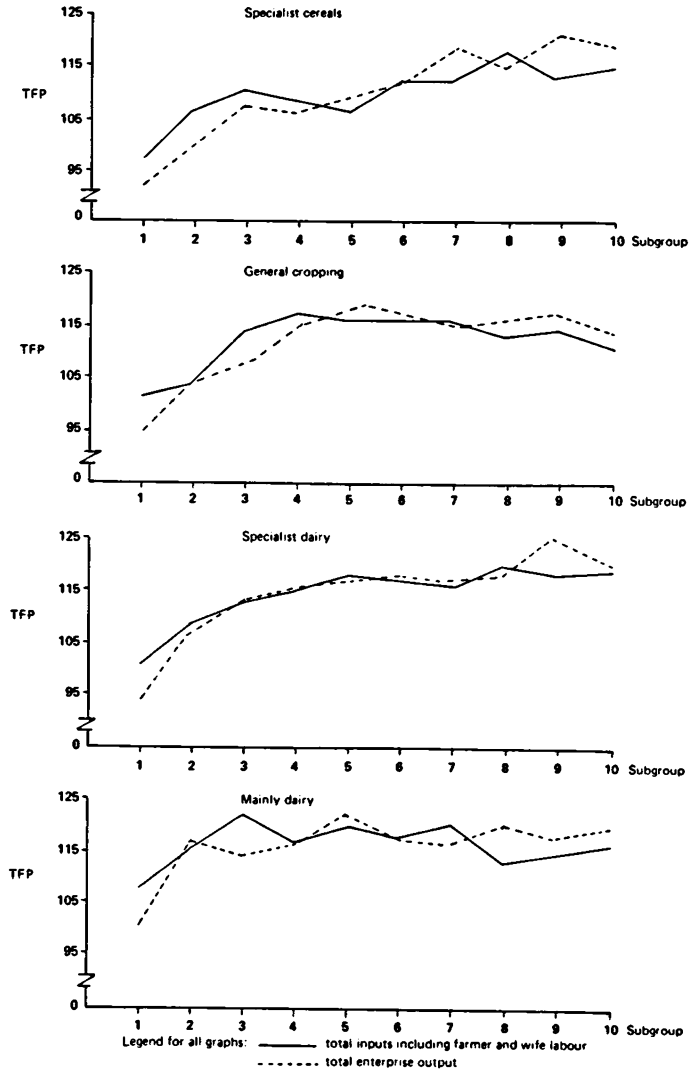
Comparisons for each farm type of the associations between mean total factor productivity and mean size indicated by the alternative size measures: total area, annual labour units and 1968 SMDs, 1981/82.



Source: Derived from 1981/82 Farm Management Survey data.

Figure 8

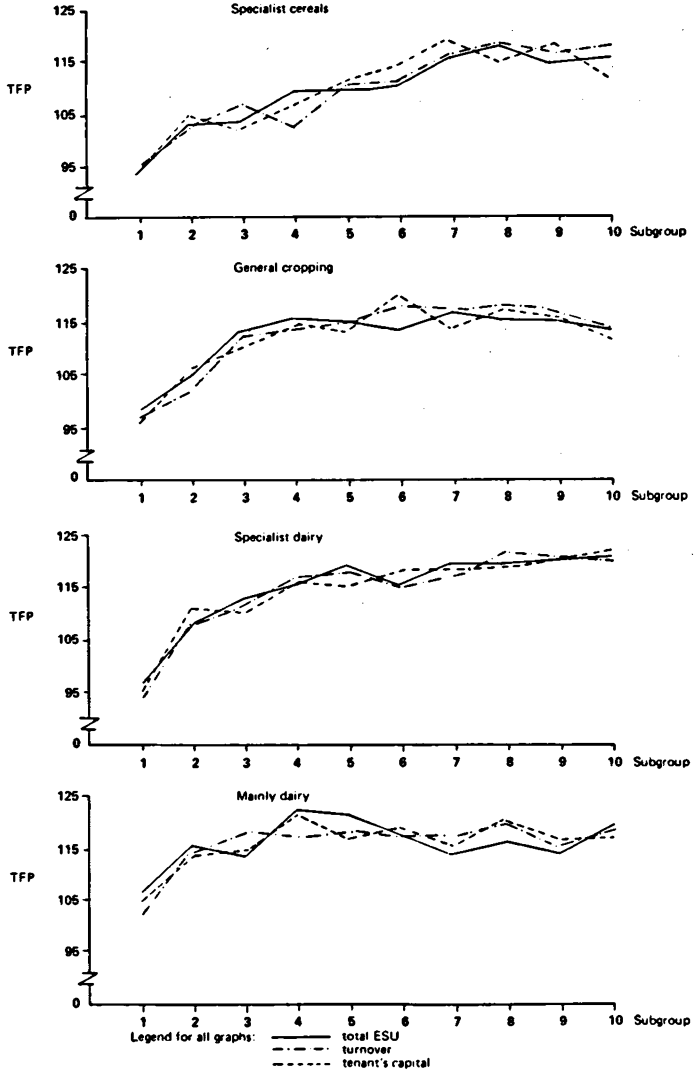
Comparisons for each farm type of the associations between mean total factor productivity and mean size indicated by the alternative size measures: total inputs including farmer and wife labour and total enterprise ouput, 1981/82.



Source: Derived from 1981/82 Farm Management Survey data.

Figure 9

Comparison for each farm type of the associations between mean total factor productivity and mean size indicated by the alternative size measures: total ESU, turnover and tenant's capital, 1981/82.



Source: Derived from 1981/82 Farm Management Survey data.

the conclusion must be that, in assessing the association between TFP and farm size, the choice of farm size measure will influence the results obtained, particularly any estimate of the farm size range above which economies of size either cease to occur or decline markedly. However, the analysis is a preliminary one in certain respects: it is for one year only (1981/82) and it covers only four farm types of the Farm Management Surveys for England and Wales. Further work is required to extend the analysis in time and coverage.

APPENDIX

IDENTIFICATION OF THE CRITICAL FARM SIZE RANGES ABOVE WHICH ECONOMIES OF SIZE MARKEDLY CHANGE

Analyses based on average subgroup data are not very amenable to statistical testing. They indicate only approximately the farm size ranges above which the relationship between TFP and farm size changes markedly. However, since these size ranges are of interest the following method is suggested as a possible means of locating them more precisely. Since the method is time consuming and experimental its application has been restricted to specialist cereals farms and to the three more conventional farm size measures.

The procedure involved repeated and sequential estimations of simple linear regressions by least-squares between TFP and size using individual farm data. To begin with a regression was run on the smallest 10% of farms and then repeated on the remaining 90% of farms. The difference between the estimates of the two slope coefficients was recorded. A second pair of regressions was then estimated, this time for the smallest 10% of the farms plus the ten next smallest farms and then for the remaining farms; once more the difference between the estimates of the two slope coefficients was recorded. This procedure was repeated, each time with ten farms being transferred from the second to the first group of farms, until it became clear that the difference between the slope coefficients of each successive pair of regressions was either continually diminishing or remaining relatively constant. The point of largest difference in slopes, in a series of differences which first generally increase and subsequently decline, indicates the farm size range within which economies of size apparently either cease to be obtainable or begin to decline in importance. Whether or not the economies cease completely, or merely decline in magnitude, depends upon whether the coefficient relating TFP to size for the group of larger farms is found to be significantly different from zero. This procedure can be used to identify more than one marked change in the rate at which TFP rises with size.

The step by step linear regression approach used approximates for a

relationship between TFP and size that may be non-linear in form and this may entail bias in the estimates obtained. If the results are judged on the evidence provided by the graphs, however, the bias would not appear to be a very serious problem with the measures used. Nevertheless where the relationship between TFP and size is markedly non-linear the estimated slope coefficients will be subject to considerable bias.

The results are summarised in Table 10. Column 1 indicates the percentage ranges of the farm size distributions within which economies of size change markedly. It appears that the critical percentage ranges are not very different for the three conventional measures. The corresponding actual size ranges are given in column 2. The estimates of the slope coefficents (columns 3 and 6) on which the identification of the ranges depends are all highly significant with the exception of that for the larger group of farms when total area is used as the measure of size.

There are a number of important qualifications that must be made concerning these results. In the first place they reflect broad aggregate relationships and cannot be interpreted as applying in any way to individual farms which can, and do, depart very noticeably from the average as the sizes of the standard deviations in Tables 1 to 4 show. Secondly, the size ranges given relate to the maximum difference between the slope coefficients and there are other size ranges over which the economies of size obtainable may still be considerable. Thirdly, economies of size are obtained, but at a reduced rate, by the larger group of farms when size is measured by 1968 smd and ESU. Fourthly, the observed TFP/size relationships are weak as indicated by the values of the correlation coefficients shown (columns 5 and 8). Finally it has to be stressed that we have not attempted to explain how TFP is determined, but have merely estimated degrees of association between TFP and size for the purposes of finding the farm size ranges above which the relationships between TFP and farm size show a considerable change. No special meaning should be attributed to the absolute values of the slope coefficients themselves.

ACKNOWLEDGEMENT

The authors wish to acknowledge the assistance of Mr A Barnett and the Economics Division III Executive Unit and comments of professional colleagues in MAFF. They are, however, solely responsible for the views expressed in the paper which do not necessarily represent those of the MAFF.

Table 1

Specialist cereals farms: mean total factor productivity and mean size by size measure and 10% subgroup,[1,2] 1981/82

Size measure	10% Subgroups									
	1		2		3		4		5	
	TFP[3]	Size	TFP	Size	TFP	Size	TFP	Size	TFP	Size
Total area (ha)	96.4 (18.5)[4]	45.5 (12.2)	105.2 (17.7)	74.9 (6.6)	104.4 (20.2)	91.4 (5.8)	113.2 (17.6)	111.6 (5.1)	108.5 (16.0)	134.1 (8.0)
Standard man days (1968)	93.8 (19.2)	281.8 (90.6)	105.1 (17.0)	479.7 (48.4)	107.2 (20.4)	619.7 (32.3)	108.1 (15.4)	770.8 (51.5)	109.2 (16.6)	926.3 (46.5)
Standard man days (1976)	95.0 (19.8)	146.5 (43.2)	105.2 (18.7)	250.2 (24.4)	106.5 (16.9)	334.6 (20.6)	109.2 (18.1)	411.0 (27.5)	110.4 (18.6)	507.3 (29.0)
European size units	93.8 (17.5)	11.5 (3.4)	104.6 (17.7)	20.4 (1.9)	103.9 (16.3)	25.8 (1.7)	109.2 (20.2)	33.5 (2.4)	109.4 (17.8)	39.1 (1.1)
Total enterprise output (£)	91.6 (18.8)	20113 (6437)	99.4 (13.5)	37266 (3789)	107.0 (20.8)	48732 (2935)	106.2 (16.0)	61603 (4379)	108.8 (16.1)	73270 (3327)
Total inputs (£) (including farmer and wife labour)	96.4 (20.4)	21847 (5950)	106.6 (20.1)	35669 (3036)	110.1 (18.3)	46310 (3092)	108.1 (16.1)	58253 (3505)	106.3 (16.9)	68881 (2863)
Turnover (£)	94.6 (19.4)	18891 (6150)	102.6 (14.5)	36196 (3892)	107.2 (20.7)	47978 (4067)	102.9 (18.3)	60111 (3445)	109.7 (17.1)	73364 (4310)
Tenant's capital (£)	93.7 (19.9)	22669 (8439)	104.7 (17.1)	46569 (5689)	102.6 (18.8)	62456 (3765)	106.1 (13.8)	77421 (4994)	111.0 (17.1)	97005 (6590)
Annual labour units	103.2 (24.4)	0.9 (0.3)	100.2 (20.0)	1.5 (0.2)	110.6 (18.3)	2.0 0.03	109.2 (16.0)	2.2 (0.1)	109.2 (17.3)	2.7 (0.2)
Cereal area (ha)	92.6 (16.8)	29.3 (8.8)	103.2 (17.9)	49.9 (4.3)	109.5 (15.3)	64.1 (5.1)	107.8 (20.1)	78.6 (3.8)	111.3 (19.6)	92.3 (5.7)

Table 1 (Continued)

Size measure	10% Subgroups									
	6		7		8		9		10	
	TFP	Size	TFP	Size	TFP	Size	TFP	Size	TFP	Size
Total area (ha)	112.4	157.9	111.1	183.7	114.6	223.3	115.5	292.5	114.0	510.6
	(18.1)	(6.7)	(18.8)	(7.9)	(17.4)	(18.8)	(15.0)	(29.6)	(13.3)	(161.3)
Standard man days (1968)	110.2	1117.6	114.9	1309.2	113.6	1588.8	118.8	2166.9	114.5	3809.0
	(21.0)	(58.2)	(17.5)	(50.3)	(15.9)	(134.4)	(13.4)	(171.5)	(11.7)	(1130.1)
Standard man days (1976)	108.0	606.6	112.6	704.4	116.6	859.2	117.2	1160.2	114.7	2032.1
	(17.8)	(26.5)	(16.3)	(29.1)	(18.1)	(67.0)	(14.0)	(98.7)	(12.1)	(591.3)
European size units	110.1	45.6	115.5	55.5	118.5	68.9	114.6	88.6	115.7	161.5
	(17.7)	(2.6)	(18.6)	(3.4)	(14.0)	(4.5)	(14.6)	(8.4)	(13.4)	(47.5)
Total enterprise output (£)	111.3	88286	117.7	111503	114.4	137557	120.5	173377	118.5	305393
	(14.7)	(5671)	(19.1)	(8606)	(13.4)	(6591)	(13.1)	(16529)	(13.4)	(86685)
Total inputs (£) (including farmer and wife labour)	111.8	80178	111.8	98504	117.5	119018	112.4	149707	114.2	267037
	(21.0)	(3791)	(15.8)	(6806)	(13.4)	(5703)	(16.5)	(14934)	(14.4)	(88520)
Turnover (£)	111.1	91380	115.5	112711	118.6	141431	115.8	179796	117.4	310070
	(17.0)	(4884)	(14.4)	(8948)	(17.4)	(8681)	(13.1)	(14789)	(13.4)	(93334)
Tenant's capital (£)	114.4	119593	119.0	143736	114.6	176960	117.6	228872	111.6	411307
	(16.3)	(5238)	(18.6)	(9901)	(16.7)	(11177)	(12.1)	(19685)	(15.1)	(131982)
Annual labour units	107.5	3.1	112.6	3.6	114.3	4.2	115.1	5.3	113.3	8.3
	(16.8)	(0.1)	(18.1)	(0.2)	(17.0)	(0.2)	(12.5)	(0.5)	(14.0)	(2.2)
Cereal area (ha)	112.0	112.6	114.1	130.2	114.5	159.4	115.0	208.7	115.5	359.2
	(18.9)	(5.2)	(16.2)	(6.1)	(16.0)	(12.2)	(13.6)	(20.3)	(14.0)	(102.9)

1 For each size measure the farms were ranked in order of increasing size and the series divided into 10 subgroups. The smallest 10 per cent of farms comprised the first subgroup, the next smallest formed the second subgroup and so on until the largest 10 per cent formed the tenth subgroup.

2 Based on the results for 398 farms.

3 TFP is total factor productivity defined as $\frac{\text{total enterprise output}}{\text{total inputs including farmer and wife labour}} \times 100$

4 Figures in brackets are standard deviations.

Source: Derived from 1981/82 Farm Management Survey data.

Table 2

General cropping farms: mean total factor productivity and mean size by size measure and 10 per cent subgroup,[1,2] 1981/82

Size measure	10% Subgroups									
	1		2		3		4		5	
	TFP[3]	Size	TFP	Size	TFP	Size	TFP	Size	TFP	Size
Total area (ha)	101.8 (23.4)[4]	35.0 (10.6)	109.3 (20.1)	67.7 (7.0)	112.1 (18.1)	88.1 (5.2)	110.4 (18.8)	112.1 (6.6)	115.2 (17.5)	135.2 (6.6)
Standard man days (1968)	101.0 (22.1)	474.4 (134.4)	105.5 (17.6)	801.6 (77.3)	110.6 (21.6)	1042.5 (77.8)	117.8 (17.6)	1312.2 (81.4)	115.1 (20.0)	1659.4 (117.6)
Standard man days (1976)	102.3 (22.5)	269.6 (76.1)	103.8 (15.8)	490.7 (47.1)	112.3 (20.2)	633.3 (50.0)	119.7 (18.5)	806.8 (56.7)	110.7 (15.3)	983.8 (47.8)
European size units	98.5 (22.8)	12.9 (4.4)	106.4 (18.3)	23.6 (2.1)	113.9 (20.3)	30.5 (2.2)	116.2 (17.4)	38.7 (2.5)	115.2 (16.9)	50.2 (3.9)
Total enterprise output (£)	93.9 (21.0)	24319 (7323)	104.6 (15.7)	46464 (6096)	109.1 (17.0)	66532 (5703)	116.1 (16.5)	84931 (5360)	119.2 (20.5)	105662 (6473)
Total inputs (£) (including farmer and wife labour)	101.3 (21.8)	25022 (6809)	104.5 (19.2)	44875 (3996)	114.1 (22.2)	60213 (4392)	117.4 (18.2)	73727 (3578)	116.3 (17.1)	89937 (6034)
Turnover (£)	97.0 (21.6)	24555 (8015)	102.7 (16.8)	46637 (6581)	112.4 (19.5)	65756 (5034)	113.4 (17.0)	82218 (5074)	115.1 (17.7)	103722 (7167)
Tenant's capital (£)	96.7 (21.6)	29177 (10299)	106.6 (18.5)	54807 (7230)	111.3 (17.3)	77319 (5531)	114.8 (19.0)	95812 (5934)	114.5 (16.3)	120398 (8063)
Annual labour units	100.2 (22.5)	1.4 (0.4)	107.6 (19.1)	2.2 (0.2)	118.4 (20.5)	2.8 (0.2)	113.1 (17.7)	3.3 (0.2)	116.4 (19.2)	4.0 (0.2)

Table 2 (Continued)

Size measure	10% Subgroups									
	6		7		8		9		10	
	TFP	Size	TFP	Size	TFP	Size	TFP	Size	TFP	Size
Total area (ha)	119.3	167.7	116.2	210.9	112.8	258.7	118.5	356.2	110.5	586.7
	(17.6)	(11.4)	(18.4)	(11.4)	(18.2)	(16.5)	(15.0)	(41.0)	(12.4)	(148.4)
Standard man days (1968)	117.2	2061.1	114.7	2544.8	115.6	3233.2	116.5	4660.2	112.2	8350.4
	(15.8)	(128.9)	(17.2)	(151.8)	(17.9)	(298.2)	(13.8)	(551.5)	(15.2)	(4232.7)
Standard man days (1976)	116.0	1224.6	117.7	1554.1	116.6	1994.1	115.2	2895.9	111.8	5277.5
	(19.7)	(92.4)	(18.9)	(94.3)	(18.2)	(205.5)	(13.9)	(326.2)	(14.9)	(3129.7)
European size units	113.5	62.4	117.4	76.3	115.4	94.3	116.6	141.7	113.0	242.2
	(18.3)	(3.8)	(18.3)	(4.0)	(16.0)	(7.5)	(13.9)	(16.8)	(15.8)	(92.5)
Total enterprise output (£)	116.9	130323	115.6	165899	117.0	207278	118.6	287666	115.5	485520
	(16.1)	(9866)	(15.6)	(10662)	(18.1)	(12591)	(15.7)	(33593)	(14.6)	(127309)
Total inputs (£) (including farmer and wife labour)	116.6	115295	116.2	142737	113.5	181589	114.7	249434	111.6	433506
	(19.0)	(7945)	(17.9)	(10242)	(14.5)	(13639)	(14.7)	(29535)	(14.1)	(120510)
Turnover (£)	118.1	128437	117.6	169346	118.4	210519	117.2	291287	114.4	484087
	(15.7)	(8695)	(18.4)	(12948)	(17.4)	(13677)	(15.0)	(29285)	(15.0)	(148757)
Tenant's capital (£)	120.3	148056	114.7	188756	117.5	237128	116.9	310639	112.8	536274
	(19.3)	(9479)	(19.1)	(13990)	(15.0)	(13671)	(14.7)	(37528)	(14.7)	(169526)
Annual labour units	114.5	4.8	116.3	5.7	114.0	7.0	115.2	9.6	110.3	16.1
	(17.5)	(0.2)	(17.9)	(0.3)	(15.4)	(0.5)	(16.8)	(1.1)	(12.4)	(6.1)

1 For each size measure the farms were ranked in order of increasing size and the series divided into 10 subgroups. The smallest 10 per cent of farms comprised the first subgroup, the next smallest 10 per cent formed the second subgroup and so on until the largest 10 per cent formed the tenth subgroup.

2 Based on the results for 583 farms.

3 TFP is total factor productivity defined as $\frac{\text{total enterprise output}}{\text{total inputs including farmer and wife labour}} \times 100$

4 Figures in brackets are standard deviations.

Source: Derived from 1981/82 Farm Management Survey data.

Table 3

Specialist dairy farms: mean total factor productivity and mean size by size measure and 10 per cent subgroup[1 2] 1981/82

Size measure	10% Subgroups									
	1		2		3		4		5	
	TFP[3]	Size	TFP	Size	TFP	Size	TFP	Size	TFP	Size
Total area (ha)	100.9 (17.1)[4]	18.4 (2.9)	109.7 (14.8)	26.6 (2.2)	111.1 (17.5)	33.6 (2.0)	110.3 (15.2)	40.4 (2.0)	116.4 (16.4)	48.7 (2.7)
Standard man days (1968)	95.2 (18.2)	374.9 (70.5)	107.4 (15.2)	544.4 (50.7)	112.9 (13.8)	691.7 (40.5)	115.7 (15.3)	862.8 (58.6)	114.8 (16.2)	1027.4 (45.8)
Standard man days (1976)	95.1 (18.1)	261.3 (49.0)	107.9 (15.2)	380.4 (35.4)	113.7 (13.8)	482.1 (28.6)	114.1 (15.3)	599.5 (36.8)	113.6 (14.8)	716.6 (31.5)
European size units	95.2 (18.1)	7.0 (1.3)	107.4 (15.7)	10.3 (1.0)	112.8 (13.6)	13.3 (0.9)	115.0 (15.5)	16.2 (1.0)	116.7 (15.0)	19.6 (0.9)
Total enterprise output (£)	92.8 (17.2)	18172 (4381)	106.6 (14.6)	29698 (3265)	112.7 (15.4)	40266 (2864)	114.9 (13.5)	50092 (3204)	116.2 (14.0)	60883 (3620)
Total inputs (£) (including farmer and wife labour)	100.0 (18.3)	18800 (3187)	108.0 (19.9)	28331 (2294)	112.6 (17.1)	35911 (2385)	114.8 (13.6)	43647 (2564)	117.4 (13.3)	52539 (2786)
Turnover (£)	93.0 (17.6)	16636 (3859)	107.3 (15.4)	27245 (2844)	111.3 (13.9)	37026 (2758)	116.8 (12.6)	45969 (2338)	118.1 (14.5)	55935 (2752)
Tenant's capital (£)	93.8 (18.2)	20172 (4841)	111.0 (14.8)	32963 (3183)	109.6 (15.3)	44328 (3573)	115.9 (13.2)	56587 (3167)	115.1 (15.5)	67228 (3633)
Annual labour units	108.5 (19.4)	1.1 (0.1)	111.8 (17.6)	1.4 (0.1)	109.0 (17.1)	1.7 (0.1)	112.5 (16.6)	2.0 (0.1)	116.0 (15.8)	2.2 (0.1)
Total Livestock units	96.2 (18.4)	34.6 (7.2)	106.9 (15.5)	50.2 (4.1)	112.3 (14.0)	63.7 (3.9)	112.4 (15.7)	79.5 (5.1)	118.7 (13.3)	96.3 (4.8)
Number of dairy cows	95.7 (18.4)	22.8 (4.4)	107.4 (16.8)	34.8 (3.5)	112.0 (12.6)	44.2 (2.8)	114.4 (16.9)	53.1 (3.1)	115.1 (12.7)	63.1 (3.1)

Table 3 (Continued)

Size measure	10% Subgroups									
	6		7		8		9		10	
	TFP	Size	TFP	Size	TFP	Size	TFP	Size	TFP	Size
Total area (ha)	116.0 (13.9)	56.8 (2.2)	118.1 (14.7)	65.2 (3.4)	119.1 (11.6)	77.0 (3.7)	120.0 (13.7)	96.3 (8.3)	118.8 (14.2)	187.5 (130.4)
Standard man days (1968)	116.2 (10.9)	1176.0 (47.2)	119.9 (12.9)	1355.6 (46.9)	117.1 (13.1)	1562.8 (78.4)	121.8 (13.0)	1919.9 (132.4)	119.5 (12.6)	3469.3 (2421.2)
Standard man days (1976)	118.1 (12.5)	817.7 (34.9)	119.8 (13.5)	945.5 (35.3)	118.5 (13.0)	1086.1 (53.9)	120.1 (12.4)	1335.6 (92.2)	119.7 (13.1)	2402.9 (1681.5)
European size units	115.1 (12.3)	22.8 (1.0)	119.1 (13.2)	26.2 (1.0)	119.2 (11.6)	30.4 (1.5)	120.0 (14.7)	37.4 (2.5)	120.0 (11.7)	66.3 (47.2)
Total enterprise output (£)	117.3 (13.4)	71990 (2875)	116.9 (8.9)	82973 (3554)	118.2 (12.5)	99268 (5995)	124.9 (12.8)	125642 (10052)	120.0 (12.8)	216595 (122853)
Total inputs (£) (including farmer and wife labour)	116.6 (10.8)	62414 (2531)	115.3 (15.6)	71634 (3010)	119.5 (13.9)	83393 (4367)	117.8 (13.5)	104292 (7710)	118.4 (11.6)	185228 (118431)
Turnover (£)	115.7 (13.1)	65596 (3227)	117.1 (10.6)	76944 (3381)	121.0 (12.5)	92442 (5748)	120.7 (16.1)	116255 (8036)	119.5 (10.5)	204554 (113632)
Tenant's capital (£)	117.6 (11.3)	79753 (3631)	117.9 (11.7)	92909 (4094)	117.8 (14.7)	108321 (5768)	120.7 (12.8)	132722 (8964)	121.2 (12.2)	227838 (143647)
Annual labour units	115.9 (14.3)	2.5 (0.1)	117.5 (14.0)	2.9 (0.1)	117.2 (13.5)	3.2 (0.1)	113.1 (14.4)	3.7 (0.2)	118.8 (13.0)	6.2 (4.5)
Total Livestock units	116.4 (14.9)	110.1 (3.3)	118.7 (11.3)	125.2 (6.8)	116.8 (12.9)	146.9 (6.9)	122.2 (13.2)	180.2 (11.8)	120.0 (12.3)	310.9 (219.6)
Number of dairy cows	116.8 (12.6)	73.2 (2.9)	119.8 (13.5)	83.9 (3.2)	119.1 (13.0)	97.2 (5.0)	119.9 (13.0)	118.6 (8.4)	120.3 (11.9)	213.8 (150.0)

1 For each size measure the farms were ranked in order of increasing size and the series divided into 10 subgroups. The smallest 10 per cent of farms comprised the first subgroup, the next smallest 10 per cent formed the second subgroup and so on until the largest 10 per cent formed the tenth subgroup.

2 Based on the results for 518 farms.

3 TFP is total factor productivity defined as $\frac{\text{total enterprise output}}{\text{total inputs including farmer and wife labour}} \times 100$

4 Figures in brackets are standard deviations.

Source: Derived from 1981/82 Farm Management Survey data.

Table 4

Mainly dairy farms: mean total factor productivity and mean size by size measure and 10 per cent subgroup,[1,2] 1981/82

Size measure	10% Subgroups									
	1		2		3		4		5	
	TFP[3]	Size	TFP	Size	TFP	Size	TFP	Size	TFP	Size
Total area (ha)	106.3	33.5	116.2	52.5	115.7	67.4	117.5	83.6	121.0	98.5
	(25.0)[4]	(7.1)	(18.0)	(4.5)	(18.4)	(5.2)	(13.5)	(4.2)	(18.6)	(4.6)
Standard man days (1968)	104.5	483.2	115.5	797.0	114.3	1093.9	119.4	1364.4	119.8	1638.1
	(24.5)	(116.6)	(17.4)	(85.5)	(14.8)	(93.6)	(14.0)	(67.6)	(20.2)	(73.7)
Standard man days (1976)	104.4	330.1	114.8	551.2	114.7	745.1	121.1	931.7	115.3	1120.7
	(24.5)	(78.5)	(17.3)	(61.1)	(15.1)	(62.4)	(16.0)	(49.2)	(17.2)	(53.6)
European size units	106.0	8.7	115.7	14.8	114.3	21.5	122.5	28.0	121.5	34.2
	(25.7)	(2.3)	(16.5)	(1.4)	(14.8)	(1.9)	(16.8)	(1.8)	(19.5)	(2.0)
Total enterprise output (£)	100.6	22468	116.9	43150	114.0	60338	116.7	76777	121.9	95305
	(24.3)	(6573)	(14.8)	(6187)	(15.8)	(5404)	(15.3)	(3660)	(19.6)	(8667)
Total inputs (£) (including farmer and wife labour)	107.2	22200	115.2	37213	121.8	51739	116.9	64970	119.7	82256
	(25.6)	(6171)	(18.6)	(4388)	(19.8)	(4645)	(10.4)	(3696)	(21.0)	(6975)
Turnover (£)	102.4	19253	114.4	37817	118.3	50283	117.7	67473	118.3	85443
	(24.0)	(5903)	(16.9)	(4926)	(15.7)	(3718)	(15.2)	(4860)	(20.5)	(7963)
Tenant's capital (£)	104.3	31995	114.0	52866	115.3	73124	121.6	90397	117.5	109286
	(24.5)	(7704)	(18.0)	(5725)	(13.9)	(6412)	(17.6)	(4513)	(14.1)	(5464)
Annual labour units	113.5	1.3	110.7	1.9	115.6	2.4	120.8	2.9	116.6	3.3
	(25.1)	(0.2)	(21.2)	(0.2)	(14.2)	(0.2)	(20.5)	(0.1)	(12.0)	(0.1)

Table 4 (Continued)

Size measure	10% Subgroups									
	6		7		8		9		10	
	TFP	Size	TFP	Size	TFP	Size	TFP	Size	TFP	Size
Total area (ha)	115.3	115.1	117.5	134.0	119.6	167.9	113.2	217.7	118.2	410.6
	(11.7)	(5.3)	(13.8)	(6.8)	(12.0)	(16.2)	(17.6)	(14.6)	(13.6)	(119.9)
Standard man days (1968)	118.8	1859.1	117.6	2130.8	117.9	2463.2	115.1	3000.2	117.6	5370.7
	(17.5)	(59.9)	(11.5)	(101.0)	(13.3)	(104.3)	(17.2)	(274.9)	(10.7)	(1831.8)
Standard man days (1976)	121.7	1264.3	116.6	1448.4	117.7	1661.3	116.4	2031.1	117.7	3622.0
	(18.1)	(37.3)	(11.7)	(64.4)	(12.4)	(72.8)	(17.5)	(193.1)	(10.9)	(1220.5)
European size units	116.2	40.6	114.4	46.0	116.7	53.0	114.6	67.8	118.7	127.4
	(14.8)	(1.6)	(13.4)	(1.7)	(13.8)	(2.4)	(14.4)	(6.1)	(11.3)	(42.3)
Total enterprise output (£)	117.1	119152	116.5	132091	120.2	151582	117.6	188853	119.0	358501
	(12.8)	(5267)	(17.2)	(4272)	(12.4)	(7305)	(14.2)	(15975)	(11.2)	(119103)
Total inputs (£) (including farmer and wife labour)	117.4	100587	119.8	113834	112.8	129767	114.0	165181	115.8	308466
	(13.2)	(4010)	(13.5)	(3797)	(10.7)	(5801)	(14.4)	(15255)	(12.3)	(109540)
Turnover (£)	118.1	104090	116.9	116894	120.1	136199	115.6	168464	118.6	323998
	(15.3)	(2862)	(11.2)	(4245)	(16.6)	(7205)	(13.1)	(16616)	(11.4)	(108656)
Tenant's capital (£)	118.0	129277	115.6	147419	120.5	178988	116.6	223622	117.2	395338
	(15.9)	(4904)	(14.2)	(7197)	(16.9)	(7404)	(13.9)	(21321)	(13.0)	(124604)
Annual labour units	119.5	3.7	119.3	4.1	116.0	4.8	116.2	6.2	112.2	10.7
	(13.0)	(0.1)	(17.6)	(0.1)	(12.7)	(0.3)	(12.6)	(0.5)	(13.8)	(3.9)

1 For each size measure the farms were ranked in order of increasing size and the series divided into 10 subgroups. The smallest 10 per cent of farms comprised the first subgroup, the next smallest 10 per cent formed the second subgroup and so on until the largest 10 per cent formed the tenth subgroup.

2 Based on the results for 310 farms.

3 TFP is total factor productivity defined as $\frac{\text{total enterprise output}}{\text{total inputs including farmer and wife labour}} \times 100$

4 Figures in brackets are standard deviations.

Source: Derived from 1981/82 Farm Management Survey data.

Table 5

Reranking of farms due to changing the measure of size[1], 1981/82

	Specialist cereals		Specialist dairy		General cropping		Mainly dairy	
	Number	%	Number	%	Number	%	Number	%
Number in 1 subgroup	31	7.8	36	6.9	44	7.5	27	8.7
Number in 2 subgroups	84	21.1	123	23.7	137	23.5	83	26.8
Number in 3 subgroups	135	33.9	194	37.5	185	31.7	110	35.5
Number in 4 subgroups	95	23.9	133	25.7	150	25.7	66	21.3
Number in 5 subgroups	43	10.8	30	5.8	52	8.9	19	6.1
Number in 6 subgroups	8	2.0	1	0.2	12	2.2	5	1.6
Number in 7 subgroups	2	0.5	1	0.2	3	0.5	0	0.0
Total number of farms	398	100.0	518	100.0	583	100.0	310	100.0

1 The number of farms, by farm type, appearing in the stated number of subgroups under each of the nine generally applicable size measures. The three more specific size measures which are excluded are total livestock units, number of dairy cows and cereal area.

Source: Derived from 1981/82 Farm Management Survey data.

Table 6

Specialist cereals farms: rank-order correlation coefficients (Kendall's TAU)[1] by size measure

	Total Area (ha)	smd (1968)	smd (1976)	ESU	TEO (£)	TI (inc. f. & wife labour) (£)	Turnover (£)	Tenant's capital (£)	ALU	Cereal area (ha)
Total area (ha)	–	0.79	0.75	0.82	0.74	0.76	0.72	0.68	0.64	0.82
Standard man days (1968)		–	0.90	0.78	0.79	0.79	0.74	0.70	0.70	0.72
Standard man days (1976)			–	0.71	0.73	0.74	0.70	0.66	0.69	0.66
ESU				–	0.80	0.79	0.76	0.72	0.62	0.88
TEO (£)					–	0.87	0.84	0.76	0.66	0.75
TI (inc. farmer & wife labour) (£)						–	0.81	0.76	0.69	0.75
Turnover (£)							–	0.72	0.63	0.72
Tenant's capital (£)								–	0.59	0.69
ALU									–	0.59
Cereal area (ha)										–

Standard Deviation 0.03

1 As available in the statistical package SPSS.

Table 7

General cropping farms: rank-order correlation coefficients (Kendall's TAU)[1] by size measure

	Total area (ha)	smd (1968)	smd (1976)	ESU	TEO (£)	TI (inc. f. & wife labour) (£)	Turnover (£)	Tenant's capital (£)	ALU
Total area (ha)	–	0.67	0.62	0.74	0.70	0.72	0.69	0.73	0.60
Standard man days (1968)		–	0.89	0.79	0.78	0.79	0.73	0.68	0.73
Standard man days (1976)			–	0.73	0.73	0.74	0.68	0.64	0.72
ESU				–	0.81	0.82	0.77	0.73	0.68
TEO (£)					–	0.89	0.87	0.79	0.71
TI (inc. farmer & wife labour) (£)						–	0.83	0.77	0.73
Turnover (£)							–	0.76	0.68
Tenant's capital (£)								–	0.63
ALU									–

Standard Deviation 0.03

1 As available in the statistical package SPSS.

Table 8

Specialist dairy farms: rank-order correlation coefficients (Kendall's TAU)[1] by size measure

	Total area (ha)	smd (1968)	smd (1976)	ESU	TEO (£)	TI (inc. f. & wife labour) (£)	Turnover (£)	Tenant's capital (£)	ALU	Total lvstk units	Number of dairy cows
Total area (ha)	–	0.67	0.67	0.65	0.60	0.60	0.59	0.62	0.56	0.66	0.61
Standard man days (1968)		–	0.98	0.93	0.85	0.83	0.82	0.82	0.62	0.91	0.89
Standard man days (1976)			–	0.93	0.85	0.83	0.82	0.82	0.62	0.90	0.89
ESU				–	0.84	0.82	0.82	0.82	0.62	0.88	0.90
TEO (£)					–	0.88	0.92	0.83	0.61	0.83	0.83
TI (inc. farmer & wife labour) (£)						–	0.87	0.81	0.65	0.81	0.81
Turnover (£)							–	0.81	0.61	0.80	0.82
Tenant's capital (£)								–	0.60	0.82	0.80
ALU									–	0.61	0.59
Total livestock units										–	0.84
Number of dairy cows											–

Standard Deviation 0.03

1 As available in the statistical package SPSS.

Table 9

Mainly dairy farms: rank-order correlation coefficients (Kendall's TAU)[1] by size measure

	Total area (ha)	smd (1968)	smd (1976)	ESU	TEO (£)	TI (inc. f. & wife labour) (£)	Turnover (£)	Tenant's capital (£)	ALU
Total area (ha)	—	0.66	0.65	0.65	0.61	0.62	0.58	0.64	0.63
Standard man days (1968)		—	0.97	0.87	0.84	0.83	0.80	0.81	0.73
Standard man days (1976)			—	0.85	0.83	0.82	0.79	0.80	0.73
ESU				—	0.82	0.85	0.80	0.80	0.73
TEO (£)					—	0.88	0.90	0.83	0.70
TI (inc. farmer & wife labour) (£)						—	0.86	0.82	0.73
Turnover (£)							—	0.81	0.69
Tenant's capital (£)								—	0.68
ALU									—

Standard Deviation 0.04

1 As available in the statistical package SPSS.

Table 10

Regression results for specialist cereals farms, 1981/82

Size measure	Key percentile range and size range equivalent[1]		Estimated slope coefficients and significance levels for:						Maximum difference between slope coefficients
			First group of farms[2]			Second group of farms[3]			
	Percentile range	Equivalent actual size range[4]	Slope coefficient	Significance[5] level (%)	Correlation coefficient r	Slope coefficient	Significance[5] level (%)	Correlation coefficient r	(Column 3–column 6)
	1	2	3	4	5	6	7	8	9
1968 smd	15–22	450–600 smd	0.055	1	0.36	0.002	5	0.12	0.053
Total area	13–18	70–80 ha	0.317	5	0.26	0.012	10	0.09	0.305
ESU	10–20	14–24 ESU	1.623	5	0.32	0.067	1	0.17	1.556

1 The percentile and actual size ranges within which economies of scale (measured by the rate of increase of TFP with size) either cease altogether, slacken off or begin to diminish. Percentiles are the points which divide the distributions into 1 per cent stages.

2 The group of smaller farms for which the estimated slope coefficient exceeds that for the group of larger farms by the maximum amount (given in column 9).

3 The group of larger farms for which the estimated slope coefficient is less than that for the group of smaller farms by the maximum amount (given in column 9).

4 Each expressed in terms of the particular measure being used.

5 The significance levels for 't' tests give the probability that the slopes are not different from zero. The test used was the two-tailed 't' test.

Source: Derived from 1981/82 Farm Management Survey data.

REFERENCES

Britton, D K & Hill, B (1975) *Size and efficiency in farming.* Farnborough; Saxon House.

Britton, D K & Hill, B (1978) *Farm size, tenure and efficiency: findings from Farm Management Survey data for 1969–73.* Wye College, Ashford, Kent: School of Rural Economics.

Business Statistics Office (1981) Analyses of British businesses by turnover size. *British Business,* 23 January 1981, 183–185.

Business Statistics Office (1982) Analyses of British businesses by turnover size: 1981. *British Business,* 1 October 1982, 182–183.

Business Statistics Office (1983) Analyses of businesses by turnover size: 1982. *British Business,* 29 April 1983, 177–178.

Cracknell, B E & Palca, H (1959) Farm size and farm business. *Agriculture,* **65,** 593–597.

Dellaquaglia, A P (1978) Size and efficiency in Scottish agriculture. *Scottish Agricultural Economics,* **28,** 149–158.

Lund, P J & Hill, P G (1979) Farm size, efficiency and economies of size. *Journal of Agricultural Economics,* **30,** 145–158.

Lund, P J (1983) The use of alternative measures of farm size in analysing the size and efficiency relationship. *Journal of Agricultural Economics,* **34,** 187–189.

MAFF (1979) *Report of the committee of inquiry into the acquisition and occupancy of agricultural land.* Cmnd 7599. London: HMSO.

Napolitan, L & Brown, C J (1963) A type of farming classification of agricultural holdings in England and Wales according to enterprise patterns. *Journal of Agricultural Economics,* **15,** 595–616.

National Resources (Technical) Committee (1961) *Scale of enterprise in farming.* Report of the Natural Resources (Technical) Committee. London: HMSO.

Newbould, G D & Wilson, K W (1977) Alternative measures of company size – a note for researchers. *Journal of Business Finance and Accounting,* **4,** 131–132.

Scola, P M (1952) Problems of farm classification. *Journal of Agricultural Economics,* **10,** 4–16.

Sutherland, A (1983) Farm size: a reply. *Journal of Agricultural Economics,* **34,** 191–195.

Vlastuin, C , Lawrence, D & Quiggin, J (1982) Size economies in Australian agriculture. *Review of Marketing and Agricultural Economics,* **50** (1), 27–50.